5 Water Conservation

Water Use and Population Growth

As the population in Utah continues to grow, the demand for water increases. The population along the Wasatch Front is currently 1.6 million people and is expected to increase to 2.2 million people in 2020 and to more than 5 million by the year 2050 (*Envision Utah 2000*). In Utah, 67% of residential water is used for outdoor use. This indicates a key area for us to save water in Utah.

The traditional role of water districts and purveyors has been to develop the water resources within their service areas through supply management projects that meet the unique and growing needs of the communities they serve. According to the American Water Works Association (AWWA), "In balancing current and future water supply and demands, the objective should be to determine which combination of supply-and-demand management alternatives is optimal from social, environmental and economic perspectives" (*AWWA, 1993*). Various water management practices can be conveniently separated into supply management (augmentation) and demand management (conservation) measures.

Deer Creek Reservoir

- **Water conservation helps improve water quality. Urban development can impact water quality in a variety of ways. As areas become more developed, a greater variety of pollutants are generated. Some of these, such as petroleum products or industrial discharges, can be highly toxic to aquatic life and can pollute an entire drinking water supply. The effects of other pollutants, such as fertilizers, are more indirect. These nutrients can stimulate excessive microscopic plant growth in our reservoirs, creating taste and odor problems.**

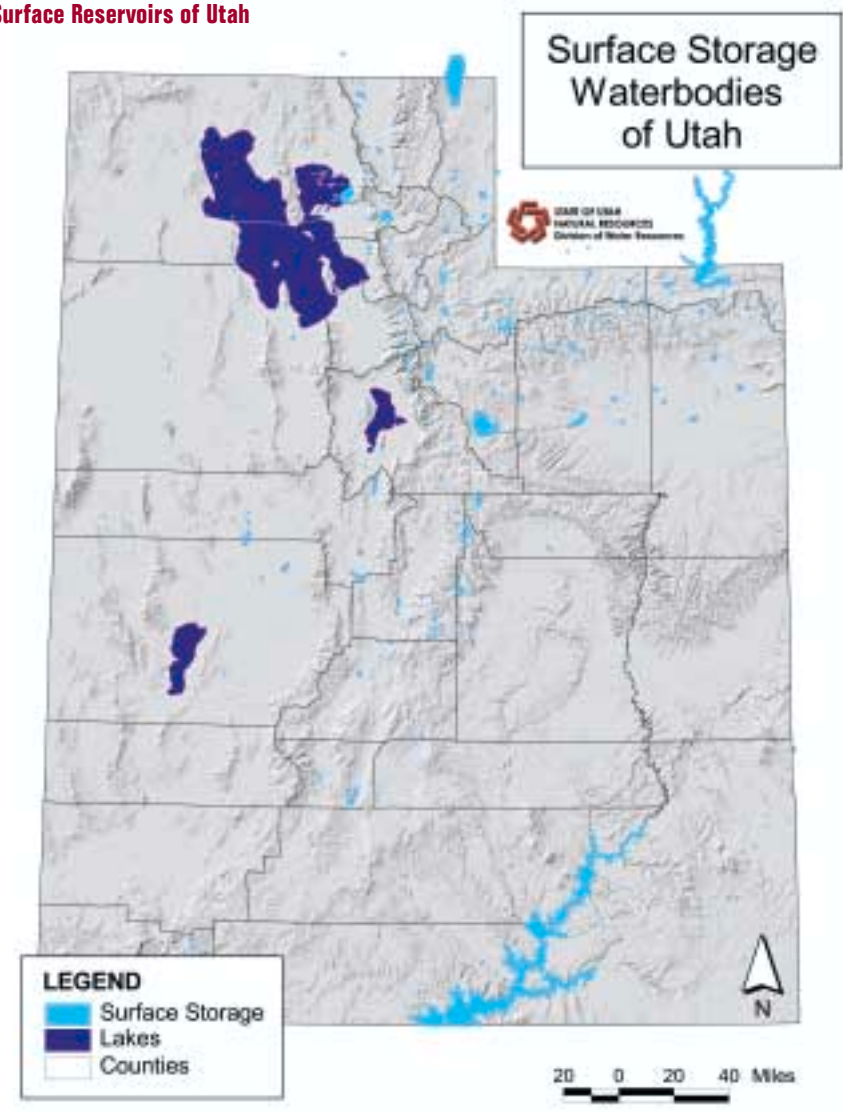
- **Water quality management in Utah's urban areas generally falls into four major categories:**
  - **Protection of surface and groundwater sources of drinking water;**
  - **Management of the quality of municipal and industrial point source discharges so that the receiving waters are not degraded;**
  - **Reduction of the impacts of storm water runoff from urban areas;**
  - **Watershed scale protection, including reduction of nonpoint source pollution.**

Benefits of Conservation

The Utah Division of Water Resources (*2001*) lists the following benefits of water conservation:

- Delay costs associated with capital investments to upgrade or expand existing water facilities, including the need for additional staff, O&M costs, and other expenses the new capital projects would require;
- Reduce impacts from sewage or wastewater flows, delaying or reducing the need for more wastewater treatment facilities;
- Conserve energy, as less water needs to be treated, pumped, and distributed to the consumer;

Surface Reservoirs of Utah



Sara Larsen, Utah Division of Water Resources

- Lessen the leaching of chemicals and sediments into streams and aquifers with improved agricultural and urban irrigation efficiencies; and
- Reduce stream diversions, enhancing water quality and environmental and recreational functions.

The Environmental Protection Agency (*2001*) echoes the above benefits and emphasizes that water conservation offers major environmental, public health, and economic benefits while improving water quality, maintaining aquatic ecosystems, and protecting drinking water resources. Reducing wastewater flows, recycling industrial process water, reclaiming wastewater, and using less energy have significant benefits to the environment .

▶ CONVERSION OF ACRE FEET TO HOUSEHOLDS

The average household uses 860 gallons of water per day. This is equal to 25,800 gallons of water per month or 309,600 gallons of water per year. This equals approximately 1 acre foot per year.

▶ The major water degradation culprit in urbanized areas is the increase in "impervious surfaces," which can alter the water movement through our watersheds. Paved driveways, sidewalks and parking lots are impervious surfaces. Salt Lake City has stormwater rates to encourage the increase of permeable surfaces for commercial and industrial customers.

Ground Water Aquifers

(Adapted from: Figure 1, in Groundwater Conditions in Utah, Spring of 2000, Cooperative Investigations Report No. 41, U.S. Geological Survey, Utah Division of Water Resources and Utah Division of Water Rights.)

Areas of Significant Ground Water Development in Utah

No. in Fig. 5	Area	'99-00 Avg. (ac-ft/yr)†	No. in Fig. 5	Area	'99-00 Avg. (ac-ft/yr)†
1	Salt Lake Valley	133,000	20	Beaver Valley	6,000
2	Utah and Goshen Valleys	100,000	21	Dugway, Skull Valley, Old River Bed	5,000
3	Beryl-Enterprise area	60,000	22	Rush Valley	4,000
4	Pahvant Valley	60,000	23	Grouse Creek Valley	4,000
5	East Shore area	60,000	24	Cedar Valley, Utah County	3,000
6	Milford area	48,000	25	Park Valley	3,000
7	Cedar Valley	36,000	26	Park City area	*
8	Cedar Valley, Iron County	33,000	27	Vernal area	*
9	Parowan Valley	29,000	28	Upper Bear River Valley	*
10	Cache Valley	28,000	29	Spanish Valley	*
11	Tooele Valley	27,000	30	Blanding area	*
12	Sevier Desert	25,000	31	Bear Lake Valley	*
13	Juab Valley	21,000	32	Monticello area	*
14	Central Sevier Valley	19,000	33	Heber Valley	*
15	Central Virgin River area	17,000	34	Duchesne River area	*
16	Ogden Valley	13,000	35	Upper Sevier valleys	*
17	Sanpete Valley	12,000	36	Upper Fremont River	*
18	Snake Valley	10,000		Total of other areas (*)	42,000
19	Malad-lower Bear River	9,000			
				STATE TOTAL	851,000

* Less than 3,000. See "Total of Other Areas (*)" for combined total.
† Source: Tables 1, 2 & 3 in, Ground-Water Conditions in Utah: Spring of 2000, Cooperative Investigations Investigations Report No. 41. U.S. Geological Survey, Utah Division of Water Resources and Utah Division of Water Rights.

