WESTERN RESOURCE
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NEW HOUSE NEW PARADIGM

A Model for How to Plan, Build, and Live Water-Smart

WESTERN RESOURCE
ADVOCATES

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Western Resource Advocates' mission is to protect the West's land, air, and water.

Our lawyers, scientists, and economists:

1) advance clean energy to reduce pollution and global climate change;
2) promote urban water conservation and river restoration; and
3) defend special public lands from energy development and unauthorized off-road vehicle travel.

We collaborate with other conservation groups, hunters and fishermen, ranchers, American Indians, and others to ensure a sustainable future for the West.

This report was prepared by Drew Beckwith, WRA's Water Policy Analyst. Preparation of the report benefited from the comments and advice of Bart Miller, WRA's Water Programs Director. It was funded by grants from the Winslow Foundation and the Aveda Corporation.

NEW HOUSE, NEW PARADIGM:
A Model for How to Plan, Build, and Live Water-Smart

ACRONYMS AND ABBREVIATIONS

AF	acre feet
AFY	acre feet per year
AZ	Arizona
BMP	best management practice
CO	Colorado
ET	evapotranspiration
GPCD	gallons per capita per day
GPF	gallons per flush
GPH	gallons per household
GPM	gallons per minute
HB	House bill
HET	high-efficiency toilet – 1.28 GPF
kgal	thousand gallons
LEED	Leadership in Energy and Environmental Design
LID	low-impact development
NM	New Mexico
NV	Nevada
PSI	pounds per square inch
SB	Senate bill
ULF	ultra low-flow (toilet) – 1.6 GPF
UT	Utah
WRA	Western Resource Advocates

EXECUTIVE SUMMARY

The Interior West is simultaneously the driest and fastest growing region of the United States. With an expected influx of hundreds of thousands of new residents to this region in the coming decades, it is imperative that a new style of development be implemented now — one that recognizes and embraces the distinct lack of water in this region. This report shows what this new style of development can look like and how it can succeed through the integration of smart planning, green building practices, and programs aimed at encouraging residents to live a water-smart lifestyle.

In the "New House, New Paradigm" report, Western Resource Advocates (WRA) describes the nexus between land use and water demands and offers a model for how water-smart growth can meet both the housing needs of our new residents and preserve our natural rivers and watersheds. The model addresses water conservation and efficiency in the planning, building, and living phases of new residential development. WRA highlights existing water-smart developments throughout the region as case studies to demonstrate the feasibility of this new growth style and to highlight water conservation successes.

THE PROBLEMS

Population growth in the Interior West has outpaced the rest of the nation, placing an increasing strain on already limited water resources *(Table ES-1)*. This reality makes efficient use of our limited water resources imperative for the future sustainability of this area.

Table ES-1. *Population growth and precipitation in the Interior West.*[1]

STATE	POPULATION (JULY 2008)	POPULATION GROWTH (2000-2008)	RANK	PRECIPITATION (INCHES)	RANK
Nevada	2,600,167	30%	1	9.5	50
Arizona	6,500,180	27%	2	13.1	48
Utah	2,736,424	23%	3	11.9	49
Colorado	4,939,456	15%	7	15.5	45
New Mexico	1,984,356	9%	17	13.9	46
U.S. Average		8%		34.3	

Traditionally, water supplies were acquired by damming rivers and building pipelines — complete with the environmental degradation that accompanied these practices. With the "easy" water projects already built, some communities are now proposing to build fantastically expensive pipelines to capture ever more distant sources of supply. However, over the past decade there has been an increased recognition that conservation, efficiency, and supply-side alternatives can play just as prominent a role as big water projects in meeting future water demands.

1 Population data from: U.S. Department of Commerce, Bureau of the Census. 2008. Table 2: Cumulative Estimates of Resident Population Change for the United States, Regions, States, and Puerto Rico and Region and State Rankings: April 1, 2000 to July 1, 2008 (NST-EST2008-02). December 22, 2008. Precipitation data from: U.S. Department of the Interior, National Atlas. 2009. Precipitation of the Individual States and of the Conterminous States. http://www.nationalatlas.gov/printable/precipitation.html#list.

Much work is being done to advance sustainable development — several groups look at ways to plan for future development in a responsible manner, many reports describe the benefits of green building, and environmental organizations across the West advocate for improved water conservation practices. While each of these efforts has contributed to water savings and a reduction in per capita demands, truly sustainable development will not be achieved until these three areas of conservation potential are brought together and implemented as a whole.

BUILDING THE SOLUTION

Planning for water-smart development requires the efforts of dedicated people from across multiple fields and organizations. Even though the vast majority of planning decisions are made at the local level, states can still play a role by promoting policies and enforcing laws that require a proof of water supply before new developments can move forward. Visioning processes that take a regional approach to planning and identify a preferred future can also play a role in defining and promoting water-smart development.

Planning future development according to the principles of Smart Growth has the potential to drastically reduce water use, infrastructure costs, and water loss when compared to the status quo of western suburban sprawl. Local planning agencies and utilities can incentivize this style of development by offering density bonuses, discounting tap fees, and prioritizing funding for water-smart projects. Local agencies are also on the front lines of integrating land use and water supply planning and should communicate more thoroughly about how each group's decisions impact one another. Master-planned communities that incorporate water-efficient practices, like aggressive conservation, can provide excellent examples of water-smart development.

Building water-smart development requires the use of high-efficiency indoor appliances and fixtures and the planting of water-wise landscapes. Several builders across the Interior West are pursuing green building practices in new homes and are using measures such as high-efficiency toilets, ENERGY STAR® appliances, and WaterSense® faucets to differentiate their water-conserving homes in the market place. Homes landscaped according to the principles of Xeriscape™ and that utilize smart irrigation controllers and alternative sources of water supply — like rainwater harvesting — can drastically reduce outdoor water needs. These water-smart building techniques lock water savings into the home and do not require behavioral changes from homeowners, ensuring reduced water use into the future.

Figure ES-1. *Highlighted water-smart developments in the Interior West.*

Living water-smart requires common-sense approaches to using water wisely, and can be employed by any resident, whether or not they live in a community that was planned and built water-smart. Education plays a vital role in bringing knowledge to homeowners. Whether this education is presented in the form of "bill stuffers" — promotional pieces inserted into mailing envelopes along with the bill — or web-based marketing, simply knowing how much water a resident is using — and should be using — can be an effective conservation tool. Rebates and other incentives can be used by utilities to encourage water-smart living, and a properly designed rate structure that rewards conservation, discourages waste, and provides revenue stability is a necessity for any water-smart development. Finally, homeowner association rules and conservation-oriented city ordinances add the extra enforcement necessary to ensure efficient water use at every household.

DEMONSTRATING SUCCESS

Water use data collected by the communities highlighted in this report — Stapleton in Denver, CO; Sterling Ranch near Denver, CO; Daybreak in South Jordan, UT; Civano in Tucson, AZ; and Rancho Viejo and Oshara Village near Santa Fe, NM *(Figure ES-1)* — clearly shows that water-smart developments use significantly less water than conventional development. For example, the community of Civano in Tucson, AZ, has demonstrated a reduction in water use of 35-45% compared to the greater Tucson area *(Figure ES-2)*.

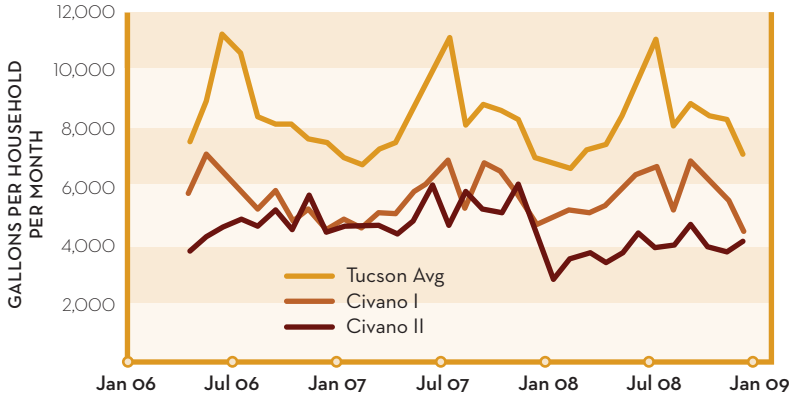


Figure ES-2. *Water use at Civano I, Civano II, and the Tucson average.*[2]

These communities demonstrate that a widespread and holistic adoption of water-smart techniques can stretch our existing sources of water supply into the future. On average, the developments in this report are currently achieving water use reductions of 13-50% compared to existing homes in their area, and many have demonstrated a consistent reduction in water use over several years.

This report can be used by land use decision-makers, planners, home developers, building contractors, water utilities, homeowner associations, and responsible citizens who are interested in achieving a sustainable future for their communities. Because the report draws together examples from across the Interior West, it is well-positioned to serve as both a resource and point of encouragement for others interested in water-smart growth. As more people move to the West and water becomes even scarcer, smart development that is consistent with the region's natural environment needs to become the norm rather than the exception.

2 Water use data for Civano is compiled from the annual Energy and Water Use reports completed by Al Nichols Engineering. http://www.civanoneighbors.com/civano/environment.htm#reports.

RECOMMENDATIONS

Planning Water-Smart

- Encourage decision-makers to recognize that sound land use planning can be a source of water supply.
- Integrate land use planning with water planning and, vice versa, by fostering greater communication and cooperation between planners and utilities.
- Provide density bonuses, streamline the approval processes, offer discounted tap fees, and extend utility rebate programs to homebuilders engaged in water-smart development.
- Holistically plan new developments from the ground up to be water-smart by including such measures as recycled water distribution systems, water-wise landscaping, and efficient fixtures and appliances.
- Encourage government and local agencies to lead by example, partner with other groups and organizations, and educate the community on the benefits of water-smart development.
- Update general plans to support more compact forms of development, encouraging infill and revitalization over sprawl.
- Pass legislation that requires new developments to demonstrate an adequate supply of water before approval is granted.
- Implement and enforce ordinances that encourage efficient water use, such as time-of-day watering and banning the waste of water.

Building Water-Smart

- Utilize performance-based third-party certification systems to select water-efficient indoor fixtures and appliances.
- Reduce outdoor use by limiting irrigable areas, restricting turf, or using a conservative water budget.
- Landscape areas with native, water-wise plants and adhere to the practices of Xeriscape.
- Irrigate with an efficient system that uses appropriate emitters and is run by a smart controller.
- Utilize alternative sources of water supply for indoor and outdoor uses where legal and appropriate, including recycled water, greywater, and rainwater.

Living Water-Smart

- Offer continual education about the myriad ways to conserve water at home.
- Provide and pay attention to frequent, easy-to-read, and graphically based billing statements.
- Utilize a progressive rate structure that provides equity and revenue stability, plus encourages conservation.
- Incentivize water-smart living by offering and taking advantage of rebate programs for water-efficient technologies.
- Adopt and follow responsible ordinances and covenants, conditions, and restrictions that promote water-efficient behavior and discourage water waste.

INTRODUCTION

In the West, our past, present, and future is defined by the absence of water. The scarcity of this essential resource makes its intelligent use critical to a sustainable future in this arid landscape. Without heed to the already precarious relationship between water supply and demand in the West, thousands of people have moved here in the past two decades, and thousands more are following in their footsteps. The Interior West (Colorado, Utah, Arizona, Nevada, and New Mexico), in particular, is the fastest growing region in the nation, but its states are collectively the driest. Consequently, rates of water use in the Interior West are some of the highest in the United States *(Table 1)*.

Table 1. *Population growth, precipitation, and water use in the Interior West.*

STATE	POPULATION[a] (JULY 2008)	POPULATION GROWTH[a] (2000-2008)	RANK[a]	PRECIPITATION[b] (INCHES)	RANK[b]	WATER USE[c] (GPCD)	RANK[c]
Nevada	2,600,167	30%	1	9.5	50	336	1
Arizona	6,500,180	27%	2	13.1	47	222	9
Utah	2,736,424	23%	3	11.9	49	293	2
Colorado	4,939,456	15%	7	15.5	44	240	5
New Mexico	1,984,356	9%	17	13.9	46	203	16
U.S. Average		8%		34.3		179	

[a] U.S. Department of Commerce, Bureau of the Census. 2008. Table 2: Cumulative Estimates of Resident Population Change for the United States, Regions, States, and Puerto Rico and Region and State Rankings: April 1, 2000 to July 1, 2008 (NST-EST2008-02). December 22, 2008.

[b] U.S. Department of the Interior, National Atlas. 2009. Precipitation of the Individual States and of the Conterminous States. http://www.nationalatlas.gov/printable/precipitation.html#list.

[c] Calculated from: U.S. Department of the Interior, Geological Survey. 2004. Estimated Use of Water in the United States in 2000, Table 5. http://pubs.usgs.gov/circ/2004/circ1268/htdocs/table05.html.

This influx of population presents a unique opportunity for the region to plan future development in a smart, water-efficient manner. Unfortunately, sprawling development has been more of the norm throughout the West for the past 20 years. A stereotypical scene on the outskirts of Denver, Salt Lake City, Phoenix, or Las Vegas is a large subdivision far from existing urban areas that has large lots and big houses, landscaped to the curb with turf grass. These developments often look very similar to each other and do not incorporate the distinct regional qualities that make each of these areas a desirable place to live. Most importantly, however, these developments do not recognize that the vast majority of the Interior West is very dry, and that water usually travels great distances and at great cost before reaching the tap.

Western rivers are severely impacted by the choices we make. Massive diversion projects that reduce natural flows are causing deleterious impacts to fish habitat, riparian vegetation, and recreational opportunities. These projects cost millions of dollars to build and new ones will likely cost into the tens of billions. A new style of development is needed to accommodate population growth: one that recognizes and embraces the distinct lack of water in this region. It is time to

recognize that smart land use planning is effectively a new water supply.

