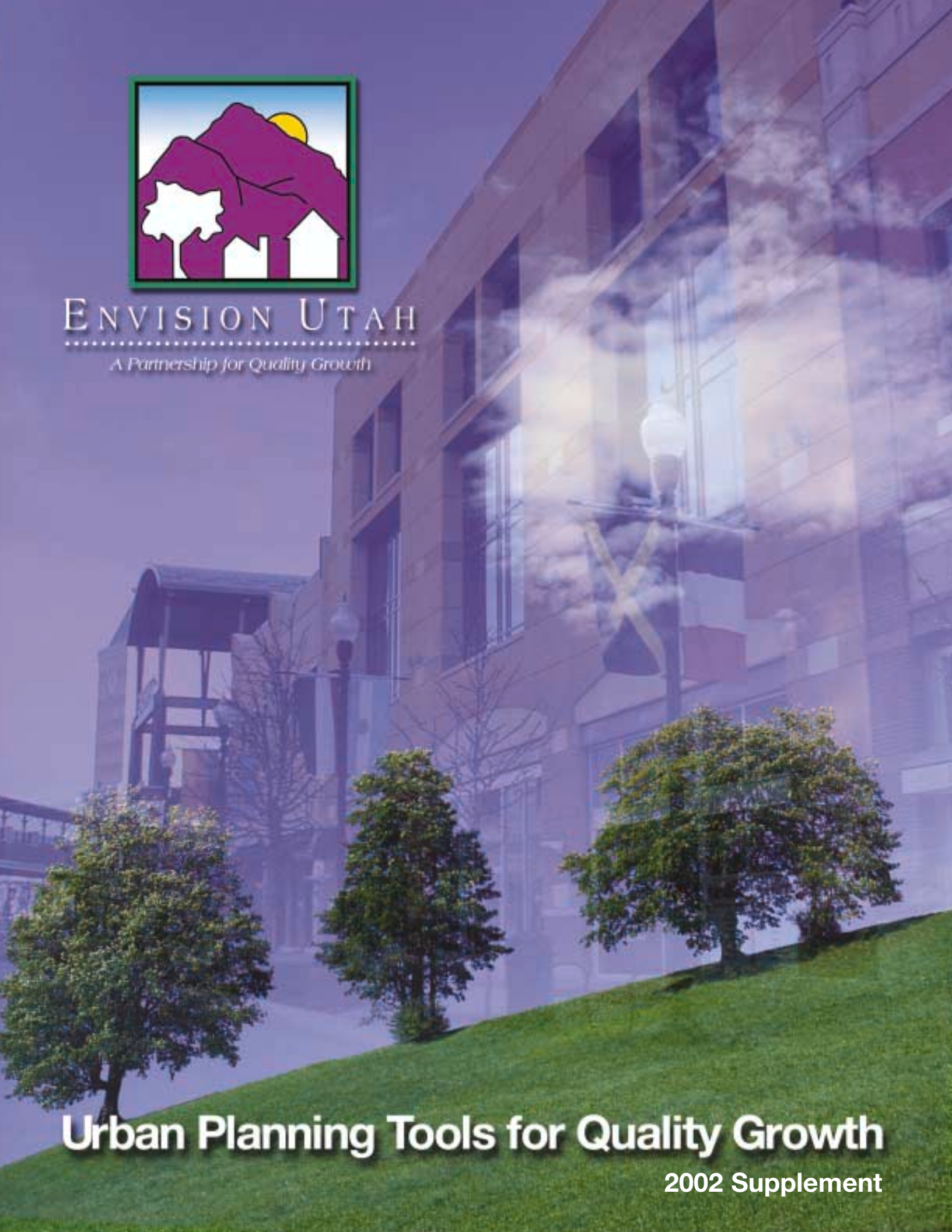


ENVISION UTAH

A Partnership for Quality Growth

Urban Planning Tools for Quality Growth

2002 Supplement

Urban Planning Tools For Quality Growth

2002 Supplement

Chapter 9

Upon its release in October 2000, Urban Planning Tools for Quality Growth, or "The Toolbox" as it has come to be known, was enthusiastically received by many municipalities. One year later, communities now regard it as an essential resource as they seek to create quality neighborhoods and projects, and to balance growth with the preservation of sensitive lands and other precious resources.

Because of the overwhelming reception of the Toolbox and continuing interest in the topics it addresses, Envision Utah decided to re-issue it with four additional chapters. When the Toolbox was first released we did not foresee a need to update and expand it. The Toolbox was published to serve municipalities, developers and other stakeholders for the foreseeable future. However, as we identified other topics and best practices, we decided to publish this new and expanded edition.

Two new chapters build on the section "Making our Community A Good Place to Walk" from the original document by providing more strategies in the area of Commercial and Retail Development and Street Design and Pedestrian Safety.

In addition, we have updated the Water Efficiency chapter due to changing data and findings since the first release. This chapter is now placed in a subdivision of the Toolbox called Natural Resources. Also included in this section are new chapters of Energy Conservation and Urban Forestry. The three areas of water efficiency, energy conservation and urban forestry touch on the everyday concerns of our cities and counties as they try to accommodate development while preserving our precious natural resources. Obviously, how we handle these challenges will significantly affect the quality of life in Utah and the Wasatch Front well into the future.

We hope this revised edition of the Toolbox will contribute to keeping the Greater Wasatch Area an incredible place to recreate, live and raise a family for many generations to come. We trust that you will embrace this second edition with as much enthusiasm and excitement as the first.

Greg Bell, Chair
Envision Utah

Natural Resources Introduction

As Utah's population continues to grow, local communities must balance consumption and conservation of the state's natural resources. How can the growing need for water in a thirsty community be balanced with limited resources and expensive infrastructure alternatives? Are there opportunities for energy savings by introducing a variety of trees into our urban landscapes? Can water conservation programs bring secondary energy saving benefits to communities trying to provide expansive services to growing communities?

Recognizing the key to successful resource management is bringing together motivated people empowered to do the right thing. Communities that focus on collecting and managing good information and providing inclusive processes that are respectful of differing values, become the stewards for progressive and responsible resource management. This stewardship is translated into comprehensive plans that support the development, conservation and management of a community's natural resources.

The first step in capturing the benefits of proactive management is understanding the interrelationships between the seemingly unrelated resources. It takes energy to capture, process and distribute water to a community. Effective water conservation programs not only reduce the need to build expensive water utility infrastructure, but these programs save energy. Trees planted strategically and managed properly in a community also help communities save money while performing street maintenance. Cooler streets and communities shaded by the urban forest reduce energy needs of community homes and businesses. A win-win situation for everyone involved.

Understanding the interdependency of our natural resources and then taking the next steps to properly manage them is an admirable goal being undertaken by many communities. Managing energy use, water use and supporting the viability of urban forests improves the quality of life for many residents along the Wasatch Front. The following chapters, Water Conservation, Urban Forestry, and Communities Planning for Energy Efficiency, include tools, strategies, and concepts to help communities take these next steps. These tools provide an opportunity to realize the benefits of addressing the needs of growing communities and their use of limited natural resources.

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.**

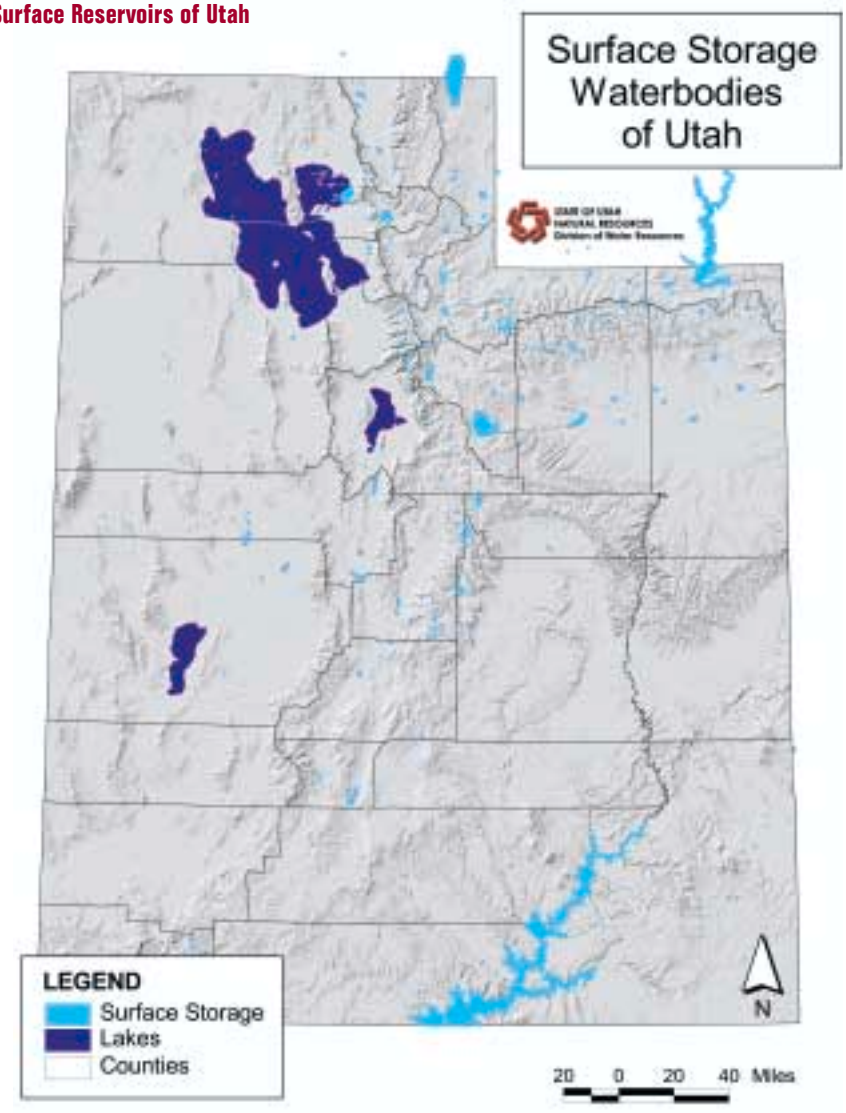
- **Water quality management in Utah's urban areas generally falls into four major categories:**
  - **Protection of surface and groundwater sources of drinking water;**
  - **Management of the quality of municipal and industrial point source discharges so that the receiving waters are not degraded;**
  - **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.