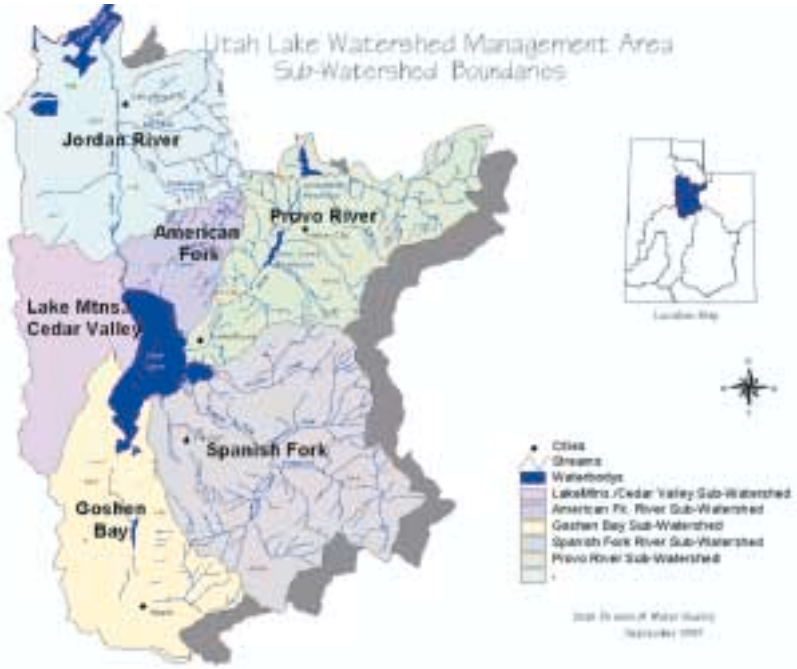
Eric Edgley, Utah Division of Water Resources

Existing Conditions

The State of Utah has been engaged in water planning for many years. From the state's perspective, a major water problem is getting the water from where it occurs naturally to where it is needed for municipal, industrial and institutional purposes.

The greater Wasatch Area, comprising the Jordan River, Utah Lake and Weber River basins, will need 481,000 acre-feet more water per year by 2050. While conversion of agricultural water to municipal and industrial uses will meet much of the expected demand in some basins, further movement of water from basins with a surplus supply will be required to meet future needs in others. The amount to be moved between basins can be reduced by ground water development, reuse of sewage effluent and effective water conservation programs. Recognizing water conservation or demand reduction as a partial solution to the imbalance between water supply and demand, the state has set a goal of reducing public water use 25 percent by 2050. This will reduce statewide demand by 400,000 acre-feet per year. (*2001 Utah Water Resources*)

The Utah Division of Water Resources has also examined commercial, industrial and institutional water use, and has concluded that the area of greatest waste, and therefore of greatest potential savings, is in outdoor use. (*Municipal Industrial Water Supply and Uses, 2000*).



Conservation Plan Development

"A carefully designed plan is the blueprint for a successful water conservation program." (*AWWA 1993)* For water conservation to become a reality in Utah, water users must adopt a new ethic of efficient water use. Clear, objective and purposeful planning by local, state, and federal government officials and agencies will become the catalyst for conservation. Long-term conservation of water resources must also be supported by private industry and organizations. Developers and landscapers can incorporate water conservation strategies in their plans and activities.

Need for a Plan

Cities, in their role as retail water providers, are in the best position to promote water conservation because they are closest to the end user. Water districts, which provide wholesale water to cities, are also key stakeholders. The traditional role of water districts has been to develop, treat, and deliver new water supplies for present and future users. Recent state legislation requires water conservancy districts and retail water providers to assume an additional role. Water districts and cities that supply culinary water and have more than 500 service connections are now required to submit water conservation plans to the Utah Division of Water Resources, updating and resubmitting these plans every five years. The purpose of this legislation is to encourage cities and water conservancy districts to plan for more efficient use of existing water supplies.

Careful planning precedes a successful water conservation program and identifies major water problems in providing water for expected growth. Planning includes setting specific, measurable goals and evaluating the methods for reaching these goals. One key method is an effective water conservation program that reduces the per capita demand for water.

Creating a Water Conservation Plan

An effective water conservation plan must include sufficient detailed information for the conservation team to follow the plan through to its complete implementation. Indeed, water conservation plans may never be fully implemented as they were originally written, as periodic updates may uncover new opportunities for additional water demand reductions. For any water conservation plan to be successful, it must be incorporated into a city's general plan. When plans are tied together and strive to achieve integrated goals, a high degree of acceptance and success can be realized.

Useful plans will include the following elements:

Description of the Water Storage and Delivery System

This section should include the number of acres covered by the physical system, the number of people and connections served, land uses and demographics. If the system includes unique characteristics or pertinent history that explains water use habits or conditions, these should be added. Significant losses to the system from old and leaking pipes and storage facilities may also be identified in this section.

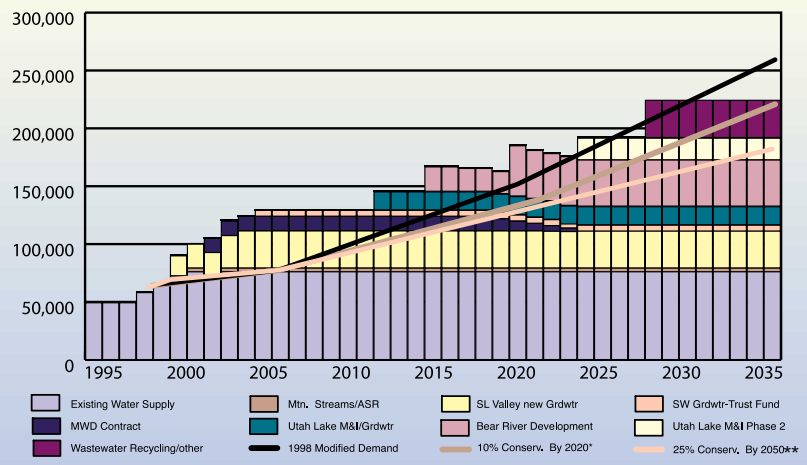
Inventory of Water Supply

Identifying and quantifying the sources of water supplies assists the planner in understanding the extent of the available water supply. Such an inventory is most often presented in acre-feet but may be shown in the units used for metering and billing purposes such as 1000 gallons (kgals) or 100 cubic feet (ccf). The inventory should calculate and show the amount of available water for which water rights are owned and the amount purchased each year from another entity. Constraints or limitations on the water system should be shown in this section. These may include limits on system capacity or inadequate water rights.

Estimates of Present and Future Water Demands

Here the present water use is quantified from meter readings or water sales according to billing records.

FIGURE 9
Potential Impact of Conservation Goal on the Water Needs of JVWCD



* JVWCD's water conservation goal.
** Hypothetical line showing the effects of the state=s goal of 25% conservation by 2050.
(Adapted from Jordan Valley Water Conservancy District's, "Water Conservation Plan," March 1999, Fig.2-16, p. 2-15.)