This report argues that the style of growth that will occur in the Interior West (the how and where) directly impacts water supply and demand issues in the region. In the following pages, Western Resource Advocates (WRA) describes a model for how development and growth can occur in a water-smart manner. The model addresses water conservation and efficiency in the planning, building, and living phases of new residential development and is based on the successes of existing water-smart developments throughout the region.

The "Planning Water-Smart" section describes the nexus between land use planning and water demands, and offers several approaches for how new development can be planned water-smart. Smaller lot sizes and denser development located close to existing population centers use less water and cost less in infrastructure, compared to more traditional suburban development patterns. States, local planning agencies, and utilities can all encourage water-smart development through the prioritization of funding, enacting land use codes oriented towards water conservation, and promoting more water-efficient construction.

The "Building Water-Smart" section describes certification programs that lend third-party credibility to water-smart products and lists several indoor and outdoor water-smart technologies that reduce water use. These include products, such as high-efficiency toilets and low-flow showerheads; design features, like water-wise landscapes and efficient irrigation systems; and alternative water supply sources, such as recycled water and rainwater harvesting. Many of these techniques lock in water savings to the home and do not require any behavioral changes from homeowners.

The "Living Water-Smart" section describes education programs, audits, water pricing, and homeowner association rules that contribute to keeping a community's water use low. These practices can be utilized by any community, whether or not it has been planned and built water-smart.

Throughout the report, specific developments are referenced and highlighted for incorporating water-efficient planning, building, and living principles. These communities span the Interior West and include Stapleton in Denver, CO; Sterling Ranch near Denver, CO; Daybreak in South Jordan, UT; Civano in Tucson, AZ; and Rancho Viejo and Oshara Village near Santa Fe, NM *(Figure 1)*. These communities also range in size from 175 units to 20,000 units, showing that water-smart development can be incorporated at any scale (*Table 2*).

Figure 1. *Highlighted water-smart developments in the Interior West.*

By virtue of their water-smart practices, all of these developments use less water than traditional development in the same area. Water use data is presented in the last section of this report. The water savings achieved by these water-smart developments not only decrease homeowners' utility bills, but they also reduce the strain on the West's fragile rivers and ecosystems.

Issues of water scarcity and their solutions are not confined solely to the Interior West, so the developments highlighted in this report should not be thought of as the only water-smart developments; they are just a few examples. California has several new developments that use considerably less water than their traditional counterparts.[1] In addition, there are several small developments (of just a few buildings or less) scattered throughout the U.S. that are also achievi- significant water conservation.[2] In general, however, the focus of water-smart development is in the West where the lack of water is truly a defining characteristic of the area.

This report can be used by land use decision-makers, planners, home developers, building contractors, water utilities, homeowner associations, and responsible citizens who are interested in achieving a sustainable future for their communities. Because the report draws together examples from across the Interior West, it is well-positioned to serve as both a resource and point of encouragement for others interested in water-smart growth. As more people move to the Interior West and water becomes even scarcer, smart development that is consistent with the region's natural environment needs to become the norm rather than the exception.

Table 2. *Size of highlighted water-smart developments*[3]

DEVELOPMENT	OCCUPIED HOMES (2008)	HOMES AT BUILD-OUT (20-50 YEARS)
Civano I & II (AZ)	725	2050
Daybreak (UT)	2200	20,000
Oshara Village (NM)	30	175
Rancho Viejo (NM)	1200	12,000
Stapleton (CO)	3500	12,000
Sterling Ranch (CO)	0	12,050

1 Alamo Creek in Danville, CA, is required to meet an average household water use target of 320 GPD, where the average East Bay Municipal Utilities District household uses more than 500 GPD. Source: Buranen, Margaret. 2009. Contract for Conservation. *Water Efficiency*, May/June 2009. http://www.waterefficiency.net/may-june-2009/contract-for-conservation.aspx.

2 Green building practices, which include water conservation strategies, are becoming increasingly popular in the residential housing market. The Flats at South Pointe in St. George, UT, and the Spire Condominiums in Denver, CO, are just a few examples of this new trend.

3 Occupied Homes and Build-Out data attained through personal communication with development representatives.

PLANNING
WATER-SMART

Water-smart development begins with water-smart planning. There is a direct link between the style of land use and the water demands required to support that land use. Developments planned in accordance with the principles of Smart Growth will use less water, have decreased infrastructure costs, and have lower rates of water loss compared to a traditionally planned community. States, local planning agencies, and utilities can all encourage water-smart development through the prioritization of funding and by enacting water-efficient land use codes. Master-planned communities are in a unique position to control several aspects of water-smart development, and market appeal is growing for these types of neighborhoods.

CONVENTIONAL GROWTH VS. SMART GROWTH

Conventional suburban development contains large lots, at low density, in areas that are dispersed from the urban core. This style of development increases the cost of water delivery and wastewater treatment in new neighborhoods and inherently requires more water to sustain than smarter, more compact growth.

Large lots require a significant amount of water because they are usually accompanied with extensive landscaping. In the dry Interior West, supplemental irrigation is required to maintain these landscapes and outdoor water use can easily comprise 50% of total residential use, if not 70% or more in especially hot and arid regions *(Table 3)*.[4]

Table 3. *Residential outdoor water use as a percentage of total annual water use.*

STUDY SITE	SAMPLE SIZE	OUTDOOR ANNUAL USE (KGAL/HOME)	TOTAL ANNUAL USE (KGAL/HOME)	PERCENT OUTDOOR USE (KGAL/HOME)
Boulder	100	73.6	128.0	57.5%
Denver	99	104.7	166.6	62.8%
Phoenix	100	161.9	232.7	69.6%
Scottsdale	59	156.5	216.6	72.3%
Tempe	40	100.3	165.5	60.6%

Urban planners and water managers have long known that housing type influences water use. Over 35 years ago, the Real Estate Research Corporation performed a modeling study that compared water consumption in residential developments of different densities and concluded that density has a direct impact on water consumption: bigger lots mean greater water use.[5] Household water use data compared to the average single-family lot size in Clark County, NV (the Las Vegas area) also corroborate this conclusion; as lot size decreased from the 1980s through 2000, water use also declined *(Figure 2)*.[6] Furthermore, a study of water use and lot size in Utah demonstrated that as lot size decreased from 0.5 to 0.2 acres, per capita water demands dropped

4 Western Resource Advocates. 2003. *Smart Water: A Comparative Study of Urban Water Use Across the Southwest*. Boulder, CO: Western Resource Advocates, December 2003. http://www.westernresourceadvocates.org/water/smartwater.php.

5 Real Estate Research Corporation. 1974. *The Costs of Sprawl*. Washington, D.C.: U.S. Government Printing Office, April 1974. http://www.smartgrowth.org/pdf/costs_of_sprawl.pdf.

6 Western Resource Advocates. 2003. *Smart Water: A Comparative Study of Urban Water Use Across the Southwest*. Boulder, CO: Western Resource Advocates, December 2003. http://www.westernresourceadvocates.org/water/smartwater.php.

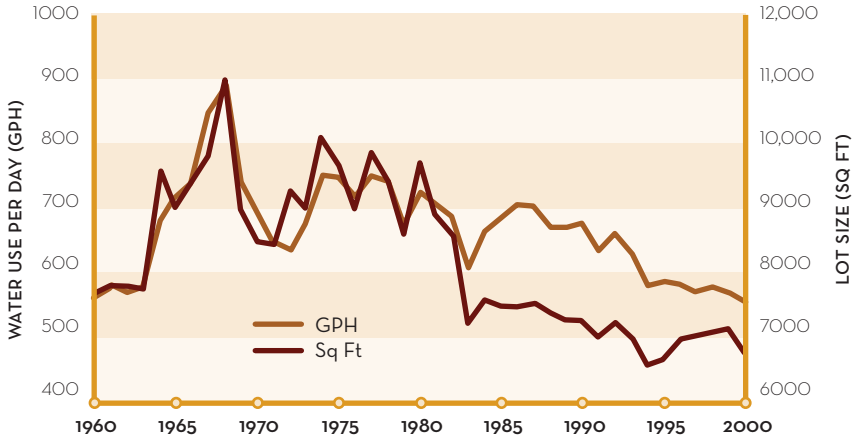


Figure 2. *Average water consumption per household by year of construction compared to average lot size.*

from 220 to 110 gallons per day.[7]

In addition to using more water per unit, sprawling developments require greater infrastructure investments than compact neighborhoods. The long water mains required to service dispersed lots result in higher costs per parcel. Transmission mains that bring water from a treatment plant to the neighborhood must span longer distances between parcels, and because homes in low-density development are usually set further back from the street, the distribution mains that bring water into the house must also be longer. Longer pipes not only cost more, they also lose more water through leakage. Furthermore, longer mains require higher pressure to push water through the system, which also increases the incidence of leaks. Leakage is a financial burden on water utilities, represents lost revenue, and is an inefficient use of a limited natural resource.

When new development occurs outside of city centers, existing infrastructure must be expanded to meet the needs of the new neighborhood. This is also the case when new developments leap-frog each other out into previously undeveloped land. In some cases, the new infrastructure extends from already old, worn out, and leaky pipes; as a result, the leakage and breaks common to older systems increases, along with the costs associated with operating an inefficient system.

Developments built according to the principles of Smart Growth can substantially reduce infrastructure costs and improve water use efficiency.[8] These benefits are mostly achieved through the use of just two of the principles: compact building design (which includes smaller lot sizes) and directing development towards existing communities. One study by the Transportation Research Board and National Research Council estimates that more compact growth could save $4.77 billion, or 6.5% of water infrastructure costs from 2000-2025.[9] Compact development forms and smaller lot sizes require less water per resident; Smart Growth is inherently water-smart.

SMART GROWTH PRINCIPLES

- Mix land uses.
- Take advantage of compact building design.
- Strengthen development and direct it toward existing communities.
- Preserve open space, farmland, natural beauty, and critical environmental areas.
- Foster distinctive, attractive communities with a strong sense of place.
- Create a range of housing opportunities and choices.
- Create walkable neighborhoods.
- Provide a variety of transportation choices.
- Make development decisions predictable, fair, and cost-effective.
- Encourage community and stakeholder collaboration in development decisions.

STATE-LEVEL PLANNING POLICIES

Land use planning is commonly implemented on the local level; however, some state policies and statutes can be important for encouraging water-smart development. Several western states

7 U.S. Environmental Protection Agency. 2006. *Growing Toward More Efficient Water Use: Linking Development, Infrastructure, and Drinking Water Policies.* http://www.epa.gov/dced/water_efficiency.htm.

8 The principles are presented in no particular order. nformation about Smart Growth is available at http://www.smartgrowth.org/.

9 Burchell, Robert W., et al. 2002. *Costs of Sprawl–2000.* Transportation Cooperative Research Program Report 74. Washington, D.C.: National Academy Press, 2002. http://www.trb.org/news/blurb_detail.asp?id=608.

require a proof of water supply before a proposed development can move forward. The Californian "show me the water" laws — SB 610 and SB 221 — are probably the most recognized of this type of higher-level approach. Similarly, Colorado's HB 08-1141 requires local governments to make a determination as to whether a developer has demonstrated that the proposed water supply is sufficient and sustainable to serve the peak daily, monthly, and yearly water supply requirements of the proposed development.

STAPLETON IS SMART GROWTH

The Stapleton neighborhood sits on the site of Denver's old airport. After Denver citizens voted to build the new Denver International Airport, a group of civic and business leaders engaged the general public in a five-year planning process that resulted in the Stapleton Development Plan – a vision for the future of the old airport site. The development plan, otherwise known as the "Green Book," utilizes many Smart Growth principles. Not surprisingly, the community is denser than traditional suburban sprawl (averaging 12 units per acre), is built within the existing city limits, incorporates mixed-use zoning, contains housing that is affordable to a wide range of incomes, and promotes walking through a network of open spaces, parks, and community centers.

The Green Book established several guiding principles, many of which trend towards water-smart practices. The first principle under environmental responsibility is to minimize demand for resources (on-site requirements for water, energy, and materials) and maximize opportunities for on-site supply of resources. This principle has carried forward through Stapleton's development and has resulted in the use of:

- Systems that redirect storm water flows for irrigation of wetlands and open spaces.
- A centrally managed irrigation control system that incorporates current weather conditions to maximize irrigation efficiency.
- A specified plant list for open spaces and revegetation that stresses native, drought-tolerant plant assemblages.
- Aggressive, community-wide conservation and demand management programs.
- High-efficiency homes that meet the water use reduction standards of Built Green Colorado.

Stapleton estimates that its more compact urban neighborhood design has resulted in a 40% decrease in water use per household compared to conventional development standards. In addition, Stapleton was also the top-selling community in Colorado during 2008, revealing that water-smart development is also desirable in the marketplace.

Sources:

Forest City Development. Discover Stapleton. http://www.stapletondenver.com (accessed June 23, 2009).

The Stapleton Foundation. 1995. *Stapleton Development Plan: Integrating Jobs, Environment and Community.* http://www.stapletonfoundation.org/.

In general, state-wide agencies, such as the Department or Division of Water Resources, do not become involved with land use planning policies, but there are some exceptions. Harris Sherman, director of Colorado's Division of Natural Resources, has repeatedly encouraged utilities, planners, and various water professionals to consider and address the link between land use and water. He clearly sees the need for a new approach to development that will be able to accommodate the doubling of Colorado's population over the next 40 years without overstretching our limited water resources.

Funding mechanisms at the state level, like the Safe Drinking Water and Clean Water State Revolving Funds, could be leveraged to support water-smart development. Prioritizing these funds to improve and maintain the effectiveness and integrity of existing infrastructure can decrease leaks and improve overall water delivery efficiency.