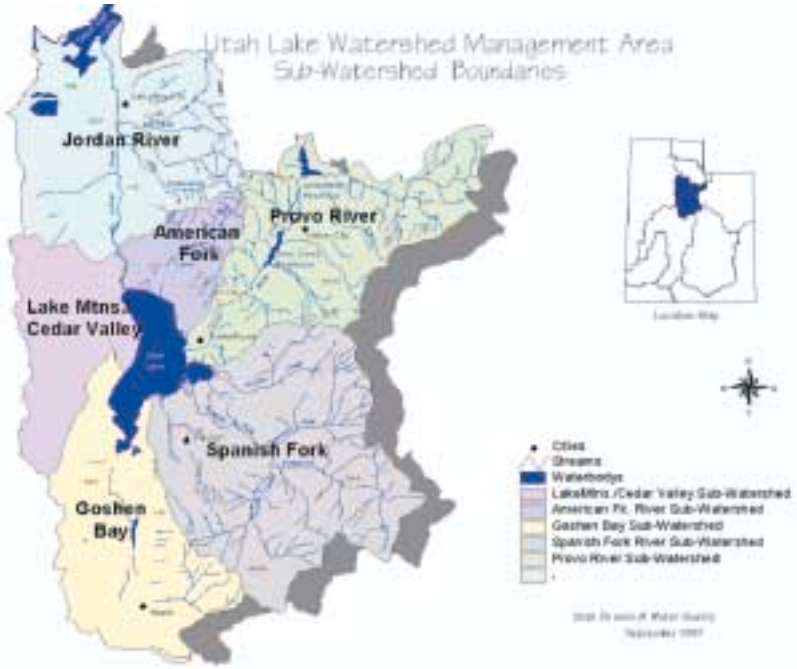
Eric Edgley, Utah Division of Water Resources

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.

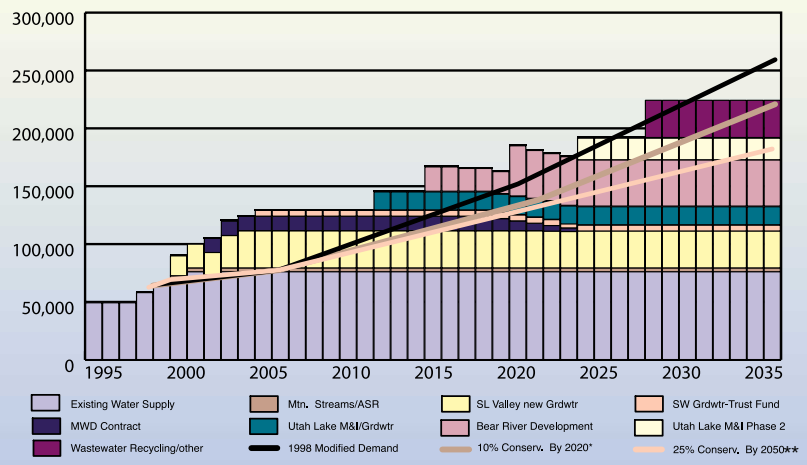
Inventory of Water Supply

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:

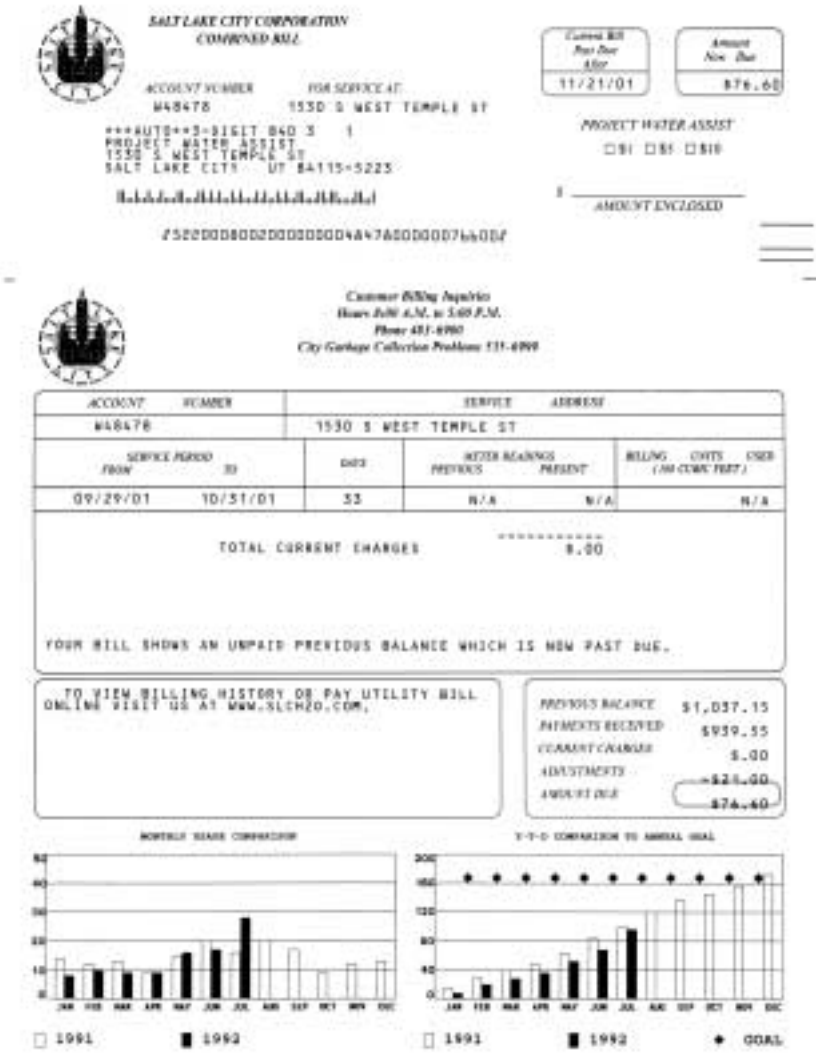
- Focus groups, workshops and/or community council meetings.
- Citizen Advisory Council.
- Literature explaining the process and new rate structure.
- Customer service outreach when complaints are received.

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.

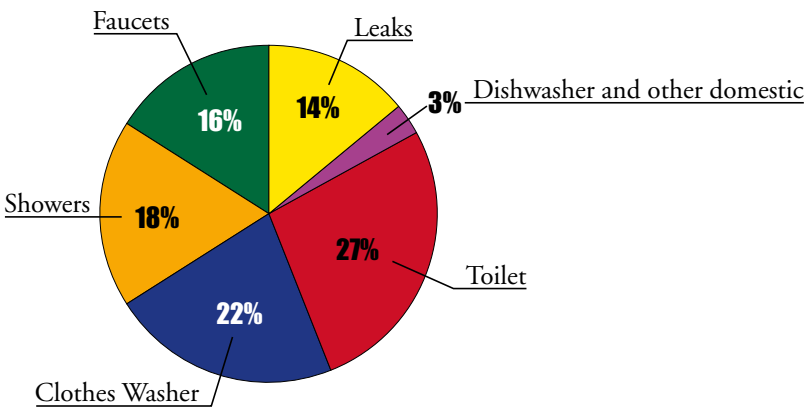
6] Irrigate Efficiently

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

6 Urban Forestry

Introduction

America's urban forests are missing 634,407,719 trees.

In a 2001 national study conducted by AMERICAN FORESTS titled "Gray to Green: Reversing the National Urban Tree Deficit," satellite imagery was used to document the number of trees that are missing from America's urban areas due to development and other factors. The study also demonstrates that many cities across the country are becoming "cities of sidewalks and parking lots."

Today, 80 percent of Utah's population lives and/or works within urban areas. The quality of life for them and their families is dependent upon the urban environment. Healthy, safe, and well-managed urban forests enhance this environment by contributing to clean air and water, increasing property values, moderating temperature, lessening energy demands, reducing erosion and storm water runoff, providing wildlife habitat and offering year-round enjoyment. Without a vibrant urban forest, quality of life would appreciably suffer.

Urban Forestry Programs, supported by a variety of organizations and agencies within Utah, promote the use of trees and other plants as tools to enhance the quality of life within our cities and towns. As Utah continues to grow and urban areas expand, the need for urban forests increases, as does the need for their proper management.

Utah residents enjoying the urban forest.

Attention to Utah's unique climate provides the opportunity to support diverse and thriving urban forests. Climate is characterized by many factors including temperature, precipitation and relative humidity. The most widely used climate classification system, the Köppen system, has categories based on annual and monthly averages of temperature and precipitation. Within the Köppen system, the climate of Utah's populated areas is categorized as both dry arid (desert) and dry semiarid (steppe) depending on the location within the state.

Urban forests in Utah present many opportunities as well as great challenges. Utah is a good place to grow trees. Utah has fewer of the disease and pest problems that affect trees in other, more humid parts of the country. Tree diversity in Utah is possible and should be an ongoing goal in its many agencies and organizations. A key forestry challenge, however, is Utah's soil. It tends to be saline in some areas with a high pH.

Climate issues present the major opportunities and concerns when dealing with Utah's urban forest. The climate of Utah's most populated areas along the Wasatch Front may be categorized as dry and semiarid or steppe (*Köppen Classification System*). Average annual precipitation amounts range from a high of 23 inches in Ogden to a low of 13 inches in Orem. The use of trees in the urban landscape, when coupled with these low precipitation amounts, necessitates a water use plan that incorporates irrigation.

In order for most trees to prosper in Utah's climate, water needs to be applied in proper amounts and at the proper times. It is especially critical to apply water to younger plants, to keep them from drying out and to support their early development. More mature trees also need water, especially during extreme heat. It should be noted, however, that many trees have lower water requirements than other more commonly used landscape plants like annual flowers and turf grass. The investment in proper water planning and tree maintenance yields many dividends for the urban forest.

Benefits of the Urban Forest

When successfully established, the Urban Forest creates many benefits for the surrounding community. Examples of these benefits include:

Sense of Community

Trees serve to define neighborhoods and communities and give them a unique identity. Large established trees line the streets of many Utah neighborhoods. The canopies that protect the Harvard and Yale communities in Salt Lake City give the streets an inviting and unique sense of belonging. Large cottonwood trees in the Holladay area provide the namesake for many community and local businesses.

Salt Lake City's Yale community.

Quality of Life

Trees soften the hard urban landscape with color, texture, fragrance and overall beauty. Trees add visual interest to an otherwise monotonous environment. These environments change and grow, adding value to the community over time.

Increased Property Value

Studies show that tree lined streets and neighborhoods show higher property values by as much as 20%*. Tree lined commercial and retail properties tend to have higher traffic and therefore higher customer volumes than those located on barren streets, pushing up the value of the property.

(*Article: SLC Tribune, February 27 1999).

Reduced Road Maintenance Costs

Shade from street trees is economically beneficial to cities because it protects the street paving from weathering. The asphalt paving on streets contains stone aggregate in an oil binder. Without shade, the oil heats up and volatilizes, leaving the aggregate unprotected. Vehicles loosen the aggregate and much like sandpaper, the loose aggregate grinds down the pavement. Streets should be overlaid or slurry sealed every 7-10 years over a 30-40 year period, at a cost of $50,000 a mile. Heavy shade can defer this maintenance from 10 years to every 20-25 years.

Cooling and Energy Savings

According to a study conducted by the University of Utah and TreeUtah, shaded surfaces can be cooler by as much as 9 degrees when compared to non-shaded surfaces. Trees shade dark surfaces and cool the air through evapotranspiration. Urban trees provide shade and protection from the strong Utah summer sun, enhancing the human comfort level realized by that community. This shade effectively moderates the high temperatures that often occur in the urban landscape and thereby reduces cooling costs. Planting trees to shield the sun's rays can reduce the amount of heat that buildings absorb. These savings can range from 10 to 40 percent for a typical home or office in energy use savings. Evergreen trees strategically placed for windbreak protection can save as much as 20 percent towards energy use.