Major water users and their current requirements should be identified. Future demands on the water system are usually based on population growth estimates, obtainable from the Governor's Office of Planning and Budget for most Utah communities. http://governor.utah.gov/gopb/

List of Water Problems

In this section the water manager should identify, and, when possible, rank the problems being experienced with the water system in order of severity. If future problems can be foreseen with a degree of certainty, they should be included. Problems may be those identified above relating to significant losses, constraints on system capacity, or insufficient water rights. Part of defining water problems should include a calculation of the system's per capita water use, and a comparison to the state average water use and the water use of similar size communities.

List and Analysis of Potential Solutions

Potential solutions should be described that may include finding and repairing leaks or replacing old lines and tanks. Needed water supply source additions may be described in this section. Water conservation, or demand reduction, should be emphasized in this section as a means of delaying expensive additions to the supply or delivery system. The analysis of potential solutions should focus on comparing the costs of implementing conservation practices to

reduce demand with the cost of adding another source of water supply.

List of Goals

Once problems are identified and the various solutions are analyzed, the community planner has sufficient data to set clearly defined, measurable and attainable goals. These goals may include fixing leaks in the system, reducing the peak use, minimizing overall water use or increasing supply source options. For example, if the problem is inadequate water rights or source of supply, a practical goal may be to reduce the water use rate to an amount that is appropriate for the current situation. Some communities are self-supplied for a fraction of the total water needed and must purchase additional water from a wholesale supplier. If the purchased water is significantly more expensive than the owned supply, the goal may be to reduce the future amount of water purchased. An evaluation of the costs and benefits for each of the selected demand reduction practices should be included. In this evaluation, the costs involved to reach each of the goals should be compared to the costs that would be incurred if water were purchased and water savings were not realized through conservation.

Procedure for Implementing the Plan

Implementation begins with acceptance of the plan by the community's governing body, e.g. city council or district board.

Creating a financial plan to show how the selected water conservation practices may be funded is helpful. It is also important that the water conservation plan is incorporated into the community's general plan, development and other ordinances. The financial plan should include possible sources of grant and loan funds that may be available from state and federal agencies to fund water conservation programs. The use of excess reserve funds in the city's water and sewer enterprise fund may be evaluated, in addition to the general fund budget. Once funding sources are identified, timelines should be estimated and responsibility assigned to the individual(s) who will carry the planned practices to completion and monitor progress toward the goals.

Procedure for Assuring Completion

Attention should be focused periodically on whether or not the water demand reduction practices and facilities are doing the job and moving the community toward its water conservation goals. Questions most often asked are: Whether or not the adopted conservation practices having the desired effect? It is also recommended that goals be reset or updated every year. Time and resources need to be scheduled for updating the water conservation plan every five years to comply with the statutory requirement. This update requirement provides an opportunity to review the community's conserva-

■ **Public support and participation have been key factors to the success of Envision Utah. We have found a successful methodology to engage people in dialogue and encourage on-the-ground action at local and regional levels. Envision Utah's fact-based, public involvement process involves key stakeholders and the community from the beginning, using a bottom-up process to find local solutions to accomplish a regional vision.**

■ **Envision Utah can work directly with communities to help develop broadly and publicly supported plans. Professional planners from Envision Utah can help evaluate optimal approaches and identify best management practices both locally and nationally. Our staff is available to help communities identify key stakeholders, provide technical expertise and help plan workshops where residents and stakeholders work together to analyze problems and suggest solutions that can be used in the development of water conservation techniques. By bringing residents and key stakeholders to the table from the beginning, the best possible success for implementation can be achieved.**

tion program, determine its effectiveness, and measure progress toward agreed–upon goals.

Media Development

Once a plan has been developed, it is important to familiarize the appropriate constituencies and stakeholders with the contents of the plan. This will help accomplish successful implementation of the water conservation plan and awareness of new procedures that have been developed.

Public involvement is a vital component in the success of any water conservation program. Ways to involve the public might include:

- Hosting public hearings to allow the public an opportunity to ask questions and offer comments on the proposed water conservation plans and/or policies.

- Providing public education materials, including flyers in billing statements. Information given to the general public should be easy to read and concise, without technical language. The major benefits of the plans, describing why they have been developed and what results they bring, should be highlighted. Identify the number one message that needs to be shared with the public and try to develop one or two sentences to relay that message. Details of the plan can be included, but should not be needed to help the reader understand the message.

- Inviting key stakeholders to release information together.

A press conference can be used to encourage media support. Holding a meeting to release information can assist reporters with getting information needed to write a story. The participation of visible leaders, such as local officials, can draw more media representatives to a press conference.

A press release should be distributed upon final development of the plan. Local weekly newspapers are more likely to publish the information; however, the major daily newspapers may also be interested in this information if a regional angle can be provided. Each major newspaper has a reporter who covers informational targets in various regions. Contact the assignment editor for the name of the reporter covering a particular city or county.

A press release should include the following information:

- Contact name and number from participating organization

- A brief paragraph (one or two sentences) describing the number one message that the public needs to know

- A quote from key leader lending support to plan

- Information on press conference time and location

- Benefits that implementation will bring to the community

- A more detailed description of what the plans entail
- Copy of the actual plan or report attached

Faxing or e-mailing information is the most effective way to reach the press with information, but it is essential to follow-up with a phone call, speaking with the media representative to encourage coverage.

Best Management Practices and Examples

Best Management Practices (BMPs) are conservation activities that are intended to reduce long-term urban water demands. These BMPs are in addition to programs that may be instituted during occasional water supply shortages. The following fourteen BMPs are commonly implemented in water conservation programs.

Example of the form used by the Division of Water Resources for evaluating water conservation programs.

Water Conservation Plan Evaluation Form

Plan Submitted by: _____ Reviewed by: _____ Date: _____

Scoring: Rate each of the following items on a scale from 1-10. (1 to 4=inadequate, 5 to 7= adequate, 8 to 10=excellent)

Characteristics of an Adequate Plan	Score	Comments
I. Description		
A. Describes the service area and water system		
B. Details pertinent demographics (population, connections, land use, etc.)		
C. Explains unique characteristics or pertinent history of system		
II. Water Supply Inventory		
A. Identifies and quantifies the water supply sources of its system		
B. Describes constraints of the system (water rights, system capacity)		
III. Present Water Use and Future Water Needs		
A. Quantifies the present water use in the system		
B. Identifies abuses, overuses, and losses in the system		
C. Estimates future water needs based on population growth projections		
IV. Water Problems, Conservation Measures, and Goals		
A. Identifies and prioritizes present and future water problems		
B. Describes current water conservation measures		
C. Identifies other water conservation measures		
D. Quantifies the costs and effectiveness of all conservation measures		
E. Sets water conservation goals that can be quantified		
V. Implementing and Updating the Water Conservation Plan		
A. Recommends measures to reach water conservation goals		
B. Recommendations are consistent with present and future needs		
C. Identifies the resources required to monitor progress and accomplishment of goals		
D. Sets deadlines for implementation of measures and accomplishment of goals		
E. Details a procedure for updating the water conservation plan		
		AVERAGE SCORE

Envision Utah's Community Design Workshop process helps communities develop a plan, given existing conditions and basic principles for the area. These workshops involve teams of citizens representing a cross-section of local interests working together to develop rough concept plans. Residents and key stakeholders are divided into teams that are carefully designed to represent a variety of interests. These teams analyze information, including the current situation, best management practices and potential solutions. At the conclusion of the working session, each team presents its ideas to the entire group of participants for comment and critique.

This information is then analyzed by planners and incorporated into the development of a final product. This workshop process is important in ensuring general acceptance of the plan. Public comment hearings are not enough. Bringing residents and stakeholders to the table through working sessions, where ideas are discussed, argued and presented, gives planners critical information to help in the development of plans.

Governor Leavitt at Kick-off for Utah's Water Conservation Effort 2001.

Example of improper water usage.

1] Water Survey Programs for Single-Family Residential and Multi-family Residential Customers. Develop and implement a strategy of water-use surveys to single-family and multi-family customers.