VISIONING PROCESSES

Regional visioning is one approach to land use planning that is being applied by several metropolitan regions, counties, and cities. Strategic, regional visioning is different than direct planning in that it identifies a wide range of potential future possibilities and then uses methods to quantify certain qualities about those futures (e.g., per capita water use, household energy use, air quality, vehicle-miles traveled, and transportation options). Regional visioning recognizes that urban challenges have natural boundaries, like air sheds, watersheds, and commuter sheds, which must be considered in seeking best solutions.

Citizens are engaged throughout the visioning process, and the community eventually selects

the potential future that is most aligned with its values. The "preferred alternative" future is then used to guide the update of each individual community's general plan, so that in the long run, all planning documents are pointing towards the desired common future. The preferred alternative most often identified through visioning processes is more water-smart than the status quo.

ENVISION UTAH EMBODIED AT DAYBREAK

Envision Utah is a visioning process for the greater Wasatch area of Utah that was implemented in the late 1990s and early 2000s. Envision Utah's preferred "quality growth strategy" aims to keep Utah beautiful, prosperous, and neighborly for future generations by:

- Protecting air quality.
- Encouraging water conservation.
- Creating transportation choices.
- Preserving critical lands.
- Promoting housing opportunities for everyone.
- Supporting efficient infrastructure.
- Exploring community development.

Over 20,000 citizens participated in the Envision Utah process, and now local governments are changing their general plans and ordinances to more closely align with the quality growth strategy.

The Daybreak Master Plan that will guide development of Daybreak, UT, embraces many of the principles identified by Envision Utah and encourages water-smart growth. One of the key guiding principles of this plan is to implement watershed management and water conservation. The plan recognizes wastewater an essential resource that can be reused to help reduce demand for new water sources, and recommends landscaping using Xeriscape principles, native materials, and low-water/drought-tolerant plants that celebrate the unique environment of the Wasatch Front. These ideas are specifically detailed in the plan through a series of objectives and more specific policies, such as:

- *Objective ESD-2.2:* Encourage sustainable development that promotes the efficient use of land, conservation of natural resources, and resource-efficient design and construction.
    - o *Policy ESD-2.2.1: Water efficiency.* Encourage conservation strategies for potable water in common or public landscaped areas through techniques such as water-wise or native plants, minimal turf areas, high-efficiency irrigation technology, or the use of rainwater harvesting, greywater systems, or raw water.

Sources:

Envision Utah. About EU: Quality Growth Strategy. http://www.envisionutah.org/eu_about_eu_qualitygrowthstrategy_main.html (accessed August 18, 2009).

Newberg, Sam. 2006. Humans/Nature. Urban Land. April 2006. http://joe-urban.com/wp-content/uploads/2006/09/Humans-Nature - April 2006 Urban Land.pdf.

Salt Lake County. 2006. West Bench General Plan, Public Draft. June 2006. http://www.waterresources.slco.org/pdfWLibr/WBenchPlanChap4.pdf.

LOCAL PLANNING

The vast majority of land use decisions are made at the local level (county and city) by planning departments, boards, and commissions. The decisions of these entities are guided by the community's general plan or comprehensive plan, which describes where, how, and what type of development can occur. Because these documents play such an important role in land use decisions, it is crucial that they be updated frequently to capture the current ethic and values of the community. In the past, land use plans did not include analyses of available water supply or address water as an issue with respect to the style of growth, but some are now adding this by including a water use element to the plan.

As one example of local water-smart land use planning, developers in Santa Fe County, NM, are required to demonstrate an adequate supply of water before the county will subdivide the parcel. If the water supply is inadequate, the developer must purchase and transfer water rights to the local water supplier before development permits are granted. In any western state, communities that are planned from the ground up to be water-smart will require less water demand and may be easier to move through local permitting processes.

In order for water-smart development to succeed, it is crucial that planning agencies and water suppliers engage in more thorough communication. Traditionally, planners have focused on land use policy and water suppliers have focused on providing water to people, without either of the

groups recognizing that one's decision has a marked impact on the other's responsibilities. This lack of coordination can lead to the approval of developments that lack a water supply, or the construction of projects that require excessive amounts of water, because they were not planned for the environ ment in which they were built. In many cases, planning boundaries do not overlap with water supply boundaries, but this is not an excuse in itself for lack of communication between the two groups.

Overcoming the disconnect between land use and water planning can be accomplished by integrating water data into planning documents — as suggested above with a water use element — and by integrating land use into water planning. For example, estimating future demands based on land use patterns, rather than population growth, may provide a more accurate estimate of future water needs.

The following steps illustrate one method to integrate land and water planning:

- Establish existing water use patterns.
- Determine water use factors for each land use.
- Map current and potential land uses, including both infill and intensification, and new greenfield development to be added.
- Calculate total future water demands based on water use factors (building in water conservation assumptions).
- Develop a basis for comparing future water needs against future supplies.[10]

Cities can support and incentivize water-smart development through various strategies. Providing a density bonus or up-zoning to create smaller lots is attractive to real estate developers, and it enables water suppliers to provide the same level of service to a community for much less water. A streamlined approval process for projects that exhibit water-smart characteristics is another opportunity to promote responsible styles of development.

Ordinances aimed at reducing water use are also a powerful tool local governments can employ. Effective ordinances that promote efficient water use behavior include time-of-day and/or day-of-week watering schedules, and a prohibition on the waste of water. Landscape ordinances promoting the use of native vegetation — which is well-adapted to dry conditions — or limiting the amount of turf are also appropriate in the Interior West. Cities should lead by example and construct all new buildings and landscapes to be as water-smart as possible.

UTILITY PLANNING AND POLICIES

Utilities can have a direct role in encouraging water-smart development, and doing so can be beneficial to their bottom line. Having a "fix it first" policy that prioritizes maintenance and repair of existing infrastructure over expansion can contribute to lower borrowing costs for capital projects because bond interest rates are determined based on the management of the utility's physical assets.[11] Maintaining existing infrastructure also reduces water leaks and minimizes revenue loss.

Utilities can incentivize water-smart growth by offering to discount the impact fee or service fee for developments that plan to use significantly less water than a traditional development. In areas where taps are in limited supply, a competition that awards points for water-smart and other green building practices could be used to determine which project receives water service. Utilities can also partner with other organizations to promote water-efficient buildings by offering special certifications. Or utilities can outright ban certain types of land use practices; for example, the Southern Nevada Water Authority has permanently banned all turf landscaping in the front of new homes.[12]

10 Johnson, Karen and Jeff Loux. 2004. *Water and Land Use: Planning Wisely for California's Future*. Point Arena, CA: Solano Press Books, 2004.

11 U.S. Environmental Protection Agency. 2006. *Growing Toward More Efficient Water Use: Linking Development, Infrastructure, and Drinking Water Policies*. http://www.epa.gov/dced/water_efficiency.htm.

12 Sovocool, K., senior conservation research analyst, Southern Nevada Water Authority. Personal communication.

MASTER-PLANNED COMMUNITIES

A significant portion of new growth today occurs in large "master-planned" communities. In this style of development, large tracts of land are purchased by one developer, who organizes the construction and sale of new homes, and names the community something like Rock Creek, Elk Meadows, or Whispering Pines. Prior to construction, the developer submits a master plan of the new community to the local planning agency that describes how the new development will conform to locally established zoning rules and regulations *(Figure 3)*.

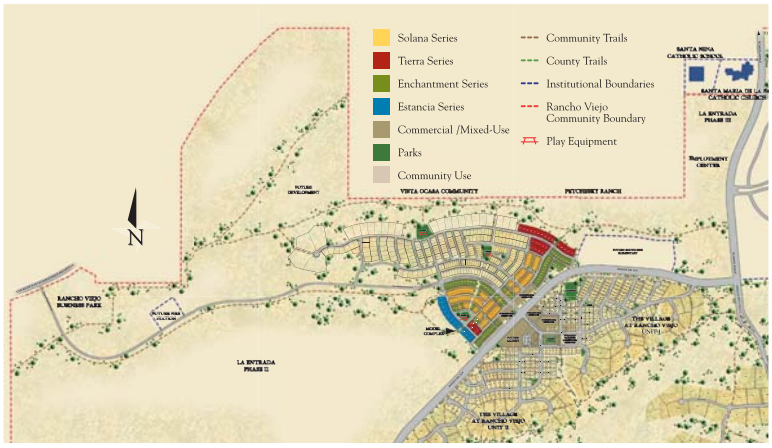


Figure 3. The master-planned La Entrada neighborhood at Rancho Viejo, NM.

Master-planned communities have the opportunity to implement water-smart development choices at many levels. At the largest scale, decisions about where housing, roads, and commercial areas will occur within the development do have an impact on water use. As one example, concentrating residential development on flatter areas will reduce irrigation runoff and improve irrigation efficiency. Installing a recycled water distribution network for individual homes and/or common areas that provides water supply flexibility is another possibility. Increased density, as discussed previously, is also an effective land use decision to reduce water use.

Planning the community in landscape zones that have different water needs is another important factor to consider. Open spaces can be left undisturbed or revegetated with native plants that are water-wise and drought-tolerant. The use of local plants adds a sense of place to the community that can make it feel more a part of the surrounding landscapes. Urban streetscapes can be designed to harvest rainwater and storm water runoff to reduce irrigation requirements. And in communal parks and playfields, turf areas should be planted appropriately where they are used often. Non-functional turf that only gets walked on while being mowed is not used in water-smart developments.

At the individual housing level, master-planned communities can determine the type of appliances and fixtures used within each residence. Irrigated areas can be limited to a square footage per residence or required to use select plants from a pre-approved list. Houses can be built to capture rainwater with underground cisterns and plumbed with greywater systems to further reduce water use. Collectively, these options and opportunities can allow a development to be planned water-smart from the beginning.

MARKET APPEAL

Green building practices that include water-smart standards are increasingly gaining market appeal. The U.S. public is becoming more concerned about the environmental impact of homes and is increasingly interested in how green building practices can save them money. Green buildings can cost more money up front, but pay off that up-front cost through significantly reduced utility bills. Nationally, membership in the U.S. Green Building Council is growing and Leadership in Energy and Environmental Design (LEED) accreditation is on the rise. As water

STERLING RANCH INCORPORATES WATER-SMART DEVELOPMENT FROM THE START

The 3,000-acre proposed development of Sterling Ranch in Douglas County (southwest of Denver, CO) will be a master-planned community that incorporates water conservation throughout all aspects of its design. The community is planned from the ground up to address the goals set forth in the Douglas County 2030 Comprehensive Master Plan, which places significant weight on the efficient use of water. The vast majority of Douglas County communities currently rely on non-renewable groundwater, which is causing severe water supply problems within the county.

Sterling Ranch created a water plan that describes the management of water resources for the new community. One of the most unique aspects of the water plan is the single-family residential water use target. The target for each residence is set at 0.22 acre-feet of water per year (AFY), or 71,500 gallons. The target is apportioned into 0.14 AFY for indoor use and 0.08 AFY for outdoor use. While this quantity of water may be great for some areas of the Interior West, Douglas County households use 0.6 AFY on average, and local zoning standards require 0.75 AFY of water supply per unit; thus, this target represents a significant reduction compared to the status quo.

Sterling Ranch plans to achieve the indoor water use target by requiring all new homes to be built with water-efficient appliances and fixtures. This requirement will be part of the land sales contract and may include measures such as high-efficiency toilets, ENERGY STAR appliances, low-flow faucets, and WaterSense showerheads. Reliable studies have calculated indoor water use at 0.11 AFY and 0.12 AFY after homes have been retrofitted with new fixtures, strongly suggesting that 0.14 AFY is an achievable target. Sterling Ranch will likely exceed its target because the data these studies rely upon is almost a decade old, and water conservation technologies have improved dramatically in the past ten years. Every home will be certified before final sale to ensure all indoor and outdoor requirements are met.

Sterling Ranch plans to achieve the outdoor water use target by limiting irrigated landscapes, requiring water-wise plantings, and mandating efficient irrigation systems. All residential irrigated landscapes will be limited to 1,500 square feet per unit. The water plan evaluates four separate landscape designs that differ in the amount of turf vs. plants, the type of plants, and the style of irrigation system. All of the plans incorporate at least a third of the landscape in turf, and all plans use a maximum of 0.06 AFY, which provides a 33% safety factor in achieving the actual outdoor water use target.

To ensure residents are meeting the target, Sterling Ranch will support an extensive water conservation program. Each house will have an individualized water budget, and dual meters will separate all indoor use from outdoor use. Water will be billed monthly on an inclining block rate structure, with separate components for indoor and outdoor use that will effectively communicate the value of water.

Sources:
Colorado Water Conservation Board. 2004. Statewide Water Supply Initiative Phase I, Appendix E. http://cwcb.state.co.us/IWMD/SWSITechnicalResources/SWSIPhaseIReport/SWSIPhaseIReport.htm.
Headwaters Corporation. 2009. Sterling Ranch Water Plan. http://www.douglas.co.us/planning/documents SterlingRanchWaterPlan 20090423.pdf.

supply pressures become more acute in the future, investments in water-smart practices will be essential.

It is hard to determine how much value homebuyers place on water conservation or sound water policy when choosing a new home because many decisions go into buying a home (e.g., location, floor plan, price, and amenities). However, real estate data from the Civano, AZ, neighborhood suggest that green homes are selling at prices 18-20% higher per square foot than equivalent, traditionally built homes in the same area of town.[13] In addition, Stapleton was the top-selling community in Colorado during 2008, further suggesting that water-smart development is desirable in the marketplace.