Utah's great climate variability can make the care of trees and other landscape plants challenging for Utah residents. Precipitation in Utah is much more variable in the mountainous areas than in the valley regions and this is largely the result of the interaction of storms with mountain ranges. Many peaks in the Wasatch Range, the Uinta Mountains, and other isolated areas may receive 40 or more inches of precipitation annually. In contrast, large areas of the Great Basin and smaller sections of the Canyonlands area and Uinta Basin receive less than 6 inches of annual precipitation.

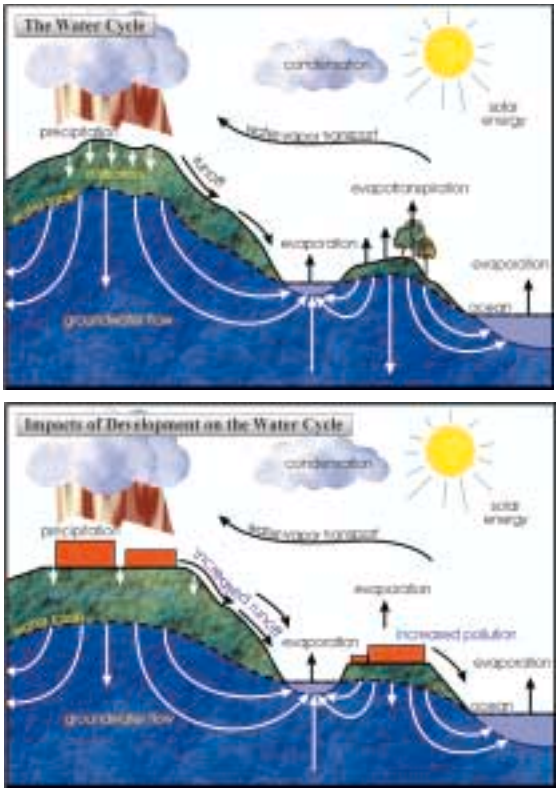
Urban trees provide cooling shade to streets and sidewalks.

- **Benefits of the Urban Forest:**
- **Sense of Community**
- **Quality of Life**
- **Economic Value – Increased Residential Property Value**
- **Reduced Road Maintenance Costs**
- **Cooling / Energy Savings**
- **Air Quality Improvements**
- **Improving Water Quality**
- **Enhancing Personal Health**
- **Wildlife Enrichments**
- **Shade and Cooling**
- **Reduced Noise Pollution**
- **Bioremediation**
- **Reduction of the Urban Heat Island**
- **Traffic Calming**
- **Pedestrian Friendly Spaces**

Over time, a tree in an urban landscape will grow and provide shade to the surrounding buildings and streets. It takes just 10 to 15 years for a tree to grow to a significant size, enabling it to produce significant cooling and energy savings.

Air Quality Improvements

Trees help cleanse the air by absorbing gaseous pollutants like CO, NO_2 and SO_2. They adsorb airborne particulate matter like dust, smoke and ash. One acre of trees provides enough oxygen to support 18 people and will absorb the amount of CO_2 produced by a car driving 26,000 miles per year.



Trees increase infiltration, improving water quality.

Improving Water Quality

Trees and their supporting root structures provide the foundation that holds a community together. They stabilize the ground and help to decrease storm water run off and erosion. Trees in the urban landscape serve to hold topsoil and groundcover in place—reducing erosion and minimizing chemicals that flow into storm drains, rivers and creeks. Runoff is decreased as tree crowns intercept precipitation reducing the rain's impact on the ground and by increasing evaporation. This slower process enables more precipitation to permeate the ground and support a greater recharge of ground water supplies.

Enhancing Personal Health

Trees create feelings of relaxation and well being. For those individuals living in urban environments, trees are often a major component of their connection to nature. The benefits of trees within the community have been documented in unique ways. For example, medical research indicates that patients assigned to rooms with a view of trees and green open spaces have shorter post-operative hospital stays.

Wildlife Enrichment

The urban forest supports a variety of other creatures. Many forms of wildlife come to live in urban communities solely because trees provide a protective habitat in which they can live. Trees are the natural nesting and resting places for wildlife and birds providing a more complex and vibrant environment for humans. Wildlife provide other valuable services to the community, for example some birds serve as natural predators to pests.

Noise Pollution

The sound of leaves moving in the breeze creates a "white noise" that softens the harsh sounds associated with a typical urban environment. Trees provide a softer environment, giving the perception that noise pollution is reduced and the normal sounds associated with the urban environment are more easily tolerated.

Bioremediation

Trees can remove and break down pollutants in areas with contaminated soil and ground water. Roots absorb polluted groundwater and add organic matter to the soil that enhances pollutant breakdown through increased microbial activity. A local example of this process is located in Ogden, Utah. Poplar trees were planted to clean groundwater contaminated with petroleum hydrocarbons. A Utah company, Phytokinetics, Inc., installed this very effective system in 1996.

Reduction of the Urban Heat Island Effect

Densely populated areas with their many streets, asphalt parking lots, and little room for open spaces, contribute to a condition called an urban heat island. Urban heat islands exist in cities across the nation and around the world. Due to large expanses of dark impervious surfaces, minimum tree canopy, and emissions of CO, NOX, and other pollutants from industry and traffic, ambient temperatures in urban centers are hotter than the surrounding environment. This increased temperature coupled with gaseous pollutants and particulate matter result in ground level ozone (smog) causing problems with public health, the environment, and human comfort. Planting and managing more trees in these Urban Heat Island areas can significantly offset the concerns with pollution and increased temperatures.

Trees are used to clean petroleum hydrocarbons from the soil at this Ogden location.

Traffic Calming

Studies show that trees help to slow traffic along commercial and residential streets by giving the perception of a narrower roadway. When coupled with other traffic calming techniques, street trees are especially effective.

Pedestrian Friendly Spaces

Trees planted in park strips provide a barrier between busy streets and sidewalks, making pedestrians feel safer and more comfortable. Trees shade hot sidewalks during summer months, offering people the opportunity to spend more time shopping, visiting or sightseeing in the city.

The benefits to a well-planned and managed urban forest are many. Communities are healthier, more enjoyable, diverse with wildlife and inviting. Utah's early ancestors and planners recognized these benefits and called for large community gardens and green spaces as seen in today's Pioneer Park.

Large street trees give the perception of a narrower roadway, which slows traffic.

Costs and Disadvantages of the Urban Forest

Urban forests and trees have many benefits, and while these benefits far outweigh the costs, they are not without problems. A good urban forestry program must acknowledge these problems and minimize their impacts.

Problems to be aware of include:

- Citizen support for urban trees usually is very strong in the abstract, but support for spending significant amounts of money on public trees is much weaker.

- Trees are biological organisms that create litter (leaves, bark pieces, twigs). Litter problems can be minimized by good selection and placement, but not eliminated.

- Even healthy trees can drop limbs or break in unusual circumstances, like heavy snow or ice loading or very strong winds.

- Trees eventually weaken and then (usually slowly) die. Through this process they become more and more hazardous, with the possibility of falling limbs, breaking trunks, and wind-throw.

- Trees sometimes damage or interfere with infrastructure, especially pavement and utilities.

- Business people often are concerned about trees blocking the view of their signs and storefronts.

- Trees cost money to establish and maintain.

- It requires more planning to include trees in landscapes than to pave or turf an area.

- Trees and shrubs can obstruct views and hinder crime prevention and detection.

- Urban forest management takes a considerable amount of fairly specialized expertise. Many towns and cities have little of this expertise available on staff. This is not really an urban forest/tree problem, but it leads to many problems.

Trees always present at least some potential hazard just by their presence, and declining or dead trees become especially hazardous to people and property. Eliminating these hazards is not possible without eliminating trees, something few would want. Trees therefore are sources of liability for a community and must be managed to eliminate unreasonable risk of harm to people and property. Communities have a "duty of care" or a legal duty to act to protect others against this unreasonable risk or hazard and therefore must not turn its back on public trees and their management. Warnings from citizens or staff of hazardous situations must be acted on quickly and the situation remedied. Instituting a municipal tree hazard management program can go a long way toward helping a community act reasonably and responsibly in the management of their trees. Elements of such a program include:

- A written, approved urban forest management plan that addresses hazard tree management;

- Establishing a level of acceptable risk;

- Use of a systematic tree inspection and inventory procedure and keeping accurate records;

- Personnel training;

- Timely control of hazardous situations;

- Regular program review.

As shown above there are many issues to consider regarding the urban forest. The remainder of this chapter will focus on key elements necessary to plan for and manage a viable and vibrant urban forest.

Community Goals, Plans and Resources

Creating a Community Vision

A community needs to start with a vision in order to set goals for the urban forest. Community involvement is essential to developing this common vision. Based on the vision, long-range goals can be established with clear planning steps. The vision and goals may need to be revisited as you proceed through the planning process and as you gain new information or a community's situation changes.

Historically, Utah has made a strong commitment to the establishment of trees in the urban environment. The vision of green landscapes was brought into the Great Basin with its settlers arriving from the Midwest. The plans and ordinances of Utah's original cities mandated a strong urban forest and this can be seen in the older parts of many Utah cities. It is just in the recent years, with the fast pace of development in Utah that new urban forests have not been created and their many benefits not realized. Communities need to first recreate the vision of the urban forest, and then create the forests.

Goals for the urban forest take many forms, and in order to realize these goals a clear understanding of what the community wants needs to be established. A plan is then created to realize these goals.

Residential Planting Goals

The aesthetic role of trees in residential areas is to provide continuity to neighborhoods comprised of homes of various architectural styles and landscapes. A community can achieve a style or appeal by requiring certain residential plantings. Visionary guidelines can provide for the quality that defines communities, as they are established and mature.

Commercial Planting Goals

There are a number of areas to consider for commercial landscaping. They include the downtown area, the commercial strip and parking lots. There are many site-related constraints on trees located in downtown areas. Two areas that are often overlooked in the selection of trees are the limited rooting space accorded trees located in tree wells and potential conflicts between the trees canopy and storefront signs.

Trees help create a community vision, as shown here in the Sugarhouse section of Salt Lake City.

Defining the goals for commercial plantings and the coordination with signage and street constraints ensures a viable and productive environment for trees to mature.

Community Awareness

Another important goal is to make the communities aware of the importance of trees. Two of the many ways to accomplish this goal are through Arbor Day celebrations or a Tree City USA designation.

Arbor Day is a special day set aside for tree planting. Arbor Day celebrations vary from a simple tree planting to all-day affairs. The important thing is that the activity a community plans meets its goals and objectives. Goals vary from educating the public about the value of trees and the need to make provisions for them, to getting people involved and supportive of the efforts of a community leader focusing on the benefits of the Urban Forest. A basic Arbor Day ceremony may include: introduction and comments by a community leader, a reading of Arbor Day history, singing songs or reading poems about trees and the impact they have on our lives, the planting of a tree, and completion of the planting.