Example:
To survey outdoor water use in their local community Jordan Valley Water Conservancy District has partnered with other Salt Lake City and water districts and retailers to form a public services contract with Utah State University to offer Water Checks to the public free of charge. A typical Water Check lasts 60-90 minutes. A USU intern calculates the precipitation rate (sprinkler output), distribution uniformity (sprinkler efficiency), and water pressure, and then checks the soil and depth of the turf-grass roots. Once this information is collected, a customized irrigation schedule can be generated and reviewed with the customer. Water Checks are offered from mid-May through mid-August. In the fall, district and Salt Lake City staff assist USU in obtaining water use records of those who have had Water Checks and USU evaluates this data by tracking water use for three years before and three years after a Water Check. A toll-free "Slow the Flow" hotline (1-877-SAVEH2O, 1-877-728-3420) was established, and a second team was created to perform Water Checks for large water users and commercial businesses (in Salt Lake County only). Residential Water Checks were recently extended into Utah, Juab and Wasatch Counties by Central Utah Water Conservancy District.

2] Residential Plumbing Retrofit. Identify single-family and multi-family residences constructed prior to 1992. Develop a targeting and marketing strategy to distribute or directly install high-quality, low-flow showerheads, toilet displacement devices, toilet flappers, and faucet aerators practical to residences requiring them.

Example:
Granger-Hunter Improvement District includes low-flow device information in their "New Account Packet" as people sign up for a new account.

3] Residential ULFT (Ultra Low Flow Toilet) Replacement Programs. Implement programs for replacing existing high-water using toilets with ultra-low-flow toilets in single-family and multi-family residences.

4] System Water Audits, Leak Detection, and Repair. Annually complete a prescreening system audit to determine the need for a full-scale system audit.

Example:
Salt Lake City Department of Public Utilities audits water usage of commercial and industrial customers for the purpose of detecting leaks. Water use increases of 25% or more between November

and March are flagged and the customer is notified.

5] Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections. Require meters for all new connections and billing by volume of use. Establish a program for retrofitting existing unmetered connections and billing by volume of use. Identify intra- and inter-agency disincentives or barriers to retrofitting mixed-use commercial accounts with dedicated landscape meters, and conduct a feasibility study to assess the merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters.

6] Large Landscape Conservation Programs and Incentives. Provide non-residential customers with support, education, and assistance. Identify accounts with dedicated irrigation meters and assign Evapotranspiration-based water use budgets. Develop and implement a strategy of targeting and marketing large landscape water use surveys to commercial, institutional and industrial accounts with mixed-use meters. Provide information on climate-appropriate landscape design, etc.

Example:
Kearns Improvement District has targeted schools as large water users and has installed separate landscape meters. The schools are also placed on water budgets, resulting in significant water savings.

7] High-Efficiency Washing Machine Rebate Programs. Sets goals, objectives, and a timetable for implementation of the program. Front loading washing machines typically use half as much water as a top loading washing machine.

8] Public Information Programs. Implement a public information program to promote water conservation and water conservation related benefits.

Example:
Jordan Valley Water Conservancy District hired a professional advertising agency to assist in a public information/education campaign. The "Slow the Flow, Save H2O" slogan, a jingle, outreach agent (Water Lou) and advertisements have been established. In its third year, 2001, "Slow the Flow, Save H2O" has become a widely recognized campaign associated with the district and its partnering agencies in their efforts to promote water conservation. Ads and printed materials are updated annually to promote new programs as well as existing programs as they are continued from year to year.

Water Lou - Jordan Valley Water Conservancy District Spokesperson.

The Water Conservation Demonstration Garden at the Jordan Valley Water Conservancy District was designed and built to be an education tool for the community. The garden emphasizes proper landscape design, irrigation technologies and low-water-use plant selection to show how to have a beautiful yard and still save water. Plants are chosen for their ability to do well with low precipitation, extreme temperatures, low humidity, and alkaline soils. A weather station will measure evapotranspiration to guide precise irrigation. Free Waterwise Gardening workshops, a volunteer maintenance group, and tours add to the educational program.

9] School Education Programs. Implement school education programs to promote water conservation and water conservation related benefits.

Example:

The State Office of Education (SOE), in partnership with entities such as the Utah State University International Office of Water Education, Division of Water Resources, water conservancy districts, the non-profit *Living Planet*, and other state and local agencies, sponsors a variety of water science and conservation-focused in-service opportunities for teachers. In addition, the SOE can schedule educational exhibits that travel to local schools for educational demonstrations.

Schools in the Uinta Basin make extensive use of materials, teacher training, in-class demonstrations and field trips through the Plants, Animals, Water, and Soil (PAWS) program sponsored by the USDA Dinosaurland RC&D Office. Water science and conservation account for at least 25% of the Basin's science curriculum.

10] Conservation Programs for Commercial, Industrial, and Institutional Accounts. Identify and rank commercial, industrial, and institutional customers according to use and establish long-term implementation targets for the replacement of high-water-using fixtures and practices.

11] Wholesale Agency Assistance Programs. Wholesale water suppliers could provide financial incentives or equivalent resources and conservation-related technical support and information to their retail water agency customers to advance water conservation efforts and effectiveness.

12] Conservation Pricing. Eliminate non-conservation pricing and adopt conserving pricing.

Jordan Valley Water Conservancy District's Demonstration Gardens.

Example:
Kearns Improvement District has implemented a new pricing structure to discourage wasteful water practices. High water users pay their full fair share including a high peaking rate.

Salt Lake City and Sandy City also have seasonal rates that offset the peak demand.

13] Designate a water conservation coordinator to promote water conservation.

Example:
Some water purveyors, cities, and agencies in Utah currently have Conservation Coordinators, including Salt Lake City, Central Utah Water Conservancy District, West Jordan City, Jordan Valley Water Conservancy District, St. George, Utah Division of Water Resources, Washington County Water Conservancy District, US Bureau of Reclamation, City of Sandy and Utah State University.

14] Waste Water Prohibition. Enact and enforce measures prohibiting gutter flooding, single pass cooling systems in new connections, non-recirculating systems in all new conveyor car wash and commercial laundry systems, and non-recycling decorative water fountains.

Tools and Resources

Practical tools and resources are fundamental to managing Utah's water resources. Water agencies, districts, and cities all look for opportunities to make better use of key natural resources for many communities. The State Division of Water Resources plays a significant role in the education of practical concepts, tools and pricing methodologies that all work together to provide a strong foundation for conservation.

The Utah Division of Water Resources

The Utah Division of Water Resource's traditional solution to water supply problems has been to furnish funding and technical assistance to districts and local governments that have direct responsibility to provide water to customers. The state has cooperated with federal agencies in building major water storage and conveyance projects such as the Provo River and Central Utah projects. State agencies have been the source of funding for numerous water conveyance, storage, and treatment projects throughout Utah. All projects funded by Utah Division of Water Resources are required to be analyzed for engineering feasibility as well economic feasibility.

Key recommendations from the Division of Water Resources include the following:

- Educate the public on the importance of using Utah's water resources more efficiently.
- Provide programs for training and licensing of landscape and irrigation contractors and managers.
- Remove disincentives to conservation such as volume discount rates.
- Provide incentives for conservation through managed-demand pricing, educational programs, incentives and other strategies.
- Enact monthly meter reading and billing.
- Support and promote water check programs.
- Study the feasibility of tax incentives as a means to encourage water use efficiencies.

(2001 Utah's Water Resources: Planning for the Future)

Reaching the State's goal of reducing annual demand for water by 25% will result in saving about 400,000 acre-feet of water per year.