PLANNING SUMMARY AND RECOMMENDATIONS

Several communities, utilities, and planners have implemented water-smart planning approaches that recognize the connection between land use and water demands. Stapleton and the Southern Nevada Water Authority are both planning for water-smart homes that use less water than conventional houses, while Civano and Sterling Ranch are holding residences to specific water use targets. The foresight of these entities provides an example for how to plan water-smart, and will ensure that the communities are living as sustainably as possible in the future.

Recommendations for planning agencies, utilities, cities, and master-developers to encourage greater adoption of water-smart planning across the Interior West include:

13 Al Nichols Engineering, Inc. 2008. *Energy and Water Use in Tucson and Civano, January 2007 – December 2007*. July 10, 2008.

- **Encourage decision-makers to recognize that sound land use planning can be a source of water supply.** Population growth in the West will continue to place ever-greater demands on our limited water resources. Rather than assuming that future citizens will use the same amount of water as current residents, there are many ways to ensure that these new arrivals will use considerably less water than the status quo.

- **Integrate land use planning with water planning and, vice versa, by fostering greater communication and cooperation between planners and utilities.** Land use planners and water planners must recognize that their actions directly affect each other. By planning together, these groups can build a future that meets the needs of both organizations.

- **Update general plans to support more compact forms of development, encouraging infill and revitalization over sprawl.** Communities that are built according to the tenants of Smart Growth use significantly less water than suburban sprawl. In addition, these communities are becoming increasingly desirable as empty-nesters downsize and employees want to live closer to work.

- **Provide density bonuses, streamline the approval processes, offer discounted tap fees, and extend utility rebate programs to homebuilders engaged in water-smart development.** Water-smart developments provide a unique opportunity to decrease water use and lock in water savings for years to come. These types of projects are worthy of special treatment and should be encouraged however possible.

- **Pass legislation that requires new developments to demonstrate an adequate supply of water before approval is granted.** Living outside of our means is a recipe for disaster and destruction of our natural environment. Ensuring that new developments can be served by existing water supply reduces the need for new, costly, and damaging water supply projects and promotes more sustainable living practices.

- **Holistically plan new developments from the ground up to be water-smart by including such measures as recycled water distribution systems, water-wise landscaping, and efficient fixtures and appliances.** In almost all cases, it is far more cost-effective to implement alternative water supply options and water conservation practices from the beginning as compared to retrofitting them at a later date. These techniques lock in water savings and provide flexibility in times of need.

- **Encourage government and local agencies to lead by example, partner with other groups and organizations, and educate the community on the benefits of water-smart development.** The general public must recognize and understand why water issues are important and be convinced that some changes are necessary. Building partnerships to extend the reach of influence and exemplifying water-smart practices is an appropriate role for government and utilities to play.

- **Implement and enforce ordinances that encourage efficient water use, such as time-of-day watering and banning the waste of water.** Education and incentives only go so far. In order to have a well-rounded and effective conservation program, it is important to supplement it with directives that establish appropriate behaviors.

BUILDING WATER-SMART

This report focuses on water-smart building practices in the residential sector, rather than the institutional or commercial sectors, but many of the strategies discussed herein have parallel counterparts in other building sectors. In many instances, more water can be conserved by building non-residential properties in a water-smart manner because commercial and institutional buildings generally use larger amounts of water than residential homes. There are also many technologies designed to conserve water in the non-residential sector that are not applicable to residential construction, such as waterless urinals and cooling-tower water recycling.

Certification programs that provide a third-party verification of products and services can be used by builders and homeowners to distinguish water-efficient products. These products can be used inside of homes, like high-efficiency toilets and low-flow showerheads, and can reduce indoor water use to low levels throughout the Interior West. Water-efficient sprinkler systems, appropriate landscape choices, and alternate sources of water supply are some of the choices builders and homeowners can make to conserve water outdoors. Best of all, these measures lock in water savings without requiring behavioral changes from residents.

CERTIFICATION PROGRAMS

Several certification programs exist to identify water-smart programs, organizations, and technologies. Some programs are well known, such as the U.S. Green Building Council's LEED rating system and the ENERGY STAR appliances, while others are still gaining recognition, like the WaterSense products of the U.S. Environmental Protection Agency (EPA). While these programs involve many subject areas, only the topics relevant to water conservation and efficiency are discussed below.

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN

The U.S. Green Building Council's LEED program is a green building certification system that verifies if a building was designed and built using strategies aimed at improving performance in several categories, including water efficiency. LEED buildings are awarded points in various topic areas and all points are added up to achieve a total score. The total score must meet a minimum threshold and is used to determine the building's rating, measured from lowest to highest as Certified, Silver, Gold, or Platinum. LEED-certified buildings are commonly referred to by the rating that they received, e.g., the LEED-Platinum Daybreak Corporate Center.

In the water efficiency category for homes, points are awarded for:

- Use of municipal recycled water, or capture and reuse of rainwater and/or greywater.
- Minimizing outdoor demand through water-efficient irrigation (drip irrigation, hydrozoning, evapotranspiration (ET) controllers, overall landscape water use reduction).
- Minimizing indoor demand for water through water-efficient fixtures and fittings (showers, faucets, toilets).[14]

14 U.S. Green Building Council. 2008. *LEED for Homes Rating System*. January 2008. http://www.usgbc.org/ShowFile.aspx?DocumentID=3638.

ENERGY STAR

ENERGY STAR is a joint program of the EPA and the U.S. Department of Energy, which certifies products that meet strict energy efficiency guidelines. ENERGY STAR products use 10–50% less energy and water than standard models,[15] and all ENERGY STAR products that use hot water are necessarily water-efficient, because heating water takes large amounts of energy.

WATERSENSE

WaterSense is a partnership program sponsored by the EPA that is very similar in style to the ENERGY STAR program, but focuses on water efficiency rather than energy efficiency. WaterSense products are certified to perform at least 20% more efficiently than their standard counterparts.[16] The WaterSense program is drafting, or has developed, specifications for the following product types:

- Bathroom sink faucets
- Flushing urinals
- High-efficiency toilets
- Landscape irrigation services
- Showerheads
- Weather- or sensor-based irrigation control technologies
- New homes

BUILT GREEN COLORADO

Built Green Colorado is one of oldest and largest green home building programs in the nation. It was started by the Home Builders Association of Metro Denver for the purpose of encouraging home builders to use technologies, products, and practices that result in homes that are better built and better for the environment.[17] Similar to LEED-certified homes, Built Green homes must achieve a minimum amount of points awarded for incorporating certain technologies across topic areas. A detailed checklist provides the home builder with the required specifications and associated point values. The Built Green standards have also been adopted to certify homes by Build Green Utah. A selection of the Built Green Water Conservation requirements is provided below.

- Efficient hot water delivery system is designed so that water heater is within 20 pipe feet of all hot water fixtures.
- Clothes washer has ENERGY STAR label.
- Toilets are dual-flush gravity, or pressure/vacuum assist averaging 1.1 gallon per flush (GPF).
- Landscape is designed based on a water budget with a maximum of 15 gallons per square foot per year.
- Efficient irrigation system incorporates hydrozones where shrubs and trees are irrigated with drip or subsurface irrigation.
- A list of drought-tolerant plants is provided to home buyers.[18]

15 ENERGY STAR. Appliances: ENERGY STAR. http://www.energystar.gov/index.cfm?c=appliances.pr_appliances (accessed June 25, 2009).

16 More information is available at http://www.epa.gov/watersense/.

17 More information is available at http://www.builtgreen.org/.

18 Built Green. 2008. 2008 Built Green Checklist Version 2008.1. http://www.builtgreen.org/checklist/2008_Built_Green_Checklist.pdf.

OTHER CERTIFICATION PROGRAMS

There are several other local and national programs throughout the Interior West that certify green buildings. Most of these programs use a points system to rate buildings and include several water conservation measures; however, most programs, on the whole, are not as aggressive on water efficiency as they are on energy efficiency. One program, Build Green New Mexico, certifies homes under the American National Standards Institute (ANSI) National Green Building Standard, which includes points for WaterSense-certified irrigation systems, 1.5-GPM faucets, and toilets flushed with recycled water.[19] Another program, the Scottsdale (AZ) Green Building Program provides points for high-efficiency toilets, Xeriscaping 80% or more of landscapes, and directing roof and storm water runoff to landscaped areas.[20]

INDOOR MEASURES

Indoor water conservation measures implemented during the construction of new homes are an important element of water-smart development because these technologies lock in water savings and do not require behavioral changes from residents. Most people do the same things inside of their house throughout the country (e.g., cook, clean, eat, sleep); on average, toilets use the most water in a house, followed by clothes washers, showers, and faucets *(Figure 4)*. Using high-efficiency appliances and fixtures throughout the house can lower indoor per capita water use from the national average of 69 GPCD[21] to values in the low 40s.[22,23,24]

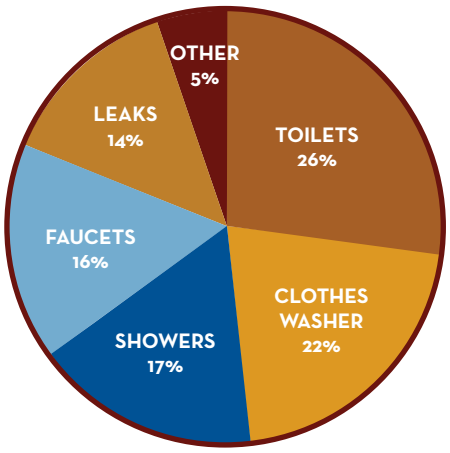


Figure 4. *Average residential water use in homes by type.*[24]

TOILETS

Toilets are the single largest water user in a home; fortunately, toilet technology has advanced rapidly in the past decade and new toilets use much less water than before. Some of the oldest toilets common in residential construction use upwards of 7 GPF, and pre-1994 toilets use 3.4 GPF. Ultra low-flow (ULF) toilets that use only 1.6 GPF are mandated in all new residential construction due to the U.S. Energy Policy Act of 1992, and newer high-efficiency toilets (HET) use only 1.28 GPF. Cutting-edge toilet technology with dual-flush capabilities or with a vacuum or pressure assist can reduce water use to 1.16 GPF *(Figure 5)*. WaterSense-certified toilets have an effective flush volume that does not exceed 1.28 GPF, with a solid waste removal of 350 grams or greater.[26] As of June 2009, there were 309 different WaterSense toilets to choose from, manufactured by more than 35 companies, suggesting that there's likely a water-conserving toilet out there to meet almost everyone's tastes.[27]

19 National Association of Home Builders. NAHB Green Scoring Tool. http://www.nahbgreen.org/ScoringTool.aspx (accessed June 25, 2009).

20 City of Scottsdale, AZ, Green Building Program. 2006. *Green Home Rating Checklist: New Construction, Major Remodels & Additions*. http://www.scottsdaleaz.gov/Assets/documents/greenbuilding/GBChecklist2007.pdf.

21 Mayer, Peter W. and William B. DeOreo. 1999. *Residential End Uses of Water*. Denver, CO: American Water Works Association Research Foundation.

22 39 GPCD based on 2.5 people per household. Source: DeOreo, W.B., et al. 2001. Retrofit Realities. *Journal of the American Water Works Association* 93(3):58-72.

23 43 GPCD based on 2.5 people per household. Source: U.S. Environmental Protection Agency. 2005. *Combined Retrofit Report: Water and Energy Savings from High Efficiency Fixtures and Appliances in Single Family Homes*. March 28, 2005. http://www.aquacraft.com/Publications/EPA_Combined_Retrofit_Report.pdf.

24 45 GPCD. Source: Vickers, Amy. 2001. *Handbook of Water Use and Conservation*. Amherst, MA: WaterPlow Press, 2001.

25 Mayer, Peter W. and William B. DeOreo. 1999. *Residential End Uses of Water*. Denver, CO: American Water Works Association Research Foundation.

26 U.S. Environmental Protection Agency, WaterSense. 2007. *Tank-Type High-Efficiency Toilet Specification*. January 24, 2007. http://www.epa.gov/watersense/docs/spec_het508.pdf.

27 U.S. Environmental Protection Agency, WaterSense. High-Efficiency Toilets. http://www.epa.gov/watersense/pp/het.htm (accessed June 25, 2009).

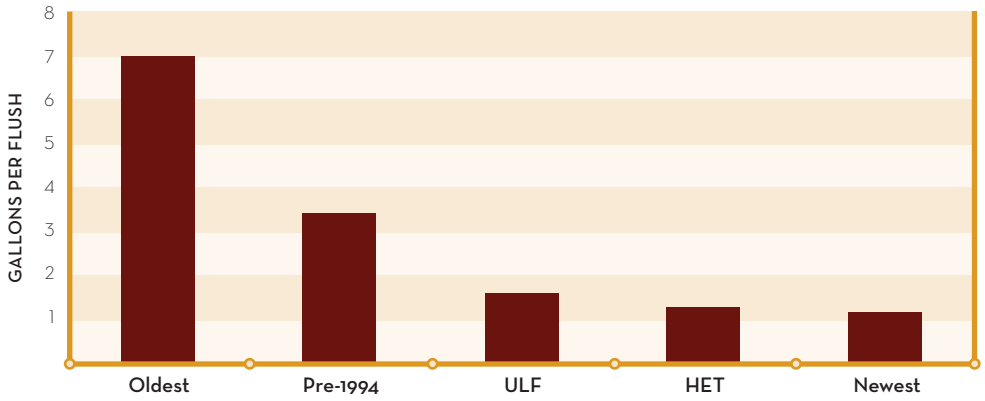


Figure 5. *Toilet water use reduced through technology improvements.*

APPLIANCES

Clothes washers rank second, after toilets, for amount of indoor water use. ENERGY STAR clothes washers cut energy and water consumption by over 40% compared to standard washers and use as much as 18 gallons of water less for every load.[28] ENERGY STAR clothes washers have a water factor of 8 or less, which measures the number of gallons per cycle per cubic foot that the clothes washer uses[29] — the lower the water factor, the more efficient the washer. As of June 2009, there were 335 different ENERGY STAR clothes washers to choose from, manufactured by more than 30 companies.[30]

Dishwashers are not a major source of water use in the home. On average, dishwashers only make up 1.4% of total indoor water use.[31] However, there are many ENERGY STAR dishwashers that use water efficiently.