Since its inception in 1976, the Tree City USA program has been recognizing communities around the country for their tree management efforts. The program has also had the effect of encouraging those communities who do not already have a community forestry program to pursue establishing one. A community must meet these four standards to become a Tree City USA:

1] A tree board or department which is legally responsible for the care and management of the community's trees.

2] A community tree ordinance, which designates the establishment of a tree board or forestry department and gives this body the responsibility for writing and implementing an annual community forestry work plan.

3] A community forestry program with an annual budget of at least $2 per capita.

4] An Arbor Day Observance and proclamation.

Any questions regarding Tree City USA designations can be directed to the state forester's office. The state forester's office is responsible for verification and approval of applications and information is then forwarded to The National Arbor Day Foundation. Qualifying communities receive a Tree City USA flag, two road signs, a plaque and several commemorative items to show this commitment to the urban forest to its residents and surrounding communities.

▶ Communities are the stewards of the urban forest. Forest trees in urban landscapes only live for 7-10 years. We must acknowledge the benefits of urban forestry and work actively to achieve these benefits.

■ A community's identity, its health and vitality are all impacted by the trees growing in its landscapes. Close integration with the buildings and other infrastructure allow the community to define their image and declare their purpose.

City Forester

Another way a community can realize the goal of a vibrant urban forest is by having a city forester on staff. The position of City Forester is created to manage the community's tree resource and administer their tree ordinance. In some smaller communities this duty may fall to a volunteer tree board or in some communities may be entirely neglected. City foresters are typically given the authority to manage all publicly owned trees within a community. This management includes the planting, pruning, treating disease and insect pests and removal of public trees. They also often have the authority to address private trees and to address public concerns such as insect and disease control and hazardous tree situations.

Some communities have made provisions for the licensing of spray applicators and tree pruners. The City Forester or tree board typically issues these licenses. Applicants for a license may be required to demonstrate competence and knowledge in the business of spray application or tree pruning by passing a written test and by demonstrating the necessary skills in a field test.

Creating an Urban Forest Plan

After a community vision has been established and goals have been set, the next step is the creation of an urban forest plan. Planning is simply systematic decision-making. It provides a means for progressing towards a goal. If there is a single action that could advance the planting and care of trees in most communities, it is a well thought out plan. Involving key stakeholders in the planning process is important for the creation of an Urban Forest Plan. The establishment of a shade tree commission, tree board, or the position of city forester is a good step toward planning for the urban forest. Individuals interested in or already responsible for municipal tree care would be invited to serve in these positions. A community's Urban Forest Plan needs to become part of the community's general plan, stated both as long-range goals and also as policy. This integration into the general plan heightens the awareness of the urban forest and incorporates the strategies into the City's overall goals. An efficient and collaborative approach provides opportunities for all city departments and citizens to be included in the planning process from the beginning. Working together to create a vision and set goals provides the foundation for an Urban Forest Plan to be successful.

Conduct a Tree Inventory

As part of the urban forest plan, an inventory of the community's trees needs to be conducted. Few communities have any idea how many trees they have on their streets, let alone where they are, what species they are, and what condition they're in. In addition, an assessment of the resources available to manage the urban forest assets should be included.

There are many different kinds of inventories and even a greater variety of ways to conduct them. Tree inventories usually collect at least the following information: species, size, tree condition and tree location. Additional information might be necessary to attain the goals set out in the urban forest plan. There are many sources of assistance available to help set up tree inventories listed at the end of the chapter.

Species

How many types of trees are located in the community? A diverse tree population protects a community's urban forest against the devastating effects of an insect or disease outbreak. Understanding the composition of your urban forest will also assist in planning for and identifying which species could be planted in the future to ensure a diverse tree population.

Size

Size is often an indication of the age of a tree, which is an important factor in the long-term viability of the urban forest. The ideal urban forest will have a broad range of ages, achieved through continuous planting and removal based on tree condition. Size is typically measured as diameter at breast height (DBH). It is measured four and one-half feet above the ground. Inventories typically place trees into diameter classes with 2 or 4-inch increments.

Condition of Trees

The condition of individual trees or stands of trees gives an idea of the urban forest's health and long-term vitality. This information helps address problem areas such as insect or disease concerns. Planting, maintenance and removal decisions can be made from understanding the condition of the trees in the community.

A common tree classification system based on condition is:

1] A "healthy," vigorous tree with no apparent signs of injury, disease or insect damage. Tree has form typical for species;

2] Tree of average condition or vigor. May have some disease, damage or injury and is somewhat off form. May need some pruning;

3] In a state of decline for any reason. Death not imminent. Serious pruning may be required;

4] Dead or Dying. Removal required.

Location

Another important inventory element is location. Trees can be located in public places such as street rights-of-way, public parks, and those in the gardens of public buildings. Commercial areas and private property also are home for many community trees.

Location information collected may vary depending on the type of area, from a general description in a natural area to an exact site address for a street tree. If one of the purposes of the inventory is to schedule maintenance work, addresses must be recorded in order to return to the location. Global Positioning System (GPS) equipment may be helpful for cataloging densely populated forests.

Conducting an inventory requires a certain amount of training. The areas of most concern are the ability to identify tree species and judge condition. These concerns can easily be addressed by contacting one of the sources of assistance located in the reference section of this document.

How to Use Trees in a Community Design

There are three basic concepts for planting trees in urban environments: formal, informal, and planting for wildlife habitat. These three concepts can also be combined on a site. Initially when planning a planting project, consideration should be given to the goal that is being sought by the project. Selecting the concept that is best suited for the project is important.

Formal

Formal planting emphasizes geometric patterns, a limited number of species, and uniform spacing. Typically only one species is utilized appropriately with predetermined spacing. Formal planting is generally appropriate when used with a grid or other geometric system of streets where a pattern already exists. Many of the most recognizable Main Streets in Utah are formal plantings composed of rows of a single species lining both sides of the street. Farmington and Brigham City are good examples of this concept.

This streetscape is an example of a formal planting pattern.

Informal

The informal style of planting emphasizes randomness, a large number of species and irregular spacing. It is most appropriate for large areas, where trees can provide variety and relief from the grid pattern of streets and homes, such as parks and open space. Informal planting in parking strips is appropriate if the area is large (15 feet or more). The informal effect cannot usually be achieved without a large area to plant in.

Many tree plantings on streets use an informal planting style, as shown here.

Wildlife Habitat

These plantings are designed to attract and sustain birds and animals that reside in and/or utilize urban areas. Plantings should emphasize irregular planting patterns, with diverse species, and sizes. Connected and continuous plantings should be selected over small, isolated plantings. There are many areas within a community where such plantings are appropriate, such as parks, cemeteries, golf courses and open spaces.

Deer inhabit this example of wildlife habitat.

The goal with these plantings is to create three vertical vegetation layers consisting of ground cover, shrubs and trees. By creating multiple layers, different habitat and cover types are created for a variety of animal species.

When utilizing these three planting concepts, a planting pattern is created. The city forester or shade tree commission can select the planting concept which best suits the specific area of the community the project is located in. Often times the character of the community is defined by the concept of the tree planting undertaken.

Managing Utility Placement Constraints

The placement of utilities, whether above or below ground, can create considerable constraints for tree planting and the viability of existing trees. The conflict created between utility lines and trees is possibly the most controversial tree issue. With thorough planning, some of these conflicts can be avoided or properly managed– trees can share space with utilities in park strips.

Improper tree selection around utilities can lead to poor tree health and bad pruning practices.

When planning a new development, a community has the opportunity to include trees in the planning process. Conducting a thorough project site evaluation to understand the growing conditions and other pertinent site factors, such as utilities, is the first step prior to selecting which tree species to plant. This opportunity also allows for the consideration of where utilities will be located in relation to existing trees. Separating the trees and utilities as much as possible and providing for wider planting strips can help avoid many of the conflicts between utility lines and trees.

Managing existing spaces where trees and utilities coexist requires a relationship between utility representatives and community officials to address concerns and create opportunities to proactively manage the community's urban forest.

Properly selected and pruned trees create a safe urban environment.

Development Review Process

In established areas of the community it may be difficult to have a significant impact with regard to vegetation unless ample planting space has already been provided, or the area is in a process of being rebuilt. In newer or undeveloped areas, there is a greater potential through the building review process to make decisions that will affect existing vegetation and provide for successful plantings. There are many groups that need to be involved, such as landscape architects and urban foresters, in order for the building review process to be successful. If a community does not have a landscape architect or urban forester on staff there are sources of assistance, detailed at the end of the chapter, which can be utilized during the review process. In order to incorporate the goals of the Urban Forest Plan, a site evaluation can be conducted prior to the landscape plan being accepted. This site-based review is fundamental to incorporate the benefits of the Urban Forest Plan into the growth and dynamic change experienced by most communities in Utah currently. It is for this process that a community's Urban Forest Plan is implemented.

Tree Ordinances and Requirements

Tree ordinances and requirements are tools used by communities striving to attain a healthy, safe, well-managed community forest. By themselves, tree ordinances cannot assure that the trees in and around our communities will be improved or even maintained. Tree ordinances simply provide the authorization and standards for management activities and should reflect the values of a community. If these activities are not integrated into an overall management strategy or Urban Forest Plan, problems can arise.

Many times, existing or model ordinances are used to draft an ordinance. Provisions are then taken and or modified from these ordinances that suit a particular community's situation. There are several reasons why this approach to drafting an ordinance can be problematic. The most important of these is that the resulting ordinance is often enacted in the absence of an integrated tree management strategy. Without an integrated strategy, provisions may be included which are inappropriate, or omitted. The ordinance is often seen as an end in itself, rather than one of many tools that must be used to attain a healthy, safe, well-managed community forest.

Ordinance Components

There are many components that can be incorporated in an ordinance, such as street tree, permit, landscape, and tree preservation requirements. Street Tree Requirements primarily cover the planting and removal of trees within public rights-of-way. Provisions outlining maintenance or removal of private trees that pose a hazard to the public are also often included. Landscape requirements include requirements and specifications for trees, or refer to separate documents containing this information. Tree Preservation requirements are directed at providing protection for existing trees, or trees that are historically significant.

Street Tree Spacing and Location Requirements

Trees can be classified into three different size classes based on their mature heights: small trees are those with a height of 25 feet, medium trees are those with a height of 45 feet, and large trees are those over 45 feet. Typically small trees should be spaced 20 feet apart, medium trees 35 feet and large trees 45 feet. Communities should strive to make planting strips at least 5 feet across, whenever possible, to increase tree vitality. Trees or woody plants should not be planted on the parking strip without the approval of a community official.

▶ Crime Prevention Through Environmental Design (CPTED)

■ CPTED recognizes that design and use of the physical environmental affects crime by affecting human behavior. Identifying intruders is much easier in, and criminals are deterred by, a well-defined space that delineates and reinforces ownership.