Reaching this goal by 2050 will be achieved only if community water system managers and operators pursue similar goals. Utah Division of Water Resources does the following to achieve water efficiency:

- Monitors attitudes and habits that explain how Utah residents use water.
- Tests new conservation products for effectiveness in Utah.
- Assists water conservancy districts, retail water agencies and industry groups to educate their customers about effective programs through media campaigns, workshops, seminars, conferences and individual consultation.
- Works with public and private agencies to develop new water conservation tools, technologies and practices.
- Supports a water conservation committee to develop best management practices including pricing systems, share program experiences, assist with specialized studies and promote technology development.

Water Pricing as a Conservation Tool

Nationwide research has indicated that Utah has some of the lowest water prices in the western United States.

Water districts and municipalities need to assess whether the pricing structures they use reflect the limited nature of water as a resource and the cost of acquisition, treatment and distribution. As pricing structures are analyzed, other costs associated with water use that are not typically included in water rates ought to be considered. These secondary costs include land-use impacts, water quality and quantity impacts and environmental impacts. It is important that communities consider the ecological costs when developing water polices and pricing structures.

Studies published in recent years indicate that pricing does have an impact on water usage. If water is priced too low, a message is sent to the public that the resource is abundant and readily available. In an era where new water sources are becoming less available and economically and environmentally prohibitive, pricing can and must be used to alter public perception of the abundance of water. "Pricing can be more than a means of meeting revenue requirements or even turning a profit." (*Stallworth, 2000*) Pricing can be an effective means of impressing on a population the intrinsic value of water.

Pricing by itself is not an adequate incentive to conserve. Price as an incentive to conserve is most effective when partnered with other conservation strategies (*Beecher, 1994*). Generally, water-use linked to necessities (cooking, bathing, sanitation) is less responsive to price than is water used for more discretionary purposes such as for car washing, landscaping and swimming pools. As household income increases, pricing strategies as a tool for conservation become less effective. (*Beecher, 1994*)

Clearly, effective conservation programs need several components. Pricing incentives, public education, and other strategies are critical to a successful water resource management program.

Water Prices of Various Western Cities

City	Estimated Cost per 1,000 gallons
Reno	$3.39
Seattle	$2.30
Los Angeles	$2.22
Park City, UT	$2.20
Tucson	$1.81
Boise	$1.68
Las Vegas	$1.65
Phoenix	$1.61
Albuquerque	$1.41
Denver	$1.14
Sandy, UT	$0.99
Salt Lake City	$0.89
Provo, UT	$0.75
Sacramento	$0.75
AVERAGE	**$1.63**
Utah Average	$1.15
National Average	$1.96

Date 2001

Prices of water from various western cities.

Pricing

Cost-based pricing quantifies the costs of water supply acquisition or capture, treatment and distribution. This is the traditional pricing method used by water districts and municipalities. It is designed to ensure financial self-sufficiency for water and wastewater systems. Pricing strategies can be developed to include intangible and less quantifiable costs such as depleted water sources, land-use issues, environmental impacts and conservation ethics.

Demand-management pricing combines the tools of incentives with cost-based pricing to create pricing structures that: 1) support traditional costs associated with water and wastewater systems, and 2) provide motivation to lower demand and to slow the rate of demand growth.

Demand-management pricing elements include:

- Repeal of volume discounts: removing existing disincentives to conservation.
- Block rates: charging a higher unit price as use rises.
- Seasonal rates: charging more for unit price during peak seasonal demand periods.
- Excess loading or excess use charges: assessing surcharges or increasing unit prices when use exceeds contracted or allotted amount.

In order to gain public acceptance of pricing increases, it is important for public education programs to explain the reasons and the goals behind the pricing strategies.

When conservation-oriented rate structures are introduced, public acceptance is improved if increased rates are linked to:

- Avoidance or deferral of the price tag associated with capital improvement programs such as expansion and upgrades.
- Avoidance of the need to develop a new water supply source, for example, when moving from groundwater to surface water.

Example of water-wise landscaping.

- The collateral benefits associated with water conservation, pollution prevention through reduced water withdrawals and wastewater flows; habitat protection; and energy conservation.
- The potential to pay for conservation measures such as metering, improved water accounting, leak detection, water-use audits, retrofits, reuse and recycling, and landscape improvements. *(Stallworth, 2000)*

Pricing Models

The following two pricing models exemplify the potential for conservation pricing. The models promote the same goal, to encourage efficient water use and reduction. The models focus on incentives to reduce peak seasonal demand as a means of infrastructure cost control. Both models strive to accurately reflect the true cost of service, particularly the price for excess watering.

Model #1:

Salt Lake City
Under this scenario, a utility calculates the incremental cost of providing water based on peak seasonal demand. Since pumps, pipes and related infrastructure are usually sized to meet peak, rather than average demands, conservation programs that target peak demand offer more value than those that target base, or average, demand. This seasonal rate structure is being used by Salt Lake City, as well as numerous other communities, including Denver, Phoenix, Seattle and Portland.

The monthly bill clearly signals the cost of wasted water. Requirements include marginal cost pricing as well as monthly meter reading and billing to modify water usage.

Model #1 Goal:

To reduce summer peak usage (July and August)

Model #1 Objectives:

- Discourage excess watering during the hotter summer months.
- Promote conservation.
- Delay need for new infrastructure.

BEFORE

Many Utah homes are built on hillside slopes, and overwatering increases runoff, negatively impacting the stormwater system.

after

This low-water landscape with "drip irrigation" reduced runoff while increasing the variety and color of the landscape.

Model #1 Strategy:

Seasonal Rate Structure

- Focus groups, workshops or community council meetings.
- Citizen Advisory Council.
- Literature explaining the process and new rate structure.
- Customer service outreach.
- Water bill that graphically demonstrates water usage.

Model #2:

West Jordan City
(Anticipated Spring 2002)
Population growth on former dry farmlands has put pressure on the existing water delivery system. A citizen advisory committee was formed to examine the issue, identify potential solutions, and offer recommendations. The advisory committee recommend that the city implement an ascending block rate structure, because it would:
1) ensure revenue stability;
2) reward efficient use; and
3) penalize water waste.
West Jordan's model follows the Irvine Ranch Water District Model. Every customer will be given a "water budget" based on number of occupants, landscape area and weather conditions (evapotranspiration [ET data). ET data is provided to customers to assist them in determining actual water needs for their landscape. This model requires:

- Strong support from the city council/board.
- Detailed customer information (landscape area, number of occupants, etc.)
- A sophisticated computer system and software program with weather stations at strategic locations within the community.

(*Sustainable Use of Water: California Success Stories, Pacific Institute*)

Benefits include revenue stability, flexibility to manage consumption during times of shortages or high peak demands, link to sewer charges, fairness and equitability, (since those who use more pay more), and a clear efficiency message.

Customers are provided with information and resources to help them make wise choices regarding water efficiency.

Water efficient garden.

The bill is also designed to clearly communicate the cost of wasted water. All of these things combine to create a strong water efficiency message.

The ascending block rate structure penalizes water waste in the landscape by charging more for water that is used over the predetermined base water use.

Model #2 Goal:

Water conservation coupled with revenue stability

Model #2 Objectives:

- Generate sufficient income for future development.
- Allocate costs across customer base.
- Provide customer incentives towards conservation.
- Reward efficient use and penalize water waste.
- Demonstrate responsiveness for the various types of water users (residential, agricultural, business, industrial, etc.).
- Create an efficiency ethic, regardless of the presence of "wet" or "dry" years.