FIXTURES

Faucets and showers each account for about 16-17% of household water use. EPA certifies WaterSense bathroom faucets whose maximum flow rate does not exceed 1.5 gallons per minute (GPM) and is in the process of developing specification criteria for showerheads.[32] The current standard for low-flow showerheads set by the federal Energy and Policy Act is 2.5 GPM at 80 PSI, but some more efficient models deliver water at 1.6 GPM or even 1.2 GPM. Kitchen faucets are also subject to the 2.5-GPM limit, but there are many aerators and faucet designs available that can deliver water at 2 GPM or less.

OTHER INDOOR MEASURES

Additional indoor water conservation measures include the use of greywater and/or recycled water and the layout of the hot water distribution system. It is not necessary to flush household toilets with highly treated drinking water, and the opportunity to use greywater from the shower or bathroom sink presents a novel way to cut down on indoor water use. Several manufacturers make systems that capture, filter, and disinfect sink or shower water to be used for toilet flushing.[33] Recycled water, if available, is also a good alternative to flushing toilets; however, this practice is used more often in commercial buildings.

28 ENERGY STAR. Clothes Washers. http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers (accessed June 25, 2009).

29 For example, if a clothes washer uses 15 gallons per cycle and has a tub volume of 3.0 cubic feet, then the water factor is 5.0.

30 ENERGY STAR. Clothes Washer Buyers Guide: ENERGY STAR http://www.energystar.gov/index.cfm?c=clotheswash.pr_tips_clothes_washers (accessed June 25, 2009).

31 Mayer, Peter W. and William B. DeOreo. 1999. *Residential End Uses of Water.* Denver, CO: American Water Works Association Research Foundation.

32 U.S. Environmental Protection Agency, WaterSense. Bathroom Sink Faucets. http://www.epa.gov/watersense/pp/bathroom_faucets.htm (accessed June 25, 2009).

33 One of these products is the AQUS® greywater system. More information is available at http://www.watersavertech.com/.

The distance water travels from the hot water heater to the point of use impacts indoor water use because many people wait for the water to "warm up" before using it. Some green building codes offer points for having all fixtures within 15 pipe feet of the hot water heater, for having a maximum of six cups of hot water in any one distribution line, or for demand-actuated hot water recirculation systems. Another approach is to use tankless water heaters that provide water at the point of use only when necessary. These tankless heaters can offer energy savings as well, and may be just as cost-competitive with standard models if they are designed into the home from the beginning of construction.

WATER-SMART DEVELOPMENTS REQUIRE INDOOR CONSERVATION MEASURES

Sterling Ranch, CO
By contract with the builders and by requirement of the homeowner association's covenants, conditions, and restrictions, Sterling Ranch will institute minimum water efficiency standards for 100% of homes. Water-efficient specifications are under consideration for toilets, appliances, fixtures, water pressure, hot water systems, evaporative coolers, water softeners, and water treatment. Sterling Ranch will utilize components of existing certification programs, such as EPA's WaterSense, SNWA's Water Smart Home, and others, but will tailor its program to meet the development's characteristics.

Oshara Village, NM
Homes in Oshara Village must meet normal standards for water-conserving faucets and fixtures, and are required to have ENERGY STAR appliances and hot water recirculating systems with insulated pipes. In addition, homes are allowed only one dishwasher that uses five gallons or less per load and one washing machine that uses 14 gallons or less per load. Oshara Village bans the use of evaporative coolers, reverse osmosis filtration, and water softeners.

Stapleton, CO
All homes in Stapleton comply, at a minimum, with the water conservation elements of Built Green Colorado.

Sources:
Headwaters Corporation. 2009. *Sterling Ranch Water Plan.*
http://www.douglas.co.us/planning/documents/SterlingRanchWaterPlan20090423.pdf.
Oshara Village. 2006. Covenants, Conditions, and Restrictions. http://osharavillage.com/Buyer_Information/index.html.
Forest City Stapleton, Inc. 2004. *Stapleton Sustainability Master Plan.* http://about.stapletondenver.com/about/sustainability.

OUTDOOR MEASURES

Efficient outdoor water use could be the single largest factor in determining if a development is water-smart. Nationally, about 30% of municipal water supply is used outdoors,[34] but in the Interior West, where supplemental irrigation is required to maintain landscapes, outdoor water use can easily comprise 50% of total residential use and may be as high as 70% in some areas *(see Table 3)*. Furthermore, the EPA estimates that at least half of irrigation water is wasted through overwatering, improper system design, and wind losses, presenting a substantial opportunity to reduce outdoor use.[35]

Many people have spent their careers on reducing outdoor water use; consequently, there is a tremendous amount of information on the topic. This section addresses only some of the water-efficient practices that can be used in water-smart development and will not describe each one in detail — this is by no means an exhaustive list. Excellent and readily available information on outdoor water conservation is available from local water utilities, local cooperative extensions, and even local plant nurseries. In fact, it is best to consult a local expert about specific outdoor watering needs because climate and weather patterns vary dramatically across the Interior West.

34 U.S. Environmental Protection Agency, WaterSense. 2008. *Outdoor Water Use in the United States*. EPA-832-F-06-005. August 2008. http://www.epa.gov/WaterSense/pubs/outdoor.htm.

35 Ibid.

LANDSCAPING

One of the best ways to reduce outdoor water use is to select plants that are indigenous, or native, to the area. Most importantly, plants native to the Interior West are drought-tolerant and require significantly less water than some imported varieties; in addition, they are also more resistant to local pests and disease. Requiring the use of native plants or other low-water use varieties from a specific list in open spaces and front yards is a hallmark of water-smart development. Using open space landscapes as a model of what individual residents can do for themselves, such as is practiced at Daybreak, UT, is one way to lead by example.

Photos, from top right: Magic straws, Daybreak; photo courtesy of ValleyCrest. Plaza at Rancho Viejo; photo courtesy of R. Thomas Berner. Civano Nursery; photo courtesy of Civano Neighbors. Neighborhood pocket park, Stapleton; photo courtesy of Forest City Enterprises.

CIVANO PROVIDES EXTENSIVE PLANT LIST

The community of Civano provides its residents with a thorough list of recommended 1) native, 2) near-native, 3) edible, and 4) non-native plants to use in their landscapes. A small selection of the more than 170 recommended native plant species is provided below.

BOTANICAL NAME	COMMON NAME
Accent Plants	
Agave americana	Century Plant
Fouquieria splendens	Ocotillo
Cacti	
Carnegiea gigantea	Saguaro
Oeolloydia sp.	Pineapple Cactus
Opuntia bigelovii	Teddy Bear Cholla
Flowers	
Aquilegia chrysantha	Golden Columbine
Phacelia campanularia	Desert Bluebells
Zinnia grandiflora	
Groundcovers	
Clematis ligusticifolia	Clematis
Eriogonum fasciculatum	California Buckwheat
Vitis arizonica	Arizona Grape
Vines	
Cardiospermum corindum	Lantern Vine
Cissus incisa (C.trifloliata)	Desert Grape Ivy
Shrubs	
Dalea wislizeni	Indigo Bush
Fallugia Paradoxa	Apache Plume
Mimosa dysocarpa	Velvet Pod Mimosa
Trees	
Cercidium floridum	Blue Palo Verde
Prosopis pubescens	Screwbean mesquite
Sambucus mexicana	Mexican Elderberry

Source:
Civano Neighbors. Civano Landscape Design Guidelines.
http://www.civanoneighbors.com/residents/guiding/landscape/index.htm
(accessed June 26, 2009).

Mexican Elderberry

Clematis

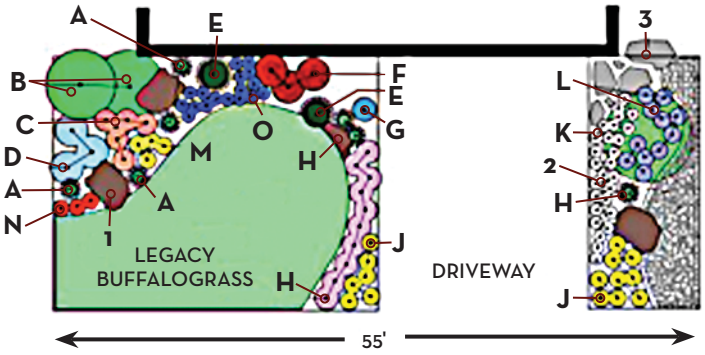
Saguaro

Limiting the total allowable irrigated area of a lot is one way to reduce outdoor water use. Another approach is to set a total water budget for outdoor use, like 15 gallons per square foot per year. The city of Boulder, CO, uses this type of water budget approach for outdoor irrigation, basing a resident's outdoor water use budget on the total irrigable area of their lot.

Restricting the placement or use of turf grass is another way to reduce water use. Kentucky bluegrass is not native to the Interior West and it requires a significant amount of irrigation, pesticide, and fertilizer to maintain a healthy appearance in this area. Restricting turf in places that are prone to inefficient irrigation, such as road medians, curb-to-curb placements, or anything less than ten feet wide, can reduce water waste.

Xeriscaping is another practice that can simultaneously reduce water use and provide beauty to the landscape *(Figure 6)*. The term Xeriscape, not zeroscape, was coined by Denver Water in 1981 to help make low-water-use landscaping an easily recognized concept. Xeriscape is a combination of the word "landscape" and the Greek word "xeros" — which means dry. It is a method of responsible landscaping that can be applied everywhere and includes the following measures:

1) Plan and design landscaping comprehensively.
2) Evaluate and improve soil if necessary.
3) Group plants according to their water needs.
4) Create practical turf areas.
5) Water efficiently.
6) Use organic mulches.
7) Practice appropriate maintenance.[36]



A Big bluestem
B Cut-leaf staghorn sumac
C Sunset hyssop
D Russian sage
E Slowmound mugo pine
F Paprika yarrow
G Faassen's catmint
H Feather reed grass
I Pink sunrose
J Oakleaf sedum
K Lavender mist sun daisy
L Lavender aster
M Yellow pine leaf penstemon
N Pine leaf penstemon
O Blue lavender

Figure 6. *Sample Xeriscape front yard plan for the Denver, CO area.*

IRRIGATION

Once landscapes are planted, efficient irrigation is imperative to keep water use low. The correct watering schedule, quantity, and precision for each plant type, modified for the most recent weather conditions, must be used for proper irrigation. Grouping plants by their water needs, a technique called "hydrozoning," enables an irrigation system to supply the correct amount of water to each section of plants without overwatering. Using drip irrigation for perennials, shrubs, and trees, and spray irrigation only for turf, also maximizes efficiency.

Scheduling irrigation with a "smart controller" that bases watering times on weather data and evapotranspiration rates ensures that sprinklers apply the appropriate amount of water throughout the irrigation season — and do not come on when it is raining. These controllers receive information directly from a local weather station or use wireless communication to download the day's weather pattern and adjust watering times accordingly. Smart controllers are especially effective because they adjust irrigation throughout the season and do not fall prey to the "set it and forget it" mentality adopted by many homeowners.

Best management practices (BMPs) that detail specific actions to achieve efficient irrigation and water use are established throughout the Interior West. These practices are implemented by landscape irrigation professionals, many of which are certified through programs such as WaterSense or The Irrigation Association. As another example, GreenCO, a Colorado trade association of plant and landscape industry professionals, has produced an excellent handbook describing 39 practical BMPs, ranging from mowing and mulching, to irrigation system design and soil amendments.[37]

36 Denver Water. Xeriscape. http://www.denverwater.org/Conservation/Xeriscape/ (accessed July 27, 2009).

37 Wright Water Engineers, Inc. 2008. *Green Industry Best Management Practices (BMPs) for the Conservation and Protection of Water Resources in Colorado: Moving Toward Sustainability.* Prepared for Green Industries of Colorado. Third release, May 2008. http://greenco.org/bmp_downloads/BMP_Manual_2008.pdf.

DAYBREAK PROMOTES EFFICIENT OUTDOOR WATER USE IN UTAH

The community of Daybreak, UT, has taken extensive steps to ensure its residents use water in the most efficient manner possible. Beginning in the planning phase, all home builders are required to match front yard landscaping to Daybreak's pattern book, which stresses perennials, planter beds, and water-wise plantings. Front yards at Daybreak are limited to a maximum of 50% turf, and drip irrigation is required for all perennials, shrubs, and trees.

Daybreak uses an approved plant list comprised of water-wise and readily available species that guides landscaping in all open spaces and individual homes. Selecting plants from one list allows Daybreak to use its open spaces as an example of what residents can do at their own homes. The open spaces are irrigated with secondary water (raw or untreated), some of which is sourced locally from Oquirrh Lake, and irrigation is controlled by a master computer that uses two on-site weather stations to apply water only as needed. Daybreak also requires all landscaped areas greater than 5,000 square feet (public or private) to use an ET controller tied into its weather stations, and installed more than 380 of these controllers in 2007 alone.

Upon moving in, Daybreak residents are provided with a well-illustrated and comprehensive landscape guide that provides tips and design techniques to help homeowners create a beautiful, unique, and sustainable landscape. The guide describes basic design principles, shows several landscape options, provides an extensive recommended plant list with color photographs, gives irrigation and maintenance tips, and even provides contact information for local nurseries.