■ Criminals don't want to be seen. Placing physical features, activities, and people in ways that maximize the ability to see what's going on discourages crime.

Trees should have a canopy high enough to walk under comfortably and allow numerous sight lines to make the pedestrians feel safe.

Permits for Planting, Pruning, and Removal

A process needs to be developed to address tree problems when they are identified and allow for the tree board or urban forester to have input prior to trees being planted, pruned or removed. In many communities, a notification and permit system has been developed to deal with this issue.

A notification process addresses the nature and solution for a tree problem. When a tree problem needs to be addressed, the notification states what the problem is and that the work must be completed according to standards set by the community, subject to inspection. Penalties can be established for work that is not completed in a timely manner and does not meet community standards. A permit system is often utilized by communities to assure that informed decisions regarding the planting, pruning and removal of trees are made.

Landscape Requirements

For benefits to be achieved from an Urban Forest Plan, guidelines need to be established to avoid conflicts with other city objectives. Improperly placed trees can create conflicts and lead to damage of sidewalks, streets, curbs and utility lines. Because of these conflicts, trees often become liabilities to the community and require premature removal.

When developing landscape ordinance requirements for residential and commercial areas there are certain things which need to be taken into account: the width of the street, the size of the parking strip, location of overhead and underground utilities, clearance above street and sidewalk and any potential sign conflicts. To minimize or avoid conflicts and reduce liability, the height of a mature canopy tree bottom should be sufficient to support sidewalk and street traffic.

Tree Preservation

The goal of tree preservation ordinances is to protect native trees or trees with historical significance. They are particularly useful in communities that are experiencing rapid growth. These ordinances typically define and identify specific trees, outline permitting procedures, discuss enforcement methods, and discuss violations and penalties to be imposed.

Tree Species Selection and Planting

Tree Species Selection

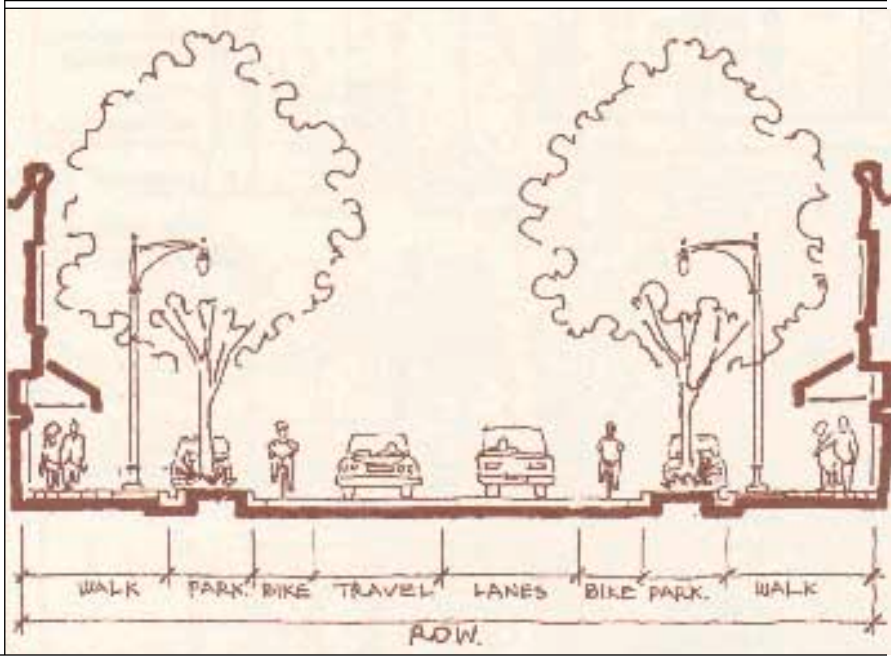
The benefits of trees are numerous but the key to these benefits is to select the right tree and plant it in the right location. The right tree in the right place not only ensures a longer life and long-term enjoyment of a tree's beauty, it also keeps maintenance costs low. A tree that is not properly matched to a site can become more of a liability than an asset. Whether planting trees along a city boulevard, in a park or around a home, the effort is worthless unless the proper tree species is selected and the tree is planted correctly.

Matching A Tree to A Site

It is very important to match tree selection to the site. Planting sites have environmental characteristics that must be considered, such as temperature extremes, soil pH, light levels and water availability. A tree should be selected to match these characteristics and thrive. In addition trees should be planted to provide a function in the landscape. For example, trees may be planted to create shade in a parking lot, screen a view, or camouflage a building. It is important to choose a tree species that is capable of growing in a location with unique environmental conditions, as well as fulfill the desired landscape functions. In many cases, it is difficult to find a tree that matches every characteristic of the site and therefore priorities must be set when selecting a tree. The light and water requirement of a tree species on site should have the highest priority. Other compromises must be made between the goals of the tree function and the limitations of the site. For example, if the shading and screening of a building is desired, a large shade tree with several smaller trees or shrubs might be planted. There are a variety of conflicts, such as overhead power lines, that might also limit the type of tree selected. In the case of the overhead power line, a tree with a maximum height of 25 feet at maturity should be selected.

When designing street environments, proper species selection is essential to meet the design goals.

Trees can be used to block the view of large buildings in the urban environment.



Improper tree selection can create numerous problems as the tree grows to full size.

Site Evaluation

It is a good idea to do a complete site analysis before a landscape plan is designed. The site evaluation will document existing site conditions that will affect the plant selection. The functional goal of the landscape can also be outlined at this time. Many site characteristics should be considered in plant/tree selection. These include:

- growing space
- light levels
- water availability
- drainage
- soil pH
- clearance requirements
- soil type
- weather
- temperature
- overhead and underground utilities

The amount of growing space available for a tree is also important. The area available above and below ground must be large enough to allow the tree to grow to its full height, branch spread and trunk diameter without interfering with its surroundings. Many trees can grow over 100 feet tall and other trees can grow wider than they are tall. Large trees have many benefits but they should never be planted beneath overhead power lines.

Shorter-growing trees or shrubs are more appropriate under overhead power lines. Trees without appropriate growing space can damage sidewalks, driveways and foundations. Knowledge of a tree's branch spread can help avoid planting it too close to buildings where siding or window damage can occur. It can also help avoid planting too close to intersections or signs, where visibility can be blocked.

Too little light or too much light or heat can cause severe problems. Some trees can develop scorched leaves. Norway maples are an example of the many species that can experience severe leaf scorch in Utah when planted on sites with inadequate water when combined with warm dry weather.

High soil pH can limit nutrient availability. Much of Utah has very alkaline (high pH) soils. The former bottom of Lake Bonneville, which at one time covered much of the Wasatch Front, has left these soils with a very high alkalinity. The high alkalinity translates to low iron availability for plants. Many tree species including Silver maple and Amur maple suffer chlorosis (yellow leaves) due to the unavailability of iron in Utah's alkaline soils.

Trees planted in poorly drained soils are subject to root diseases and poor root development. Poorly drained planting sites can cause the death of most tree species. Excess water in the root zone suffocates and kills the roots.

Drainage problems in urban landscape sites are often not recognized until after planting is complete. If a site is known to have poor drainage, drain tiles can be installed prior to planting to carry excess water away from the site. In soils where water infiltration is slow, steps can be taken to limit standing water. When irrigating plants in poorly-drained soils, slow the application rate and increase root zone aeration by drilling holes 6 to18 inches in depth, and backfilling with sand, compost, or pea gravel. It is important to choose trees that are tolerant of wet soil conditions in poorly drained areas.

Tree Species Considerations

A tree's size at maturity, the growth rate, form, hardiness, insect and disease resistance, and maintenance requirements are some of the many factors to consider during species selection. Trees that grow and mature fast often grow well on poor sites and provide shade very quickly. However, these fast-growing trees (Siberian elms, boxelder, and willow trees) often have weak, brittle wood with poor branch structure, and may break easily in storms. Fast-growing tree species are usually more susceptible to decay and other insect or disease problems.

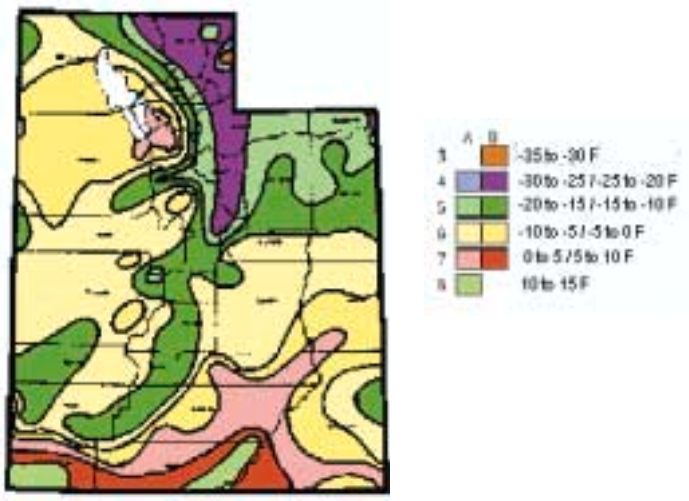
A tree's hardiness to cold weather must also be considered. Trees are listed by the lowest (coldest) zone in which they will thrive, or a range of zones in which the tree will grow. Trees planted in containers where these roots are above ground may decline in low temperatures because their roots are left unprotected.

High temperatures and dry conditions will stress many tree species. Quaking aspens, which are native to our mountains, do not do well in the warm dry climate in Utah, becoming stressed and susceptible to borers and other pests.

It is important to consider a tree's root system. Some trees have large surface roots that can damage pavement and side walks, or are difficult to mow around. Most trees can have root systems that can invade or plug broken sewer lines.

Looking at the whole picture, it is important to select a tree that is the appropriate size for the site, and that will not be stressed by the site conditions. It is also important to select trees that are more resistant to insect and disease problems.

The USDA zone hardiness map is an important tool to use when selecting trees. Trees are rated for the coolest zone they can easily survive in.



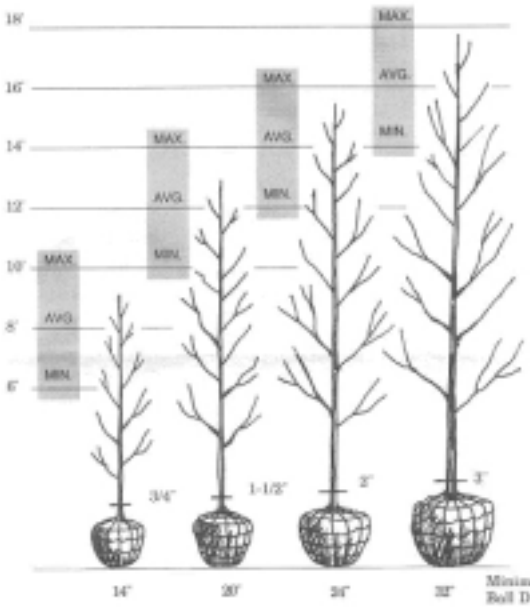
Utah State University Extension has produced a variety of publications. A key document, "Selecting and Planting Landscape Trees," includes a table with several pages that summarize a great deal of tree selection information for Utah. The Tree Selection Guide identifies cultural characteristics such as tree tolerance for poor drainage, drought, salt, alkalinity and shade as well as hardiness and transplanting ease. The guide also identifies general species characteristics such as growth rate, mature height, longevity, ability to coexist with power lines and crown shape. An online copy of this booklet can be found at the Utah State Extension website www.extension.usu.edu/publica/natrpub2.htm

Specific tree characteristics may make a tree more desirable or even unacceptable for certain locations. Exfoliating bark, flowers and fall leaf color are a few characteristics people desire in a tree. Other characteristics such as excessive leaf, fruit or twig drop may make a tree unacceptable adjacent to sidewalks, patios or parking lots.