Model #2 Strategy:

Ascending Block Rate Structure/Tiered Pricing

Model #2 Education:

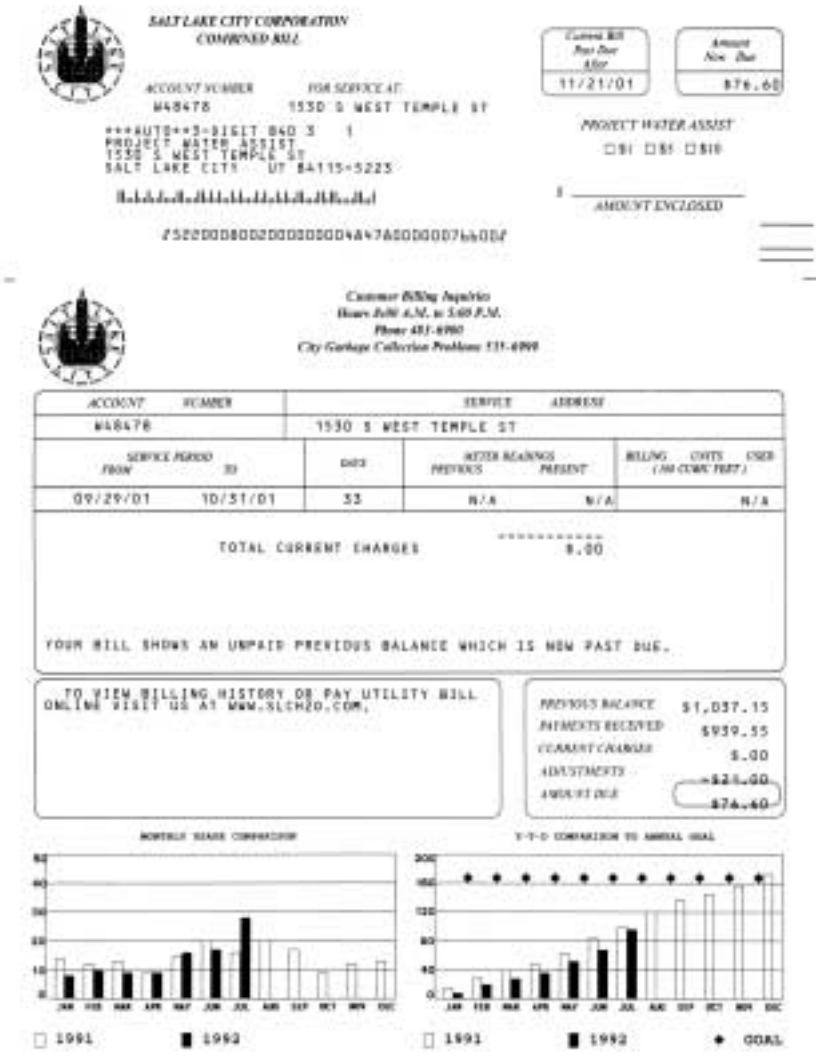
- Focus groups, workshops and/or community council meetings.
- Citizen Advisory Council.
- Literature explaining the process and new rate structure.
- Customer service outreach when complaints are received.

Billing

For a water bill to provide motivation for conservation, it needs to do more than penalize for excessive use. The pricing mechanism should also:

- Inform the user of the real cost of water.
- Be promptly and accurately presented.
- Demonstrate the amount of water used.
- Demonstrate levels of waste.
- Provide comparisons of seasonal usage.
- Provide levels of comparable usage.
- Establish the intrinsic value of water.

Salt Lake City Draft Combined Water Bill illustrating water use.



Indoor Use

Indoor residential water use has been in decline primarily from steady improvements in the efficiency of plumbing fixtures and appliances. Governmental regulations pushed these improvements, such as the U.S. Energy Policy Act in 1992 that established a national maximum allowable water-flow rate for toilets, urinals, showerheads and faucets. Clothes washers and dishwashers have also improved in water and energy efficiency. Retrofitting older homes with newer, low-volume fixtures and appliances will result in significant water savings. As an example of savings, replacing a high volume toilet that uses 3.5 gallons per flush with a low-flow toilet that uses 1.6 gallons per flush can save the average Utah household of 3.13 persons (*2000 U.S. Bureau of Census*) an estimated 11,070 gallons per year. Fixing leaks and replacing dishwashers, washing machines, faucets and showerheads can all contribute to indoor water savings. A study by the Utah Division of Water Resources estimates the following:

- Total indoor water use is approximately 33% of a household's total water use.
- Indoor conservation devices save about 20 gallons per day per household throughout the year.
- Indoor use rises slightly as income increases.

Outdoor Water Use

According to a study by the Utah Division of Water Resources. Outdoor water use is approximately 67% of total residential water use. The area of greatest consumption, and therefore of greatest potential savings, is in outdoor use, whether residential, commercial, industrial or municipal.

Fundamentals of Waterwise Landscaping

Landscape managers and homeowners can design landscapes that will require less watering, mowing, fertilizer and other chemicals to keep it looking great. The basic waterwise principles can be summarized in the following steps:

1] Plan and Design

When designing a landscape, take into consideration how the yard will be used and how it can provide the greatest benefit with the least amount of maintenance. Plan landscapes so that plants with similar water requirements are grouped together. Designate zones for areas requiring frequent watering occasional watering, and no watering at all. Be sure to match plants to yard conditions such as sun, shade, dry or damp.

Water efficient planting.

▶ The Xeriscape Conversion Study

The Southern Nevada Water Authority (SNWA) is conducting a Xeriscape Conversion Study with participants who live in single-family residences in southern Nevada. The study includes three groups: the Xeriscape Study group, the Turf group and a noncontacted comparison group. The Xeriscape Study group was composed of 499 properties where at least 500 square feet of traditional turfgrass was converted to xeric landscapes (low-water-use landscapes). New xeric landscapes were required to have a minimum of 50% canopy coverage, which avoided unattractive "zero-scapes." The Turf Study group, 253 residences, was composed of landscapes where an average 2,462 square feet was in turfgrass.

All study participants had in-ground irrigation systems and controllers. Meters were read on a monthly basis. Four years of data show that outdoor water use for landscapes that were converted to xeriscapes was reduced by almost 40% during the summer months. The mean cost to irrigate a turfgrass landscape in Nevada is $11.16 per 100 square feet compared to only $1.80 for a xeric landscape. Landscape maintenance costs and labor time were reduced on average by one third. On a per unit area basis, water consumption in xeriscaped areas (17.3 gallons per square foot per year) was much lower than traditional turf (79.2 gallons per square foot per year). This study is ongoing and will conclude at the end of 2001. However, four years of data yield show that converting a traditional turfgrass landscape to a xeric landscape can save water, maintenance time, and money. For more information contact the Southern Nevada Water Authority at www.snwa.com.

Utah Native Plant Society Heritage Gardens:
The Utah Native Plant Society (UNPS) is dedicated to the understanding, preservation, enjoyment, and responsible use of Utah native plants. The Society's mission is to foster public recognition of the spectacularly diverse flora of the state – a natural treasure to be valued and respected. The Utah Heritage Garden Program was founded to provide public demonstration gardens where people can see native plants growing in a garden setting. There are now twelve gardens in various locations around the state. Several more are in the planning stages. Contact UNPS if you are interested in establishing a Utah Heritage Garden. The only requirements are that the garden acknowledges UNPS sponsorship, include only Utah native plants, and be in a place accessible to the public. UNPS can help with planning, plants, and interpretive signage. A few Heritage Garden locations are listed below; check the UNPS website at www.unps.org for more garden locations and other information about the organization.

Wasatch Elementary School
1080 N 900 E
Provo

Price Heritage Garden
46 E 300 S
Price

University of Utah Mallway
North of the Phys. Ed. Complex
Salt Lake City

2] Make Sure Soil is Healthy

One benefit of using native and adaped plants is that many prefer poor soils, and don't need extra organic matter or fertilizer applications. Compacted soils will need to be aerated, though, regardless of what type of plant material is used. Soil preparation for more demanding plants may require enriching the soil with organic matter. A little extra work in the beginning will pay off with healthier plants. Organic matter, such as compost, will benefit the water and nutrient holding capacity of both sand and clay soils.