One of the most interesting water conservation technologies at Daybreak is its invention of a subsurface irrigation system called "Magic Straws." The Magic Straws system is based on the principle of flood irrigation and uses the underground thatch layer of turf to distribute water to the root zone. Magic Straws are built from readily available irrigation equipment that is placed 10-12 inches below the surface, with tubes that rise into the grass every 18-24 inches. The system produces zero runoff, loses zero water to evaporation, and is cost-comparable to a regular spray irrigation system. Daybreak has enlisted the help of Rain Bird® and several local sod companies to improve and promote the Magic Straws, and will begin using the system on all parks and open spaces that front to streets in the immediate future.

Source:
Haws, J., Daybreak landscape manager. Personal communication, June 15, 2009.

OUTDOOR WATER SUPPLY

There is a growing recognition that irrigating household landscapes with highly treated, energy-intensive potable water is not a wise use of the resource. Unfortunately, utilizing alternative supply sources usually means significant investments in infrastructure. Recycled water is a drought-proof supply for outdoor water use, and is much easier to build into a new development from the beginning rather than retrofitting an existing community. Using recycled water for common area irrigation, like for open spaces or ball fields, or at the individual lot level, is an excellent reuse of a limited resource.

Rainwater harvesting is an alternative water supply, although the legal requirements for doing so are different across the western states. In Arizona, the practice of rainwater harvesting is encouraged by the State Department of Water Resources and local water providers. In New Mexico, the County of Santa Fe requires the use of roof catchment cisterns on all homes greater than 2,500 square feet and rain barrels on all homes smaller than 2,500 square feet.[38]

At the other end of the spectrum, Colorado just past two laws allowing the use of rainwater harvesting — previously the practice was banned. One bill allows rural rainwater collection for residences that are not connected to a domestic water supply system (SB 09-080), and the other establishes a pilot program in new residential development that will allow collection of precipitation for non-potable uses (HB 09-1129). Studies performed at Rancho Viejo, NM, indicate that homes equipped with rainwater cisterns use 30% less water than their non-harvesting counterparts.[39]

Low-impact development (LID) techniques are another alternative water supply. Directing runoff from impermeable surfaces (e.g., roof, driveway, street) across vegetation that needs irrigation can cut down on outdoor water use; these techniques are sometimes called "raingardens"

38 Santa Fe County Ordinance No. 2003-6. http://www.co.santa-fe.nm.us/business/documents/ordinances/Water%20Harvesting%20Ordinance.pdf.

39 Units with cisterns use 0.12 AFY, those without use 0.17 AFY. Source: Thomas, P., Rancho Viejo sales manager. Personal communication. April 16, 2009.

(Figure 7). Larger-scale techniques can be implemented across a development, like curb-less roads and swales that direct runoff into vegetated areas and not immediately into storm drains. Many LID techniques also have the added benefit of improving water quality.

BUILDING CONTRACTORS

Several prominent builders are taking advantage of the recent increase in demand for green buildings. Although water conservation is usually not emphasized as much as energy conservation due to the national focus on energy issues, many builders are incorporating water-smart practices into their homes. Common approaches include selecting ENERGY STAR appliances, using low-flow fixtures and dual-flush toilets, planting a water-wise landscape, and using drip irrigation systems.[40,41,42] Indirect approaches to limit water use in the backyard include building large patios, fire pits, and other hardscape elements, which can add value and comfort to a backyard while simultaneously reducing water use.

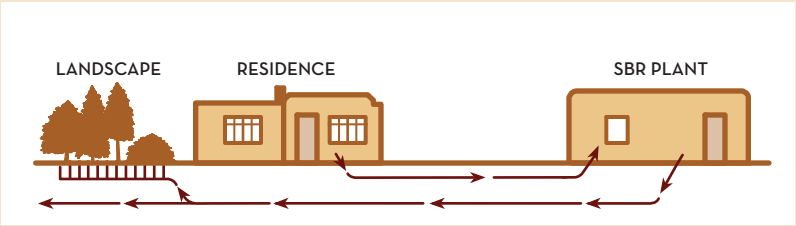
Photo courtesy of Drew Beckwith

Figure 7. *A raingarden at WRA's Boulder office.*

OSHARA VILLAGE'S DRAINS FILL WATERING CAN

To meet the challenge of providing a sustainable water supply in water-short Santa Fe County, Oshara Village is implementing sensible landscape design and advanced household water conservation, plus using recycled waste water for landscape irrigation. An onsite sequencing batch reactor (SBR) that treats the village's wastewater provides all outdoor irrigation water for residents and open spaces.

The buried wastewater treatment plant, nicknamed "Esbr," provides 30,000 gallons per day of New Mexico Environmental Department Class 1A water to Oshara Village. This water is distributed throughout the community for landscape irrigation of public and private spaces in 11 separate zones, and is also used to flush toilets in commercial buildings. To accommodate future growth, the reactor is modular, so it can be enlarged as the water needs grow; the only above-ground portion of the facility is an operations building measuring 14 feet by 21 feet.



Esbr water supply schematic. Images courtesy of Oshara Village, LLC.

Esbr operations building.

To ensure that adequate irrigation water is provided to all residents, the system is controlled by a master computer that provides landscapes with a total of approximately 75 minutes of irrigation per week, equating to about 14 inches per year. Each lot has a specific water budget, based on the square footage of the property, and there are no potable connections on the outside of any home. To ensure that landscapes can survive on their allotted budget, all designs must be approved by the village ecologist.

Sources:
Oshara Village, LLC and New Village Institute. 2007. Your Sustainable Water System.
Oshara Village, LLC. 2007. Oshara Village Pattern Book. Fourth Edition. November 17, 2007. http://osharavillage.com/images/Files/166-LowR1107Pattern_book.pdf.

40 Taylor, J., vice president of construction, Rainey Homes. Personal communication. June 18, 2009.

41 Cuculic, W., director of strategic marketing, Pulte Homes – NV. Personal communication. July 30, 2009.

42 Sabin, R., owner, Aspen Homes. Personal communication. May 7, 2009.

Builders have chosen to construct homes in a more efficient manner for a variety of reasons. Some of the more prominent motivating factors include market differentiation, representing a quality builder, and recognition that in the near future this type of construction will be the norm. Engle Homes in Colorado offers a Xeriscape front yard design option to increase variability in its developments and reduce the cookie-cutter feel.[43] Rainey Homes in Utah used its green building credentials to earn the Kennecott Land 2007 Sustainable Builder Award for its homes at Daybreak as well as the 2008 Best of State Award from Build Green Utah.

Builders do voice legitimate concerns about implementing some water-smart development practices in new homes. Technology is rapidly changing in the marketplace, and builders do not want to invest in a product that will become obsolete in a few years. Cost is also a consideration because many of the new efficient products are expensive and may be prohibitively so for the average residential homeowner. Independent certification of homes, which is crucial for marking the performance of a home, can require burdensome paperwork loads that some feel are not worth the headache to complete.[44]

Most importantly, however, appraisers and lenders have not adopted practices that value green features. In effect, this makes it problematic for builders to invest money in water-smart practices if they are unable to achieve a return on their investment when selling the property. In the end, customer demand for, and acceptance of, higher up-front costs for greener development is key, and most developers will not pursue features that raise costs without a clear indication that doing so will not reduce sales.

PULTE HOMES OF NEVADA BUILDS WATER-SMART HOMES

Pulte Homes, one of the nation's largest home builders, is actively utilizing green construction practices. The Nevada division of Pulte Homes (PH-N) has been engaged with Environments For Living, a program that promotes energy-efficient construction practices, for most of the past decade; PH-N is also a major partner in the SNWA's Water Smart Home Program. PH-N has primarily chosen to build more water-efficient houses in order to differentiate its homes from others on the market.

Through preference surveys of green features, PH-N has found that water conservation is consistently identified as one of the top three priorities for home purchasers. This information has encouraged them to incorporate high-efficiency toilets, low-flow fixtures, ENERGY STAR appliances, smart irrigation controllers, and water-wise landscaping into many of their new homes in the Las Vegas area. PH-N is also committed to measuring its water conservation savings, and is participating in EPA's ongoing Water Efficiency Benchmarking Study for New Single-Family Homes.

Source:
Cuculic, W., director of strategic marketing, Pulte Homes – NV. Personal communication. July 30, 2009.

BUILDING SUMMARY AND RECOMMENDATIONS

New residential developments across the Interior West have implemented several water-smart practices into their homes. Certification programs help builders identify better technologies and provide consumers with confidence that products are sufficiently tested. Outdoor water use can be limited by using specified plant lists and efficient irrigation systems, and BMPs provide guidance on proper maintenance to keep homeowner's landscapes beautiful. These water-smart technologies lock in water savings without requiring any behavioral changes from residents.

Recommendations for builders and homeowners to achieve a water-smart home include:

- **Utilize performance-based third-party certification systems to select water-efficient indoor fixtures and appliances.** There are an overwhelming number of choices available to the public, and these independently certified products provide a measure of

43 Wright Water Engineers, Inc. 2004. *Working Together to Promote Landscape Water Conservation.* Final Report for OEMC Project #04-011. May 2004.

44 Sabin, R., owner, Aspen Homes Colorado. Personal communication. May 7, 2009.

assurance that products are thoroughly vetted and tested. Included in this list are high-efficiency toilets, ENERGY STAR appliances, and WaterSense faucets, all of which will save money and perform to expectations.

- **Reduce outdoor use by limiting irrigable areas, restricting turf, or using a conservative water budget.** Outdoor water needs consume the vast majority of western water use. Reducing the coverage of high-water-use plants is a simple and effective means to limit water use.

- **Landscape areas with native, water-wise plants and adhere to the practices of Xeriscape.** Indigenous plant species are well-adapted to the arid West and can survive extended periods of drought; plus, they require less fertilizer and are better adapted to fighting pests. Xeriscape practices ensure that landscapes are planned appropriately for their environment and require less water than traditional landscaping.

- **Irrigate with an efficient system that uses appropriate emitters and is run by a smart controller.** Overwatering landscapes wastes millions of gallons of water every year. An irrigation system that is properly designed and adjusts watering times according to recent weather patterns allows efficient use of water.

- **Utilize alternative sources of water supply for indoor and outdoor uses where legal and appropriate, including recycled water, greywater, and rainwater.** Using locally collected water reduces impacts on rivers and streams, and can result in significant energy savings from avoided treatment and distribution. Furthermore, these alternative sources match the quality of water to its purpose of use; neither plants nor toilets require highly-treated drinking water.

LIVING
WATER-SMART

The intent of water-smart development is to develop and build communities in the most water-smart fashion from the beginning. All of the up-front work allows residents to conserve water without behavioral changes. Given the importance of the built environment, it is also vital to educate residents on newer technologies that may be present in their home, to set ground rules regarding appropriate water use, and to provide regular feedback on the volume of water each residence is using. Several of the communities described in this report have implemented these techniques and are living water-smart.

It is important to note that all communities can strive to live water-smart, whether or not they were planned and built water-smart. Small changes in water pricing, incentives, and community norms can lead to significant reductions in water use from every resident across the Interior West. Western Resource Advocates has produced several reports describing various strategies that can reduce water use; however, not all of these strategies are discussed in this report.[45]

EDUCATION

Education and awareness is the foundation of almost every water conservation program and is vital for encouraging water-smart practices. This education is usually disseminated by the local water utility, but water-smart developments may have additional reasons for educating their residents. Some developers educate because the technologies they have built into the homes require an informed resident, others educate because they are required to meet a reduced water use target as a provision for service by the water provider, and still others educate because "it's the right thing to do."

Educational messaging includes everything from providing water-saving tips to alerting resi-

DAYBREAK PROMOTES ONGOING EDUCATION

The Daybreak community in Utah is actively educating its residents through multiple approaches. Quarterly water conservation information packets are distributed to all residents that describe appropriate outdoor water use (in April) and sprinkler shut-down procedures (in November), as well as indoor conservation tips (in June and September). Daybreak has used sod test plots to show residents that turf grass irrigated with 22 inches of water is the same color green as grass irrigated with 51 inches of water. Daybreak's North Shore information pavilion contains educational pieces and placards on the pavilion's Xeriscape landscaping, which happens to be built on a steel frame that allows the entire pavilion to move from area to area as the community is being developed. In addition, Daybreak is partnering with Utah State's Slow the Flow program to promote efficient outdoor water use and is working with the city of South Jordan to include graphical water usage information in future water bills.

Sources:

Rio Tinto. 2009. 2008 Salt Lake Valley Sustainable Development Report. http://kennecott2008sdreport.verite.com/.

Kennecott Land. 2008. 2007 Sustainable Development Report. http://www.kennecottland.com/library/media/papers/pdf/KL2007SDreport.pdf.

Kennecott Land. 2007. 2006 Sustainable Development Report. http://www.kennecottland.com/library/media/papers/pdf/2006%20SDwebReport.pdf.

45 More detailed information is available at http://www.westernresourceadvocates.org/media/pandp.php.

dents to ongoing rebate programs, from using demonstration gardens to providing irrigation classes. The messages are most often delivered through "bill stuffers" — promotional pieces inserted into mailing envelopes along with the bill — but aggressive marketing campaigns use in-person meetings and multi-media approaches on TV, radio, the local newspaper, and, increasingly, the web. Active utilities also provide classes on topics aimed at improving water use efficiency in the home and outdoors. This education provides a critical connection between the water supplier and the resident, and while it is difficult to quantify the water savings associated with education and awareness efforts, these programs are essential to keeping water use rates low.