Tree Planting

Trees can last a lifetime, so it is important for a community to spend the appropriate amount of time and money to get the very best. It is important to buy the right size and type for a specific planting need. Trees can be purchased as seedlings, potted, or balled and burlapped (B&B). A tree too small for a particular urban setting is often vandalized, reducing its chance of survival. A two-inch caliper (diameter) tree is considered the most appropriate size for planting in the urban setting. They are large enough to the reduce risk of vandalism and small enough to have a root to shoot ratio adequate for surviving planting.

How to Check Proper Size and Root Ball Proportions



To reduce transplanting shock and assure that adequate feeding roots are moved with the tree, the American Association of Nurserymen has established standards for height-diameter relationships and root ball sizes. This chart illustrates these standards for most deciduous shade trees. A more complete range of sizes may be found in *American Standard for Nursery Stock* (See page 8).

What is Caliper?

Trunk diameter on young trees is referred to as its caliper size. For standardization, this measurement is taken 6" above the ground on trees with a diameter of 4" or smaller, and 12" above the ground on larger planting stock. The diameter of larger trees is measured approximately 4 1/2 feet above ground level and is expressed as diameter breast high (DBH).

Trees are perishable products and must be treated accordingly. Reputable nursery operators know how to protect trees in shipment or while on display. When a tree is brought into the community, however, it is the community's responsibility to manage its well being. The following two rules will help keep trees alive until they can be planted in the ground.

Rule #1

Carry trees carefully when transporting. Unload gently, being careful not to break branches. Always provide support beneath balled or potted plants. Never carry or move trees by holding only the trunk.

Rule #2

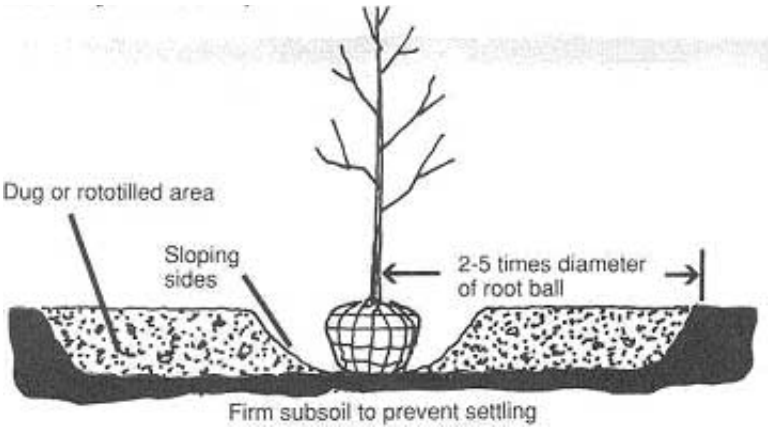
Keep the roots moist. Techniques to prevent drying vary based on type of tree and how long they must be stored prior to planting. Bare root trees should have packing material around the roots and should be stored between 30-40 degrees Fahrenheit. Balled and burlapped, or potted trees should be checked for dryness by finger length probing into the soil; sprinkle or water if necessary, then store them in a cool garage or shaded area out of the wind. Don't store trees for a prolonged period.

Don't plant a $100 tree in a $10 hole!

A properly dug and prepared hole will encourage root growth rather than adding to the difficulties already challenging the young tree. The following guidelines are based on average conditions.

Before digging, always contact Blue Stakes or your local utility offices. In most areas, the utilities offer to locate and stake underground cables and pipes at no cost.The diagramed method below recognizes the fact that most roots spread through the top 12-18" of soil laterally around the tree. Slope the side of the hole and dig or deeply roto-till an area around the hold at least twice the diameter of the ball or container. An area up to 5 times the diameter of the root ball or container is recommended if the soil is compacted, as space and aesthetics allow. Careful consideration should be given to existing trees so as not to damage their roots during this process.

Trees should be placed at the proper height to ensure continued health.



This diagram shows how large a hole needs to be dug to provide the tree with the best chance of survival.

Pots, burlap and wire baskets should be removed before backfilling the planting hole. Do not remove the burlap or wire until the tree is placed at the proper depth in the planting hole. Plant the tree at or shallower than the depth it was planted in the nursery. Define planting depth. Once the tree is set in the planting hole, cut the wire basket away from the root ball and cut and remove all burlap and rope from around the root ball and trunk. It is best to leave the burlap and wire under the root ball only if removing it will damage the root ball.

Backfill the hole with native soil unless it is clay from basement excavation or other undesirable fill material. In that case, mix in soil amendments according to instructions from a local nursery or bring in as much good topsoil as possible. Tamp gently and add water to fill large air spaces and give the tree its first watering in its new home. Be sure to water the surrounding soil area to encourage root spread.

Construction Issues

Construction affects the urban forest in many ways, and in turn the urban forest affects constructed objects, including sidewalks, streets and certain buried utilities. Though trunks and branches are the most obvious tree parts affected by and affecting construction, root systems are much more important, yet are the easiest to forget. The remainder of this section will discuss preparing sites for new tree planting after construction, protecting existing trees during construction, and the effects of trees on constructed objects.

Establishing New Trees After Construction

Allowing adequate room for a tree's trunk and crown after construction is important and easy to do. Much more critical, and more difficult, is allowing adequate room for a good root system. A tree root system is a network of fine roots that reach far out into the soil, connected to small and large woody roots that connect to the trunk.

Most roots grow laterally within 12 inches of the surface and roots can extend 2 to 3 or more times the tree's crown spread. Deeper roots are important but not very numerous.

Roots take up water and minerals from the soil and help hold the tree upright.

Fine roots only live a matter of weeks or months, but new ones are constantly being formed to replace the old ones.

To survive and grow, roots need oxygen, moisture, and a soil that is not too dense. Soil left after construction must provide these needs or roots won't survive and grow and the tree will die.

Characteristic tree root system.

To have enough roots, trees must have access to an adequate volume of well-aerated soil that's not too deep. Most of this soil should be within the top one to three feet of the ground's surface to ensure oxygen availability, but the area can have a shape from long and narrow to a square or circle. Trees need approximately 2 cubic feet of good soil per square foot of projected crown area to grow well.

If the tree's soil volume is inadequate or the soil is poor, the tree may do fine when young but eventually will be stressed or kept from reaching its full potential as it reaches the limits of its soil resources.

The soil available to the tree is most usable if it is open to the air (not paved) and is mulched. Trees can use soil under pavement but the more compact the soil, the less useful it is. Tree roots commonly access soil under and beyond sidewalks, but less commonly under streets and parking lots. Loose-laid pavers are one way to pave while allowing oxygen and water movement into the soil. Rigid pavement can be suspended over usable soil with piers or footings but such systems are expensive. Structural soils are being researched that would allow better root access under pavements while protecting pavement from cracking, but results so far are inconclusive.

Tree grates provide water and oxygen movement into the soil.

Soil on construction sites is usually left in very poor condition and requires more than a light grading to make it suitable for trees. Construction debris and chemicals should be removed from the site. The soil will almost certainly be heavily compacted so deep tillage should be done to reduce density and increase aeration. Then grading and topsoil additions can be done.

Irrigation planning is essential for most planted trees to survive in Utah. Planning for and installing an irrigation system as a site is remediated helps prevent tree roots from being disturbed later. Consider placing trees and other water-needing landscape plants in areas where runoff from pavement

Construction sites are typically not beneficial environments for trees.

▶ A Norway maple that will eventually have a 30 foot diameter crown, or a projected crown area of about 700 ft² (3.14 x 152), will need at least 1,400 ft³ of soil volume (700 x 2) to support its needs. Possible planting areas that would supply this soil volume are 26' by 26' by 2' deep, 37' by 37' by 1' deep, or 10' by 47' by 3' deep.

Trees located in wide parking or landscaping strips provide great value. They shade the surrounding pavement and beautify the open space. Trees need adequate room to support their root system. The best-designed parking strips are wide enough to support a tree that will grow to have a 2' trunk. Additional space is necessary to provide a buffer between parked cars and the tree. The ideal soil surface is not covered with turf, but with coarse bark or chip mulch or with loose laid pavers. An adequate circle opening around each tree trunk is also necessary. Curbs are necessary to keep cars away from trees and a high curb/low soil level can help keep mulch in. Including trees in the landscape design of parking lots is an ideal addition to the urban forest.

is channeled. This can supply needed water to the tree while using water that otherwise might accumulate. Tree contaminant uptake and increased microbial activity in soils with roots in them also can break down some contaminants that might be present in runoff. Selecting the proper tree for unique site requirements and situations will help insure a long and vital tree life.

If a site is very compacted or soil volume is restricted for other reasons, consider building berms to contain groups of landscape plants including trees. This can be especially useful over old parking lots and landfills. Trees in such situations can even be planted by placing them right on the undisturbed ground with a berm built up around their root ball. In such circumstances be sure to plan for and supply adequate rooting volume in the berms.

Vaults or planters used for trees rarely have adequate soil volume to sustain a tree once it gets large. This may be acceptable for some situations where a small tree is better than no tree, but planning to grow a large tree in a small-enclosed planter is a fatal decision for the tree. If a closed planting container must be used, allow for irrigation, drainage, and for oxygen to reach all parts of the soil volume. Relying on systems that require intensive maintenance like removing drain water by suction is expensive and difficult to manage.

This landscaping strip is designed wide enough to provide ample root space for trees and provide protection from traffic.

Protecting Trees During Construction

Saving a tree during construction is a difficult problem. Even though a tree may be standing when the construction is complete, this doesn't mean the tree is healthy and will continue to live. A healthy tree trunk and crown doesn't ensure a viable root system. Well-written and administered construction contracts and knowledge about trees and their root systems will increase the probability that more trees can be saved during construction on a site. The following are important steps for saving trees in construction areas:

1] Involve a knowledgeable person who cares about the trees to be saved and who understands the health and function of a tree and its root system.

- This person must be given authority in the construction process or have access to a person with authority.

- Constant oversight is needed. Trees can be lost in an hour if a trench is dug in the wrong place.

2] Assess how much the tree will

be affected by the construction; if too much of the top or root system will be lost then change construction plans or remove the tree.

- Save roots by moving trenches out from or curving them around trees. A trench 12-inches deep right next to a tree's trunk cuts off almost half of its roots.