3] Use Native and Low-Water-Use Plants

Choose appropriate plants that are native or adapted to the local climate and soil conditions. Utah has extreme temperatures, low humidity, low precipitation, and alkaline soils. Selecting plants that thrive in these conditions will save time, money and help make a successful gardener. See the Landscaping Resources section of this document for drought tolerant and native plant and seed sources.

4] Create Practical Turf Areas

Kentucky Bluegrass, the most typically used turf in Utah, has a high water requirement and should be limited to those areas needed for practical uses such as recreation. Beautiful but less water-needy plants could be used in the remainder of the landscape. Match turf areas to their intended use, as well as topographical and soil conditions. For example, avoid using turf as a "fill in" material and placing turf in areas that are difficult to irrigate properly such as steep inclines and isolated narrow strips along sidewalks and driveways. Consider using drought tolerant turfgrasses such as Blue Grama or Buffalo Grass and groundcovers like Creeping-Thyme.

5] Use Mulches

Mulches aid in moisture retention, discourage weed growth and reduce heat stress. Organic mulches such as bark also provide essential nutrients as they decay. Mulches can also be used in areas not appropriate for planting. Materials can include bark, wood chips, pine straw, nut shells, gravel, crushed stone, shredded leaves or landscape clippings.

Inefficient sprinkler system.

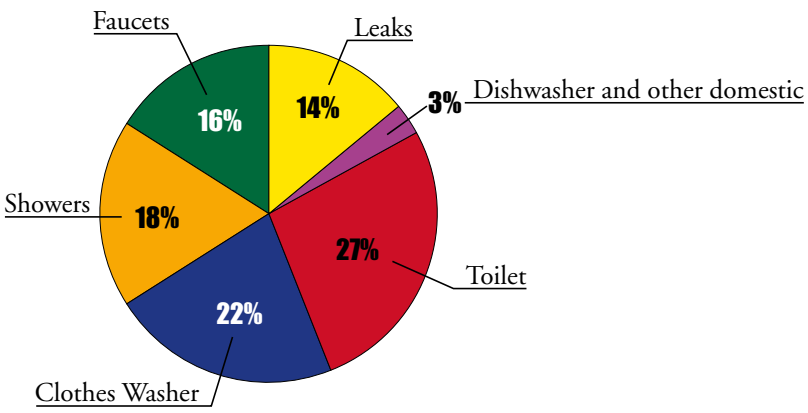
6] Irrigate Efficiently

Proper irrigation will not only conserve water but promote deeper root growth, resulting in a healthier, more drought tolerant landscape. Efficient irrigation means applying water in the proper amount and only when necessary. The design of a sprinkler system affects its efficiency, but the most efficient irrigation system can waste water because the amount of water it uses depends on how often and how long it is programmed to run. Understand the different water requirements of the "zones" in the landscape, and check automatic sprinkler or drip irrigation systems periodically to ensure plants are receiving the water they need without being overwatered. Program the irrigation system so it is adjusted to respond to the changing seasonal variations of temperature and rain. The run time of each zone should be in multiple cycles to avoid runoff. Modern irrigation technology can help save even more water in the landscape. Rain shut-off devices prevent automatic systems from irrigating during and after rain. ET-based irrigation controllers aim at applying a more exact amount of water needed by the landscape based on temperature, wind, humidity and solar radiation. Soil moisture sensors gauge plant water needs by monitoring soil moisture to determine proper time and amount of water needed.

7] Maintain the Landscape Regularly

All landscaped areas need maintenance to look beautiful and stay healthy. Control weeds so they don't steal needed water from desired plants. Minimize the use of fertilizer to avoid plant overgrowth and increased water needs. Repair hose and irrigation leaks. Maintenance needs of a carefully planned waterwise garden should decrease over time as plantings mature.

Typical water use within the home.



▶ TYPICAL WATER USE WITHIN THE HOME

The typical U.S. residence consumes about 69 gallons per person per day inside the home. This is approximately equivalent to one completely full bathtub.

As indicated by the accompanying chart, approximately 27% of all the water used indoors goes down the toilet. The clothes washer uses another 22% for a total of nearly 50% of indoor water use from just two household appliances. Showers and baths consume about 18%, and faucets another 16%. Leaks account for a significant 14%.

Surprisingly, only 3% of water used indoors is used by the dishwasher or other domestic purposes such as cooking and cleaning. Despite this fact, 100% of water supplied inside the home must meet stringent drinking water standards.

The American Water Works Association (AWWA) estimates that a comprehensive program to install water efficient plumbing fixtures within the home and fix leaks could reduce total indoor water consumption by as much as 30%.

(AWWA 1999)

Landscape Ordinances

Landscape ordinances are commonly used throughout the western United States to provide guidelines for water wise landscaping. Landscape ordinances can be developed around the following methods:

Public Education

Landscape ordinances that serve mainly to heighten public awareness are not usually enforced and do not require much staff time. Public education ordinances can be adopted readily. Like other education-related programs, they deal with changing behavior, which is difficult to quantify. A public education ordinance can serve its purpose by priming the public as more stringent ordinances are adopted over time. Public acceptance of these ordinances is traditionally high.

Restrictive Measures and Mandates

Restrictive ordinances are most commonly used in extreme situations where water is scarce. Restrictive ordinances can be used in situations where an agency is facing a short-term crisis, such as a mandatory percentage of reduction during a drought. These kinds of ordinances can also be used in long-term planning for areas where the water supply is limited and water development is no longer allowed. Components within a long-term restrictive ordinance could include turf limitations, seasonal watering times or consequences for runoff. Because of their stringent nature, restrictive ordinances are prone to controversy. Public acceptance is low when there is little effort to educate the public. However, when public awareness is increased, reduction in water use can be achieved quickly and in a positive manner.

Water Budget

Ordinances that take the greatest amount of staff time yet are most equitable and fair to the public are those that require the end-user to comply with a water budget. The water budget is calculated based on the end-user's total landscaped area and outdoor features. A water purveyor can offer incentives to conserve water by tying the budget to its respective water rate structure. Those who stay within their budget are charged a lower rate; those who exceed the budget are charged more for the extra water. This kind of incentive also acts as an enforcement mechanism. Those agencies that have implemented a water budget successfully have had the ordinance coupled with a conservation water rate. To achieve meaningful conservation through this type of ordinance, a community's staff should plan on spending a considerable amount of time educating the public about the end-user's water budget and how to interpret the water bill.

When choosing a style of ordinance, it is important to consider:

- Current Water Situation
- Growth Issues
- Staff Requirements
- Involvement of Key Stakeholders
- Strategy for Educating Customers/Public

Jordan Valley Water Conservancy District (JVWCD), as a wholesaler to nineteen member agencies (municipalities and improvement districts), acts as a resource to assist in conservation and growth issues. Over an 18-month period, JVWCD and a consultant drafted model landscape ordinances that address all new development. Representatives from Utah State University, the Utah Division of Water Resources and the Utah Nursery and Landscape Association also formed a working group to assist JVWCD in refining the ordinance. The commercial ordinance requires all new developments to submit a Landscape Plan, which includes a calculated water budget. The residential ordinance is a public education-based ordinance where all new homeowners are presented with a Landscape Education Packet containing information about water wise landscaping. These ordinances are available for all agencies throughout Utah to use and adapt to their respective city. The ordinances (commercial and residential) can be located on the JVWCD web site at www.jvwcd.org.

Wholesale Water Districts

Educating and assisting member agencies in conservation programs is one of the responsibilities of wholesale water districts. For example, Jordan Valley Water Conservancy District's goal of conserving 25% by 2050 cannot be achieved without the participation of member agencies. Programs implemented by the district are to be shared and expanded by member agencies. In acting as a resource agency, the district's objective is to provide a consistent message for the service area and complement each of the retailers' conservation plans. Since the district's adoption of its conservation plan in 1999, member agencies have become stakeholders, along with others in the region who participate by submitting voluntary contributions to fund effective programs. These agencies are referred to as partnering agencies and include member agencies within the district service area and some who may purchase water from the district. For more information call the hotline at 1-877-728-3420. Conservation related resources at the district include:

- Water Conservation Demonstration Gardens free to the public,
- Garden Fairs at the Demonstration Gardens,
- Free Waterwise Workshops,

- Waterwise Landscaping informational handouts, and
- Free Water Check Program (irrigation check) for residences and commercial landscapes.