OSHARA VILLAGE EDUCATES NEW RESIDENTS

Oshara Village and The New Village Institute partnered to produce a 30-page education book for all new homeowners titled, "Your Sustainable Water System." This book describes Oshara Village's water conservation covenants, how waste is used as a resource at the village, a list of common household waste products that are detrimental to the wastewater treatment process, landscape irrigation tips and requirements, water-conserving fixtures and appliances in use at their home, how to harvest rainwater, and the process for modifying their existing landscape. This book provides a good foundation of water conservation education for all new residents and provides them with the information they need to live water-smart.

Source:
Oshara Village, LLC. and The New Village Institute. 2007. *Your Sustainable Water System.*

Water audits are a form of education in which water providers assess current water use trends and provide advice, direction, and/or physical fixes to reduce household water use. Indoor audits can include leak detection and repair, fixture flow rate measuring, and an assessment of daily water use behaviors. These audits conclude with a "report card" suggesting improvements and offering a quantification of the water and monetary savings associated with implementing more efficient practices. Outdoor audits generally focus on a homeowner's irrigation system and also include a summary report that provides recommended watering times, water-wise plant selections, and landscape maintenance requirements.

The public can also be informed through the use of community groups and community participation. A neighborhood-wide focus group that looks at water issues is one method of getting residents actively involved in conservation. These types of groups are generally composed of knowledgeable and motivated residents who are likely to bring unique perspectives to the table. In addition, these residents build strong interpersonal relationships with other residents — which may be more effective in promoting water conservation practices than blanket mailers from the utility or developer. Other community groups, like garden clubs or flower societies, can similarly provide peer-to-peer recommendations for efficient water use based on real-world experience.

CIVANO ENGAGES COMMUNITY WITH WORK GROUPS

Civano Neighbors, the community association at Civano, AZ, funds an environmental work group to address solar energy, energy efficiency issues, reclaimed water usage, water harvesting, recycling, and other environmental issues. This particular work group, among seven others, provides cost/benefit analysis on reclaimed water usage, helps compile ongoing energy and water quantification studies, and educates residents on water harvesting practices. All of the work groups provide valuable information to the community association that allows it to communicate on a more leveraged basis with Civano's developers and homebuilders.

Source:
Civano Neighbors. Environment Working Group. http://www.civanoneighbors.com/tasks/environment/ (accessed June 30, 2009).

BILLING

Individual developments do not normally supply their own water, but it happens occasionally in large-scale isolated neighborhoods. In this case, or even when billing is handled by a local utility, there is an important amount of education that can happen through a water bill. Water bills that contain information on how much water the resident used last month and last year for the same time period, how much water they should be using, and how their use compares to that of their neighbors or the "average" customer can provide valuable information to the resident — especially when they are designed with easy-to-read graphs and are accompanied with conservation messaging. Separating water use into indoor and outdoor use through dual meters, or using recycled water for outdoor use, can enable the utility to incentivize conservation without penalizing essential water use needs.

Peer-to-peer comparison is a burgeoning field in utility billing and may prove to be very influential in encouraging residents to live water-smart. Peer pressure tactics are already being effectively leveraged by electric utilities to reduce consumption.[46] In these programs, residents' bills show their own use, along with a comparison to the neighborhood average use and to the use of the top 20% most efficient households. "Keeping up with the Joneses" can be a very powerful motivating factor.

WATER RATES

Properly designed rate structures can simultaneously reward conservation, discourage waste, provide revenue stability, and equitably distribute costs so that all residents feel they are being treated fairly. Inclining block rate structures that impose higher charges as water use increases most effectively communicate the value of water and encourage efficient use *(Figure 8)*.

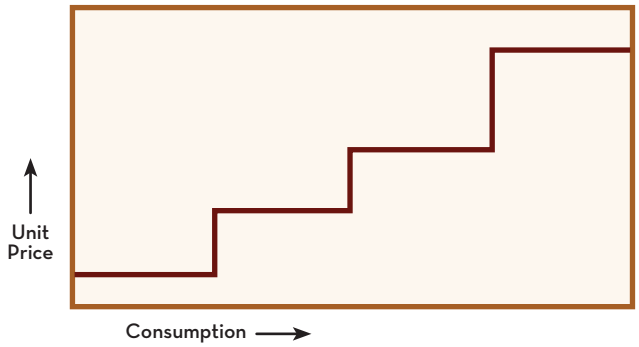


Figure 8. *Representation of an inclining block rate structure.*

Residents who use low or moderate volumes of water are charged a modest unit price and rewarded for conservation; those using significantly higher volumes pay higher unit prices. This approach provides an incentive to conserve and ensures that all residents are able to meet their basic water needs at an affordable cost.

INCENTIVES

Rebate and retrofit programs that provide cash payments or discounts on a water bill can be used to incentivize water-smart living. These types of rebate programs assist residents in purchasing high-efficiency toilets, ENERGY STAR washing machines, ET-based irrigation controllers, or any of the other indoor and outdoor water conservation technologies described earlier. When new water-efficient appliances, fixtures, and landscapes are installed, the resident can usually recover most of the up-front costs in a relatively short period of time via lower water bills.

46 The Sacramento Municipal Utility District has recorded a 2% drop in customer energy use after only six months of participating in a peer-to-peer education program. Source: Kaufman, Leslie. 2009. Utilities Turn Their Customers Green, With Envy. *New York Times*, January 30, 2009. http://www.nytimes.com/2009/01/31/science/earth/31compete.html.

COVENANTS, CONDITIONS, AND RESTRICTIONS

Homeowner associations (HOAs) are formed in new developments to manage common assets, distribute communal expenses, and ensure that the community remains consistent with certain rules. The rules of a particular neighborhood that permit and prohibit certain actions and behaviors are codified in the HOA's covenants, conditions, and restrictions (CCRs). In water-smart developments, there are many CCRs associated with efficient water use that enable the community to take advantage of its water-smart planning and building characteristics, and to keep water use rates low.

CCRs are mentioned throughout this report, and can basically be grouped into indoor and outdoor categories. Indoor CCRs include a ban on evaporative coolers, using only ENERGY STAR appliances, limiting homes to one dishwasher and one washing machine, mandating water-conserving fixtures, banning reverse osmosis water filters, and requiring appliance upgrades when a property is sold. Outdoor CCRs are more prevalent in general and include water conservation measures, such as water use budgets, a ban on pools or decorative water features, turf limitations and other landscape design mandates, prohibiting waste of water (like irrigating a sidewalk), time-of-day watering guidelines, requiring irrigation with drip systems, landscaping only with plants from an approved list, and using rain barrels.

LIVING SUMMARY AND RECOMMENDATIONS

Living water-smart requires a continual conservation message directed to homeowners. Conservation can be achieved by appropriately pricing water and monetarily encouraging residents to use less of this valuable resource. Furthermore, education in the form of mailers and graphs on water bills, as well as ground rules describing appropriate water use, can allow a community to take advantage of the water-smart features built into its homes. Any community can choose to live water-smart; it only takes a little common sense.

Recommendations for homeowners, HOAs, and water suppliers to achieve water-smart living include:

- **Offer continual education about the myriad ways to conserve waterat home.** This messaging can come in the form of mailers, audits, a well-designed website, guerilla marketing, viral videos, and dozens of other unique marketing approaches. Creating a relationship between the resident and water supplier builds trust and is crucial when implementing drought response measures.

- **Provide and pay attention to frequent, easy-to-read, and graphically based billing statements.** The days of providing only a line item bill need to be over. The potential for informing residents on how much water they do and should use, plus how much their neighbors use, is an exceptional educational opportunity and should be implemented more widely.

- **Utilize a progressive rate structure that provides equity and revenue stability, plus encourages conservation.** Rate structures are one of the most cost-effective means to reduce water use. When designed appropriately, rate structures can also provide funding to support increased conservation activities.

- **Provide incentives for water-smart living by offering and taking advantage of rebate programs for water-efficient technologies.** Reducing household water use is advantageous for both the water provider and the resident — providers defer or obviate the need to acquire new water supplies and residents save money on their water bills.

- **Adopt and follow responsible ordinances and CCRs that promote water-efficient behavior and discourage water waste.** Education and incentives only go so far. In order to have a well-rounded and effective conservation program, it is important to supplement it with directives that establish appropriate behaviors.

BENEFITS OF WATER-SMART DEVELOPMENT

The real measure of water-smart development is a demonstrable reduction in water use compared to similar, conventional development. While water use varies across the Interior West, the southwestern states use considerably more water per household than the national average *(Table 4)*. Despite this fact, data collected by the water-smart developments discussed in this report shows that planning, building, and living water-smart can significantly reduce water use, to the point that most of these developments are using less than the national average and all are using significantly less than their state's average.

Table 4. *State-wide daily per capita and monthly household water use in the Interior West.*

STATE	GPCD[a]	GPH[b]
Arizona	222	15,990
Colorado	240	16,200
Nevada	336	22,680
New Mexico	203	13,700
Utah	293	19,780
Interior West Avg.	259	17,480
U.S. Avg.	179	12,080

[a] Municipal supplied residential gallons per capita per day calculated from: U.S. Department of the Interior, Geological Survey. 2004. Estimated Use of Water in the United States in 2000, Table 5. http://pubs.usgs.gov/circ/2004/circ1268/htdocs/table05.html.

[b] Gallons per household per month assumes 2.25 persons per household, a conservative estimate.

CIVANO

The community of Civano, AZ, keeps extensive records of water use because the memorandum of understanding between the city and the development requires an annual report of energy and water use from the community. Total water demands at Civano are consistently 40-50% lower during the summer and 20% lower during the winter compared to the average customer base in Tucson *(Figure 9)*.[47]

47 Water use data for Civano is compiled from the annual Energy and Water Use reports completed by Al Nichols Engineering. http://www.civanoneighbors.com/civano/environment.htm#reports.

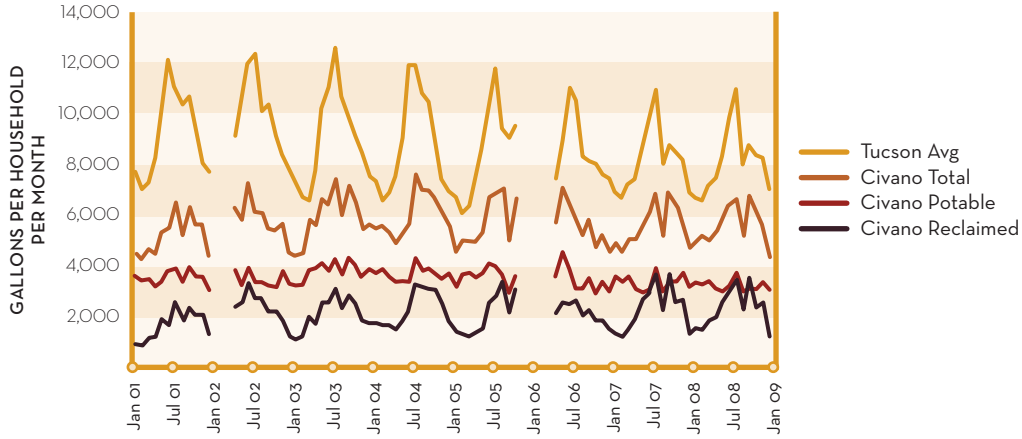


Figure 9. *Water use at Civano compared to the Tucson average.*

Summer peaks in water use from outdoor irrigation demands are quite prominent in the graph, but notice how potable use at Civano remains relatively constant throughout the years of measurement and how reclaimed water used for irrigation has much smaller summertime peaks. Over the period January 2001 through December 2008, total residential water use at Civano is equivalent to 85 GPCD, compared to 130 GPCD in the greater Tucson area, a reduction of almost 35%.[48] Civano attributes its water savings success to strict landscape standards, small lot sizes, use of rainwater harvesting and recycled water, and community awareness.

In the newest phase of Civano, Civano II, homes are not required to use recycled water for outdoor irrigation because it was deemed too expensive to install and maintain given the low volume of water use. However, recycled water is still used to irrigate common area landscapes. Water demands at Civano II are also significantly lower than the Tucson area at large *(Figure 10)*.

Civano photos courtesy of Civano Neighbors

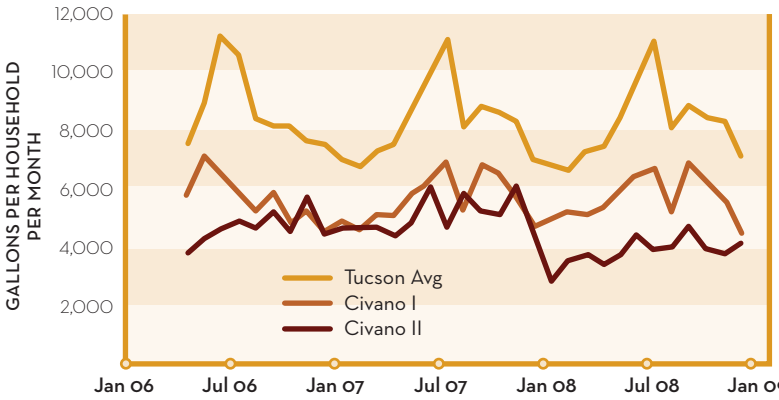


Figure 10. *Water use at Civano I, Civano II, and the Tucson average.*

48 Assumes 2.25 persons per household.

Over the period April 2006 through December 2008, total residential water use at Civano II is equivalent to 67 GPCD, compared to 123 GPCD in the greater Tucson area, a reduction of almost 46%.[49] A smaller overall landscaping budget and less foliage cause Civano II's water use to be less than Civano I.