- Avoid deep fills over root systems as they deprive the tree of necessary oxygen. Techniques are available that can save trees even when very deep fills are necessary on a construction site. These techniques can be expensive and should be targeted to saving only very valuable trees.

- Avoid heavy equipment traffic that compacts soil and kills roots.

3] Take necessary steps to identify and save valuable trees.

- Fence out portions of root systems and crowns with good fences that will be respected. Assume roots and crown outside the fence will be lost.

- Do not allow even temporary placement of supplies or equipment or any parking in the fenced area.

- Prune off parts of the crown and cleanly cut woody roots that will otherwise be torn or broken.

- Irrigate the tree regularly.

Effects of Trees on Constructed Objects

Trees can negatively affect buildings, pavement, and utilities. Trees can also impact overhead utilities. Woody roots and the base of the trunk can affect pavement thrrough cracking and heaving. The best way to prevent this is to allow for planting areas wide enough to contain the trunk base and larger woody roots near the trunk. A minimum parking strip width, for example, should be 6' to 8' to allow for root and trunk growth. This wide strip is important for large and small trees, since small trees will never get their crowns high enough to clear traffic in the street on pedestrians on the sidewalk.

Sidewalk irregularities can be mechanically ground to delay tree replacement for a few years. When damaged pavement is replaced, consider moving it farther away or curving it around the tree.

Minimize the cutting of large roots and make sure they're cut cleanly. Also minimize disturbance of the surface soil around the tree since most roots are shallow. Root barriers that are placed along the edges of pavement succeed in deflecting roots temporarily, but the roots will eventually grow under the barrier and back up toward the surface.

Trees sometimes damage buildings if planted too close. Pruning or tree removal may be necessary in such cases. Tree roots rarely damage buildings. Roots can grow into cracked foundations, but the problem is the weak foundation, not the tree.

Similarly, trees rarely damage underground utilities. Growing woody roots can pinch off or break shallow irrigation lines, but buried electric, water, gas, and sewer lines are normally too deep to be affected by roots.

In many cases not enough room is left between the tree and the sidewalk.

Roots often encounter old sewer lines and grow inside through cracks, but they can't enter sewers that are intact and they don't cause cracks. The biggest conflict between trees and buried utilities is the occasional need to excavate utilities causing tree damage or removal. Grouping utilities and placing them away from trees can minimize such conflicts.

Tree Maintenance

Watering

Trees absorb water and minerals dissolved in the water from the soil. Without sufficient soil moisture, a tree cannot absorb essential elements, photosynthesis is reduced, and tree growth is limited.

Proper watering is often referred to as the ultimate green thumb skill of horticulture. Specific recommendations for amounts of water needed vary with different environmental conditions. Frequency of irrigation depends on the species of tree, rainfall, daily temperatures, wind conditions, moisture holding capacity of the soil, evapotranspiration drainage and the stage of root system establishment.

Frequency of watering directs the type of root growth. Infrequent but deep soakings encourage production of a deeper root system and a more drought tolerant tree.

The most beneficial time to irrigate is during the early morning. Evaporation is minimized and the foliage has time to dry thoroughly during the daylight hours.

"A Tale of Two Trees."

At Planting
Family A didn't ask for planting instructions. They knew how to plant a tree. When that was done, they believed their work was done.

Actually, they were partly correct. You may receive instructions to the contrary, but little should be done to the tree at this stage. In most cases, it is best to leave all the leaf surface possible to manufacture food that will build a larger root system. It has been found that both roots and top will be larger after one year if left unpruned.

After 3-4 Years
By the time many transplants are in their new homes for 2 to 4 growing seasons, sprouts and suckers may appear. The root suckers protruding near the base sap strength from the tree. The sprouts are disproportionally vigorous and weakly attached to the tree. And look at the broken limb. By now, it has sprouted numerous branches just below the break – too many in fact.

After 5-7 Years
The baby is quickly becoming an adult. The results of not making corrections early in life are now quite visible, although some are still not obvious to the untrained eye. To the more careful observer, the form of the future crown is apparent.

15 Years After Planting
Family A's tree is now not only unattractive, but dangerous, especially when the wind is blowing. Lopsided and dense, the tree in full leaf catches the wind like a sail. Also, the narrow branch angles and multiple leaders have resulted in a weak top. The broken branch not only attracted insects, but may soon break off under the weight of too many sprouts. Decay has entered the trunk where the little bent branch tore off many years ago and a jagged stub protrudes just above it. The tree is an accident waiting to happen. It is becoming more of a liability than an asset for the property.

At Planting
Family B also planted their tree correctly, but they also noticed a broken branch and a branch that was competing with the leader: Both were pruned close to the trunk. Another, swollen from the sting of an insect laying eggs (a gall), was snipped off. Otherwise, all branches were left intact to provide maximum leaf surface to manufacture food during the first year of life in its new home.

After 3-4 Years
By now, root growth should be well on its way to anchoring the transplant and expanding to the size necessary to nourish the growing branches. Family B decides to cut off the root suckers and sprouts in the crown. Other excessive branches are thinned to reduce competition for light, water and nutrients, and a co-dominant leader is removed. A few of the lowest limbs are also removed, but others are temporarily left to help the trunk develop more taper and strength.

Growth is far enough along to reveal problems developing such as branches that rub or are growing in an undesirable direction. Narrow angles are also eliminated.

After 5-7 Years
Now is the time to make a good tree even better. Lower limbs are pruned off to "raise" the bottom of the crown well out of the way of human heads. The lowest limbs are now the permanent lowest limbs. *An important fact is recognized here. Branches do <u>not</u> move upward as a tree grows taller. The center of a branch at 5 feet will always be at 5 feet.*

Higher up, a few overzealous branches are cut back so they do not protrude beyond the graceful outline of the crown. A branch here and there is removed for more even spacing – but basically the job of sculpturing the tree is now complete.

15 Years After Planting
Family B was amazed to see their tree survive a major windstorm one summer day. While many other trees in the neighborhood suffered, split tops and broken limbs, their's stood strong and firm. Proper pruning gave strength to the branches and allowed the wind to pass harmlessly through the thinned crown. Early each spring, the tree gets scrutinized and dead or damaged limbs are cut off using proper pruning methods. Otherwise, Family B has only to enjoy the beauty and shade of their tree. And what do you know? Just before they moved recently, the real estate agent told them is was the trees in their yeard that helped sell the property so quickly

Drip irrigation can be used to reduce water waste, allowing more water to be absorbed in the soil with less evaporation. Water is applied very slowly over a longer period of time. When planning and planting for minimum irrigation, plants with similar water requirements should be grouped together and shade used wisely.

Pruning Versus Topping

Pruning is a job that needs to be done. Just like maintaining an automobile, trees must be maintained by regular pruning to ensure a long and healthy life. Forest trees grow quite well with little or no pruning, but in landscape situations, tree pruning is often necessary to remove dead branches, improve tree structure, enhance vigor, or maintain safety. Proper pruning also supports the principals of Crime Prevention through Environmental Design (CPTED).

Pruning cuts must be made with an understanding of how the tree will respond to a cut. One of the most common pruning practices, topping, is also one of the most damaging. The following are some reasons why trees should never be topped.

Starvation

Topping removes so much of the crown that it upsets an older tree's well developed crown-to-root ratio and temporarily cuts off its food-making ability. Good pruning rarely removes more than 1/4 to 1/3 of the crown, which in turn, does not seriously interfere with the ability of a tree's leafy crown to manufacture food.

Shock

A tree's crown is like an umbrella that shields much of the tree from the direct rays of the sun. By suddenly removing this protection, the remaining bark tissue is exposed and scalding may result. There may also be a dramatic effect on neighboring trees and shrubs. If these trees or shrubs thrive in shade and the shade is removed, poor health or death may result.

Insect and Disease

The large stubs of a topped tree have a difficult time forming callous. The terminal location of these cuts, as well as their large diameter, prevents the tree's chemically based natural defense system from doing its job. The stubs are highly vulnerable to insect invasion and the spores of decay fungi. If decay is already present in the limb, opening the limb will speed the spread of disease.

Weak Limbs

At best, the wood of a new limb that sprouts after a larger limb is truncated is more weakly attached than a limb that develops more normally. Rot may exist or develop at the severed end of the limb, and the weight of the sprout makes a bad situation worse.

Rapid New Growth

The goal of topping is usually to control the height and spread of a tree. Actually, it has just the opposite effect. The resulting sprouts, often called water sprouts, are far more numerous than normal new growth and elongated. The tree returns to its original height in a very short time, and with a far denser crown.

Tree Death

Some older trees are more tolerant to topping than others. Beech trees, for example, do not sprout readily after severe pruning and the reduced foliage most surely will lead to death.

Ugliness

A topped tree is a disfigured tree. Even with its re-growth it never regains the grace and character of its species. The landscape and community are robbed of a valuable asset.

Cost

To a worker with a saw, topping a tree is much easier than applying the skill and judgment of good pruning. Therefore, topping may cost less in the short run. However, the true costs of topping are hidden, including reduced property value, the expense of removal and replacement if the tree dies, the loss of other trees and shrubs if they succumb to changed light conditions, the risk of liability from weakened branches, and increased future maintenance.

Improper pruning can cause damage to a tree that will affect it for the rest of its life. No branch should be removed without reason because each cut has the potential to change the growth of a tree.

Common reasons for pruning are to remove dead branches, remove crowded or crossing limbs that may create future structural problems, eliminate hazards, and to slow growth. Trees may also be pruned to reduce wind resistance or to increase light penetration.

In most cases trimming is of a corrective or preventative nature. Pruning cuts should be made carefully, at the correct location leaving a smooth surface with no jagged edges or thorn bark. The correct anatomical location is just beyond the branch collar and branch bark ridge.

It is important to keep in mind the goal when pruning, and the street or sidewalk clearances. Consider hiring a Certified Arborist to perform tree work. The International Society of Arboriculture certifies arborists through an exam process, and requires continued training, ensuring that the arborist is knowledgeable in all areas of tree care. Work should be completed in accordance with American National Standards (ANSI) A300 Standards for "Tree Care Operations. Tree, Shrub, and other Woody Plant Maintenance-Standard Practices" (pruning).

Don't do this to trees!

Fertilization

Trees require certain essential elements to function and grow. Fertilizing a tree can increase growth, reduce susceptibility to certain diseases and pests, and can help reverse declining health. However, if the fertilizer is not applied wisely, it may not benefit the tree, and may adversely affect the tree.

Mature trees making satisfactory growth may not require fertilization. Nitrogen can unnecessarily increase growth requiring more pruning. Avoid fertilizing shade trees until late spring of the second year following planting because fertilizers can "burn" roots or stimulate crown growth faster than the roots can supply water.

Organic mulches provide some fertilization, while improving soil structure and retaining soil moisture.

Staking

Stakes and guy wires should be used only if support is necessary. Stakes can be a tripping hazard, and can weaken the tree as well.

Common problems can be avoided by keeping the following in mind when staking.