Secondary Irrigation Water

An additional component important to managing the water resources of the Wasatch Front is secondary irrigation systems. Such systems deliver untreated, lower quality water or treated wastewater from a treatment plant for outdoor lawn and garden irrigation. It is difficult to monitor total water use in a community, because typically water used in secondary systems is not metered, and is priced at a flat rate, without consequences for over-use. The primary benefit of secondary systems is that they reduce the demand for higher cost treated water, which is usually in short supply. It is often through the installation of a secondary system that water previously treated and used in agriculture can be converted to municipal uses.

Tooele Valley Reclamation System incorporates Overlake Development.

Reclamation System Example: Tooele City

Tooele City has successfully created a wastewater treatment and reclamation project that will significantly reduce the future demand for culinary water in Tooele Valley. A separate secondary water system was developed to provide irrigation water to the community. The project was a cooperative effort involving the city, a developer, the city's engineering firm and state and federal agencies.

Tooele City is facing water supply problems in meeting its culinary and secondary water needs because its watershed is "closed" and fully allocated. The city's water needs accelerated during the 1990's due to a sudden increase in its population growth rate.

Tooele needed to replace its wastewater treatment facility, originally built in 1950, due to obsolescence and lack of capacity. The city was faced with several obstacles, from limited fiscal resources to finding prospective facility sites. In 1995, the city's engineering firm identified an optimum site for servicing existing and projected growth within the city. The city's original plan was to discharge the treated wastewater from the proposed plant location to the Great Salt Lake via Six-Mile Creek. However, working with the landowner, Overlake Development, and the engineering firm, it was determined that the opportunity existed to expand the

project to include a reuse reclamation or secondary water component. Design of the wastewater and reclamation project involved the treatment plant, interceptor sewer lines, advanced treatment technology, 17 lakes for storage of the secondary water, an 18-hole public golf course and distribution lines to commercial and residential users within the potential service area. The project produces Type I effluent for unrestricted reuse in a secondary water system. The reuse system is designed to treat 2.35 million gallons of wastewater per day, with the capacity to expand to 4.7 million gallons per day.

Overlake, a planned community within Tooele, has constructed secondary water lines to each of the 695 residential housing units built to date. In the spring of 2002, secondary water will be available to these homes. At build-out, the secondary water system will service over 8000 residential units, as well as commercial and recreational facilities within and neighboring the Overlake project. Secondary water is used as the sole source of irrigation water for the 18-hole Links at Overlake golf course. Tooele City, through utilization of the secondary or reuse water, will reduce its annual demand for culinary water in the range of 4,600 acre-feet. For more information about the system, or to make reservations for public tours, call 801-843-2137. Please visit Tooele City's website at www.tooelecity.org.

Additional Reading & Resources

Waterwise Landscaping Sources:

- The Center for Water - Efficient Landscaping, www.cwel.org
- Utah Native Plant Society, www.unps.org
- Native and Adapted Plants for Utah Landscapes, www.hort.usu.edu/natives/index.html
- Smart Gardening, www.smartgardening.com
- Xeriscaping, www.xeriscape.org
- Utah State University Extension, www.usu.edu
- Utah State University Horticulture Department, www.usu.edu
- Clean Air Lawn Care Association of America, www.aqmd.gov/monthly/garden.html
- Utah Division of Water Resources, www.nr.utah.gov
- Conserve Water, www.utah.gov

Native Utah Seed and Plant Sources:

- Granite Seed (Wholesale),1697 West 2100 North, Lehi, Utah 84043. www.graniteseed.com. 801-768-4422/801-531-1456

Specialized Training Sessions for Toolbox–Envision Utah staff and consultants can visit your planning commission or city council to train them on how to best use the information included in Envision Utah's Urban Planning Tools for Quality Growth. We can specifically address any chapter, providing information on how it was developed, why these strategies work and how a community can implement the ideas included in the workbook. Concerns of local officials responsible for making planning decisions, can be addressed in a non-threatening open forum, with experts available to provide them with needed information.

- Great Basin Natives, PO Box 134, Holden, Utah 84636. www.grownative.com, 435-795-2303
- High Desert Gardens, PO Box 1419/2971 South Hwy 191, Moab, Utah 84532. 435-259-4531
- Utah Native Seed, C. Paul Ames, PO Box 355, Eureka, Utah 84628. 435-433-6924
- Utah Wildflower Seed, Virginia Markham, 3650 West 2150 South, Salt Lake City, Utah 84120. 801-277-8423
- Wildland Nursery, 550 North Highway 89, Joseph, Utah 84739. janett@wildlandnursery.com. 435-527-1234 cell:801-232-8164
- Check out this website for a list of drought tolerant and native seed and plant sources: www.thearb.org/seed_sources.htm

Waterwise Gardening Books:

- *The Xeriscape Flower Gardener.* Jim Knopf, Boulder, CO, Johnson Books, 1991.
- *Xeriscape Plant Guide.* David Winger, ed., Denver Water, AWWA, Fulcrum Publishing, 1996.
- *Plants for Natural Gardens.* Judith Phillips, Santa Fe, Museum of New Mexico Press, 1995.
- *Water-wise Landscaping.* Terry Keane, Utah State University Extension, 1995.
- *Xeriscape Color Guide.* David Winger, Denver Water, Fulcrum Publishing, 1998.
- *The Undaunted Garden: Planting for Weather-Resilient Beauty.* Lauren Springer, Fulcrum Publishing, 1994
- *Waterwise Gardening.* Lauren Springer, New York: Prentise Hall Gardening, 1994.
- *Natural by Design: Beauty and Balance in Southwest Gardens.* Judith Phillips, Santa Fe, Museum of New Mexico Press, 1995.
- *Landscaping for Water Conservation: Xeriscape.* Kim Knox, ed., Jointly published by City of Aurora and Denver Water, Denver, CO, 1989.
- *Landscape Plants for Western Regions: An Illustrated Guide to Plants for Water Conservation.* Bob Perry, Claremont, CA: Land Design Publishing, 1992.
- *Water-Efficient Landscape Guideline.* Richard E Bennett and Michael S. Hazinski, American Water Works Association, 1993.
- *Desert Landscaping, Plants for a Water-Scarce Environment.* University of Arizona, 1996.
- *Mediterranean Gardening: A Waterwise Approach.* Heidi Gildemeister, Palma de Mallorca, Editorial Moll, 1995.

Demonstration Gardens:

- Conservation Demonstration Gardens, Jordan Valley Water Conservancy District, 8215 S 1300 W, West Jordan
- Day Riverside Library, 1575 W 1000 N, Salt Lake City
- Department of Natural Resources, 1594 West North Temple, Salt Lake City
- Sego Lily Gardens, 1500 E Sego Lily Drive, Sandy
- USU Greenville Research Farm, 1800 N 800 E, Logan
- Provo Water Resources, 1377 S 350 E, Provo
- Rock Canyon Trailhead Park, Utah Heritage Garden, East end of 2300 North, Provo

Appliances and Plumbing Fixtures:

- Greenseal, www.greenseal.org
- Consumer Toilet Reports by Terry Love, www.terrylove.com/crtoilet.htm
- Toiletology 101, www.toiletology.com/index.shtml
- Dripping Faucet, water loss calculator, www.waterwiser.org/books/dripcalc.html
- Better Way to Save, www.betterwaytosave.com