Rancho Viejo photos courtesy of R. Thomas Berner

RANCHO VIEJO

Rancho Viejo, NM, was required to purchase all necessary water rights to supply the new development as a condition of permitting from the County of Santa Fe. Due to the high cost of water in Santa Fe County, Rancho Viejo pursued a reduction to the county water supply ordinance requiring 0.25 AF/unit for development, seeking a lesser supply of 0.2 AF/unit. The county granted Rancho Viejo a permit under the condition that the development would keep a water reserve account for five years until the lower water use could be demonstrated. Data from the city of Santa Fe suggest that average single-family residential water use in the Santa Fe area is approximately 0.25 AF/unit.[50]

Rancho Viejo has demonstrated consistently low water use for the past eight years and has even surpassed its own target *(Figure 11)*.[51] From 2001 through 2008, total residential water use at Rancho Viejo is equivalent to 63 GPCD, compared to 101 GPCD for other single-family residences in the Santa Fe area, a reduction of almost 38%.[52]

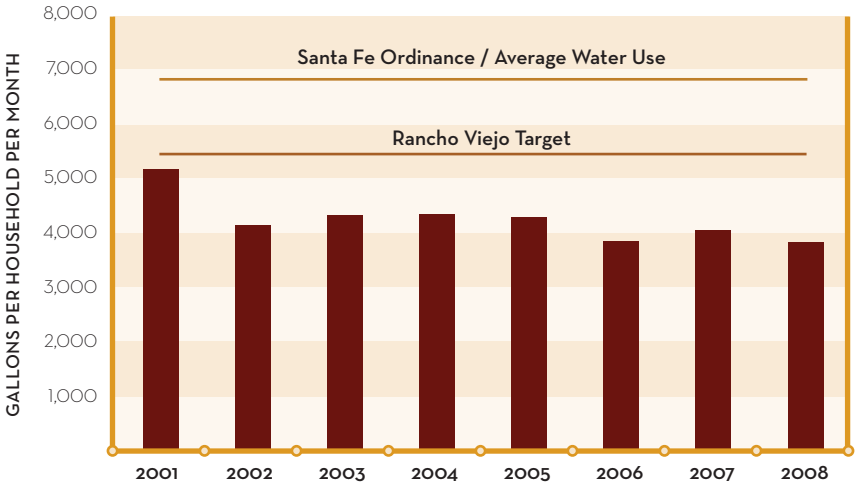


Figure 11. *Average monthly water use at Rancho Viejo, NM.*

49 Assumes 2.25 persons per household.

50 City of Santa Fe, New Mexico, Planning and Land Use Department. 2001. *Water Use in Santa Fe*. February 2001. www.santafenm.gov/DocumentView.asp?DID=1427.

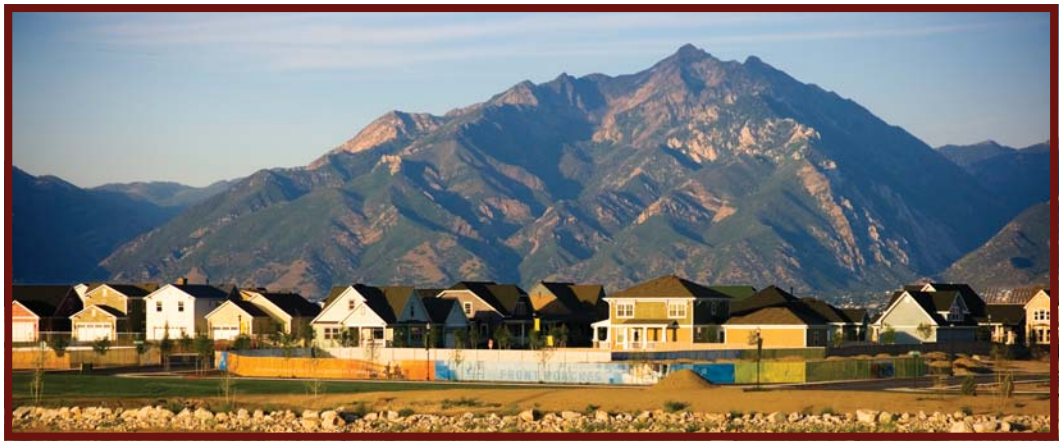
51 SunCor New Mexico. Annual Water Use in Rancho Viejo. Memorandum submitted to Santa Fe County. March 24, 2009.

52 Assumes 2.25 persons per household.

DAYBREAK

The community of Daybreak, UT, places a strong emphasis on outdoor water conservation for open spaces and individual homeowners. At the residential level, Daybreak tracks water use for 25 of its homes in Founder's Park Village and compares the average use from these homes to comparable neighboring communities in South Jordan. This data is presented in the Kennecott Land annual sustainable development reports. Averaging the past three and a half years, total residential water use at Daybreak is equivalent to 210 GPCD, compared to 234 GPCD for the neighboring communities — a 10% reduction — and 241 GPCD for the greater Wasatch Front — a 13% reduction *(Figure 12)*.[53,54,55]

Daybreak photos courtesy of Ed Rosenberg and Kennecott Land



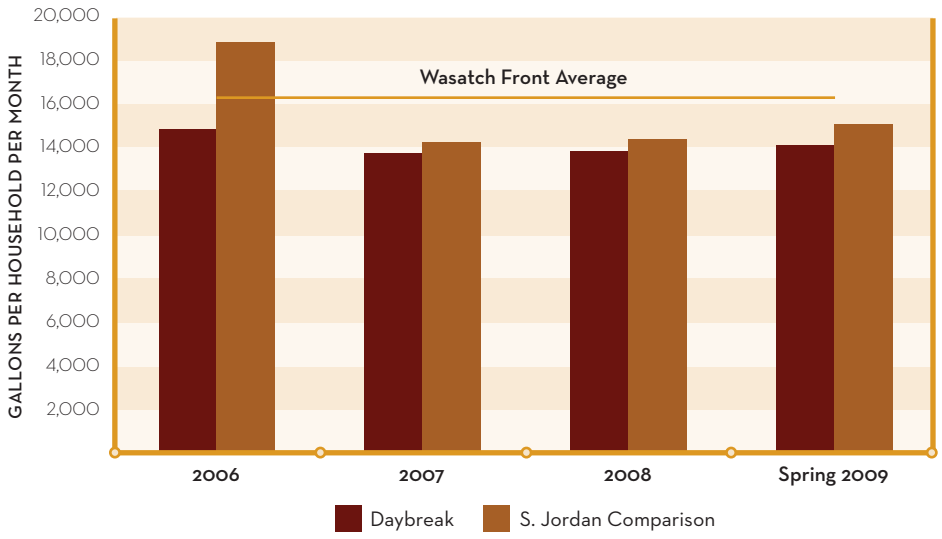


Figure 12. *Average monthly water use at Daybreak, UT.*

53 Assumes 2.25 persons per household.

54 Rio Tinto 2008 Salt Lake Valley Sustainable Development Report; and Kennecott Land 2007 & 2006 Sustainable Development Reports. http://www.kennecottland.com/?id=MjAwMDAyOQ==.

55 Adapted from data in: Utah Department of Natural Resources. 2002. *Identifying Residential Water Use, Survey Results and Analysis of Residential Water Use for Thirteen Communities in Utah.* July 25, 2002. http://www.water.utah.gov/m&i/PDF/Residential%20Final1.pdf.

OSHARA VILLAGE

Oshara Village, NM, created specific water budgets for each residential property type, such that smaller town homes are budgeted 0.115 AFY of potable water, larger estate homes are budgeted 0.131 AFY, and live/work residences and patio homes are in between this range. At build-out, the weighted average water use of all homes in the development will be 112 GPH per day *(Figure 13)*. Water use at this level is equivalent to 50 GPCD, compared to 101 GPCD for other single-family residences in the Santa Fe area, a reduction of more than 50%.[56] However, it is important to remember that all of Oshara Village's outdoor water needs are met by reclaimed water, which does not factor in to this calculation. Preliminary evidence at Oshara indicates that residents are using approximately 100 GPH, under the average water budget.[57,58]

Oshara Village photos courtesy of Oshara Village, LLC.

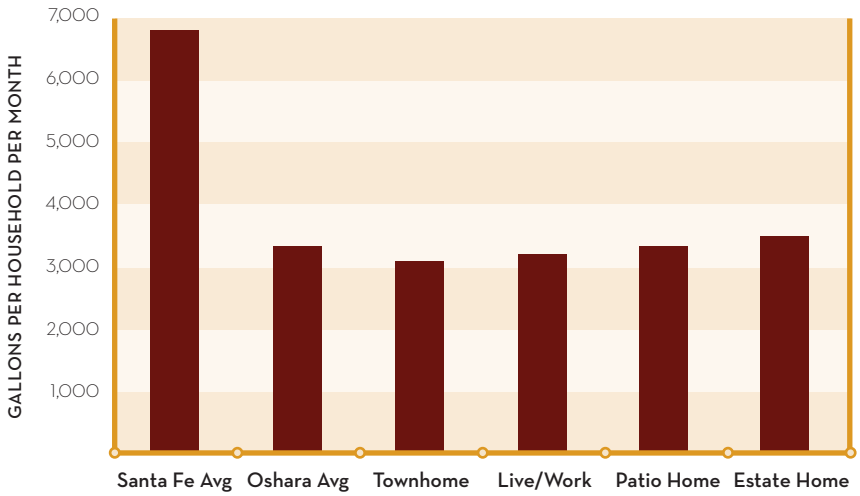


Figure 13. *Oshara water budgets compared to Santa Fe, NM, average water use.*

BENEFITS SUMMARY

Data from these water-smart developments clearly demonstrate that new construction can be built to use significantly less water than the status quo. These developments are currently achieving water use reductions of 13-50% compared to existing homes in their area, and many have demonstrated a consistent reduction in water use over several years. Everyone interested in water-smart planning, building, and living should use these communities as a resource and example of how to achieve water-smart development

56 Assumes 2.25 persons per household.

57 About 2,500 gallons of wastewater is collected at the treatment plant every day and there are 25 occupied homes at Oshara. Source: Hoffman, A., town founder, Oshara Village. Personal communication. May 19, 2009.

58 The vast majority of indoor water use is captured in wastewater systems. The U.S. Geological Survey estimates residential indoor consumptive use at 2% or less.

CONCLUSIONS & RECOMMENDATIONS

In the Interior West, where water supplies are already strained and population growth will continue to drive demand for ever more water, the policies and techniques described in this report spell out an alternative development scenario that can significantly reduce future water demands. Water-smart development presents an opportunity to use existing water supplies more wisely and to defer or eliminate the need for new, environmentally harmful water projects. Because the era of large dam building in the U.S. is over, new ideas and approaches must be used in order to secure our next supply of water. Water-smart development is a new source of water supply that can fulfill this need, and must be evaluated on the same level and with the same rigor as traditional concrete and steel projects.

People across the nation are becoming increasingly interested in green building practices as they learn more about how their actions and choices impact their own communities. New technologies are rapidly being created to fulfill this need for more sustainable living opportunities and older technologies are constantly improving. As more people move to the West, we are presented with an opportunity to achieve a significant reduction in our future energy and water requirements if communities are built upon the principles of water-smart development.

Planning water-smart communities is primarily a function of local land use agencies, but there are several opportunities for states, regional visioning processes, and master developers to influence and determine the style of new development throughout the Interior West. WRA recommends the following actions to support water-smart planning:

- Encourage decision-makers to recognize that sound land use planning can be a source of water supply.
- Integrate land use planning with water planning and, vice versa, by fostering greater communication and cooperation between planners and utilities.
- Provide density bonuses, streamline the approval processes, offer discounted tap fees, and extend utility rebate programs to homebuilders engaged in water-smart development.
- Holistically plan new developments from the ground up to be water-smart by including such measures as recycled water distribution systems, water-wise landscaping, and efficient fixtures and appliances.
- Encourage government and local agencies to lead by example, partner with other groups and organizations, and educate the community on the benefits of water-smart development.
- Update general plans to support more compact forms of development, encouraging infill and revitalization over sprawl.
- Pass legislation that requires new developments to demonstrate an adequate supply of water before approval is granted.
- Implement and enforce ordinances that encourage efficient water use, such as time-of-day watering or banning the waste of water.

Building water-smart involves a ground-up approach to incorporating water-efficient fixtures, appliances, and landscapes into new development. While many of the water-smart features discussed in this report, like high-efficiency toilets and Xeriscaped yards, can be achieved by any homeowner through retrofits, it is more cost-effective to start with them in place from the beginning. WRA recommends the following actions to support water-smart building:

- Utilize performance-based third-party certification systems to select water-efficient indoor fixtures and appliances.
- Reduce outdoor use by limiting irrigable areas, restricting turf, or using a conservative water budget.
- Landscape areas with native, water-wise plants and adhere to the practices of Xeriscape.
- Irrigate with an efficient system that uses appropriate emitters and is run by a smart controller.
- Utilize alternative sources of water supply for indoor and outdoor uses where legal and appropriate, including recycled water, greywater, and rainwater.

Living water-smart is a matter of choice for any resident across the Interior West, but it is certainly easier for those living in water-smart developments. Many of the strategies discussed in this report, such as continual education and progressive water rates, apply to everyone wishing to live a more sustainable life. WRA recommends the following actions to support water-smart living:

- Offer continual education about the myriad ways to conserve water around the house.
- Provide and pay attention to frequent, easy-to-read, and graphically based billing statements.
- Utilize a progressive rate structure that provides equity, revenue stability, and encourages conservation.
- Incentivize water-smart living by offering and taking advantage of rebate programs for water-efficient technologies.
- Adopt and follow responsible ordinances and CCRs that promote water-efficient behavior and discourage water waste.

Water-smart development is not a difficult or expensive goal to achieve, but it does require forethought and support. The communities highlighted in this report are a testament to the fact that a new style of development can use significantly less water than the status quo. These communities should serve as an example for how all future developments can plan, build, and live water-smart.

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