- If the main stem droops, find the best place for support ties by moving your hands up the trunk to locate the point above which the top can stand up on its own, place the support ties about 6" above that point.
- Use at least 2 ties to minimize the chance of bark damage from rubbing.
- Allow slack when staking and guying to allow the top to sway.
- Avoid driving stakes into the root ball, or using stakes with flanges that will break roots when removed.
- Remove support ties after 1 or 2 years.

Mulch

Mulch is a young tree's best friend. It holds down competing weeds or grass, retains soil moisture, prevents soil cracking that can damage new roots, protects the trunk from lawnmower damage, and helps prevent soil compaction. Organic mulches such as wood chips or bark mulch can also contribute to better soil structure and aeration as they decompose.

While the complete removal of grass in areas around trees is sometimes impractical, as much area as possible in the drip line of the tree should be covered with mulch. Avoid limestone rock and allow no mulch to touch the tree's trunk or to be piled higher than 6 inches around the trunk.

The proper use of mulch around trees is very important.

Plant Health Care

Today plant and tree management needs to focus on keeping the tree in good health. Plant Health Care (PHC) is a holistic approach to maintaining trees and landscape plants in good health. It combines cultural, biological and chemical strategies. The focus is on the plant rather than the pests.

Tree health problems are usually the result of many stress factors. While pesticides play an important role in plant health management, they also have limitations. Integrated Pest Management (IPM) is a systematic approach to insect and disease management. It includes a combination of techniques including the use of resistant plants and cultural controls of plant pest problems. The goal is to maintain tree health while minimizing the adverse ecological impact of the controls.

Trees greatly enhance Utah's urban environment!

Conclusion

Trees are a valuable addition to any community. When properly and successfully established and managed, the urban forest provides a significant range and quantity of benefits. Communities see an increased quality of life, a defining sense of place, economic advantages, reduced road maintenance, energy savings, improved air and water quality, enhanced personal health of the community residents, reduced noise pollution, increased traffic calming, enriched wildlife habitats, bioremediation, and friendly environments for pedestrians to wander.

Capturing some or all of these benefits requires a diligence and commitment to the well being of a community's urban forest.

The state of Utah is fortunate to have many groups that can provide assistance in creating a healthy urban forest.

Sources of Assistance

Many agencies and organizations are available to help cities and towns plan for and implement urban forestry programs. The list below describes some of these sources and how they can help you.

Agency/Organization

Utah Division of Forestry, Fire & State Lands (UDFFSL)

Description: UDFFSL is a state agency that provides direct technical urban forestry assistance to communities. The Utah Community Forester (Brook Lee) provides consultation to communities on how to develop their urban forestry program and runs the Tree City USA recognition program (see above). The Urban Forestry Coordinator (Tony Dietz) makes grants available for community forestry development, tree planting, and outdoor classroom development. The coordinator also coordinates the Arbor Day poster contest with elementary schools.

Types of Assistance: Technical assistance to communities, grants, Tree City USA, Arbor Day poster contest.

Contact Persons: Brook Lee, Utah Community Forester; Tony Dietz, Urban Forestry Coordinator

Address: Utah Division of Forestry, Fire & State Lands, P.O. Box 145703, SLC, UT 84114-5703

Phone: (801) 538-5456 (Brook Lee) or (801) 538-5505 (Tony Dietz)

E-mail: nrslf.blee@state.ut.us or nrslf.tdietz@state.ut.us

Web Address: www.nr.utah.gov/slf/slfhome.htm

Agency/Organization

Utah State University Extension

Description: USU Extension is dedicated to extending the resources and knowledge of USU to Utahns. A Forestry Extension Specialist is based at USU (Dr. Mike Kuhns), who works with county-based Extension Agents and others to carry out forestry Extension educational programs across the state. Educational programs and materials are available on urban forestry programs, tree selection and maintenance, and urban forest management at the wildland-urban interface.

Types of Assistance: Educational programs and materials.

Contact Persons: Mikel Kuhns, Extension Forestry Specialist; County Extension Agents

Address: 5215 Old Main Hill, Utah State University, Logan, UT 84322-5215

Phone: (435) 797-4056 (Mike Kuhns) or your County Extension office

E-mail: mikek@cnr.usu.edu (for the Forestry Extension program)

Web Address: extension.usu.edu/natres/forests

Agency/Organization

National Arbor Day Foundation (NADF)

Description: NADF is an international non-profit organization that helps people plant and care for trees in many ways. They promote Arbor Day worldwide, encourage good urban forestry programs through the Tree City USA recognition program, increase the quality of utility forestry through the Tree Line USA recognition program, and educate communities and people about urban forestry programs and tree care. Tree City USA in Utah is coordinated through the Utah Division of Forestry, Fire & State Lands.

Types of Assistance: Educational programs and materials, community and utility recognition (Tree City USA, Tree Line USA), Arbor Day promotion.

Address: National Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE 68410

Phone: (402) 474-5655

E-mail: info@arborday.org

Web Address: www.arborday.org

Agency/Organization

TreeLink

Description: TreeLink is a comprehensive website about urban & community forestry. With over 15,000 links, viewers can link to local organizations, government agencies, academic institutions and national groups whose mission involves trees and tree care.

Types of Assistance: Education, networking, promotion.

Phone: (801) 359-1933

E-mail: info@treelink.org

Web Address: www.treelink.org

Agency/Organization

TreeUtah

Description: TreeUtah is a non-profit organization dedicated to improving Utah's quality of life by enhancing the environment through tree planting, stewardship and education. They organize tree-planting projects, provide community grants, and can work with and train local volunteer tree planting groups.

Types of Assistance: Tree planting, volunteer organization and motivation, grants.

Address: TreeUtah, 511 W 200 South Suite 150, SLC, UT 84101

Phone: (801) 364-2122

E-mail: treeutah@treeutah.org

Web Address: www.treelink.org/treeutah

Agency/Organization

Utah Community Forest Council (UCFC) and Utah Chapter ISA

Description: UCFC is a non-profit organization that promotes urban and community forestry in Utah by providing training opportunities for professional tree care providers and lay people. It distributes educational materials, produces a newsletter, sponsors educational events, and keeps registers of certified arborists and of tree appraisers. The International Society of Arboriculture encourages proper tree care throughout the world through its promotion of the science and practice of arboriculture and through its Arborist Certification program. The Utah ISA Chapter carries ISA programs out in Utah in conjunction with the UCFC.

Types of Assistance: Educational materials and programs, newsletters, tree care and urban forestry training and promotion, arboriculture assistance and arborist certification.

Address: Utah Community Forest Council, P.O. Box 961, SLC, UT 84110-0961

E-mail: rrpickettus@yahoo.com

Additional Reading

Tree Pruning: A Worldwide Photo Guide
By Dr. Alex L. Shigo
Published by Shigo and Trees, Associates
Durham, New Hampshire 03824
ISBN 0-943563-08-9

Principles and Practice of Planting Trees and Shrubs
By Dr. Gary W. Watson and Dr. E.B. Himelick
Published by the International Society of Arboriculture
Savoy, Illinois 61874
ISBN 1-881956-18-0

Trees and Development A Technical Guide to Preservation of Trees During Land Development
By Nelda Matheny and Dr. James R. Clark
Published by the International Society of Arboriculture
ISBN 1-881956-20-2

Urban and Community Forestry, A Guide for the Interior Western United States
Gordon L. Younker, Editor
Published by the USDA Forest Service, Intermountain Region, 1990
Available from the Utah Community Forest Council (see above).

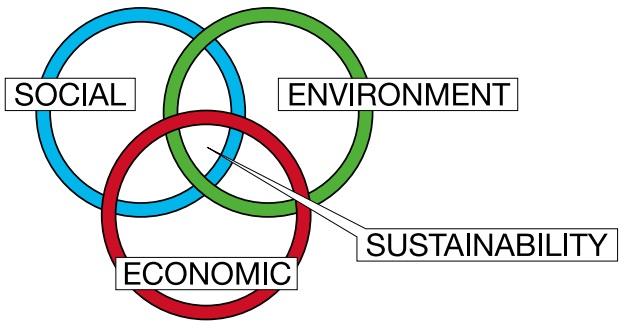
Trees of Utah and the Intermountain West
By Michael Kuhns
Published by Utah State University Press, Logan, UT 84322-7800
ISBN 0-87421-244-8

7 Energy Efficiency

Communities Planning for Energy Efficiency

Governor's Proclamation
Governor Leavitt stated: "It is in our economic and personal financial interest to cultivate an ethic of conservation and energy efficiency."

In times of concern, citizens look to strong and well-informed leadership for solutions and ideas. Officials in government and in energy related fields have worked hard to create political, economic and social solutions to the recent energy problems experienced in the West. The primary goal of this chapter is to provide local government, community planners, and concerned citizens with concepts designed to integrate energy efficiency strategies into communities. These strategies, if implemented, help reduce energy consumption and energy related infrastructure costs, as well as increase reliable energy supplies and economic and resource sustainability.



Benefits of Sustainable Energy Communities

The United Nations in 1987 defined sustainable development as "...(meeting) the needs of the present without compromising the ability of future generations to meet their own needs." Economic, environmental, and social factors are three interconnected elements of sustainability. To gain maximum sustainable benefits from these three elements, a sustainable community works to bring them into balance.

Sustainable communities work to bring these three factors into balance.
(UEO)

Consider the three fundamental factors of sustainability as individual rings that overlap. A skewed ring means the other two no longer overlap equally and the entire system is off balance. For instance, a skewed economic "ring" causes the social and environmental "rings" to become imbalanced. This imbalance promotes isolation, which does not sustain the three "rings" to work efficiently and respectfully toward a sustainable community.

Incorporating energy efficiency into community planning is a major step towards community sustainability. Although energy is an integral part of our everyday life, attaining energy sustainability is a way of life. Energy sustainability is a dynamic process that supports change and encourages new ways of thinking.

Economic Benefits

Sustainable energy strategies benefit a community because they save money. For example, sustainable community designs typically plan for narrower and shorter streets, shorter utility corridors, and fewer streetlights and traffic signals than traditionally developed areas. This type of urban design can result in less money spent and energy consumed for construction materials and follow-up maintenance. These communities then have the option to spend energy savings on parks and civic centers that contribute to a healthy and social lifestyle.

Additional economic benefits of an energy efficient and sustainable community, in comparison to more traditional urban designs, may include the following:

- Increased savings on air emissions control systems and maintenance because of reduced energy production.
- More money retained within the community because of decreased purchases for power on the open market, especially during peak energy demands.
- Increased workforce because of energy-savings revenue reinvested in community and economic development.
- Greater opportunities for start-up and relocating high tech firms because of utilized alternative energy resources.
- More disposable dollars for education because less money is spent to heat and power schools.
- Increased eligibility for affordable housing because of decreased spending for energy utilities and transportation services.
- Increased discretionary income because of decreased spending for energy utilities.

These financial gains can increase the quality of life for the community and boost local economies. All of these possible economic benefits are dependent on many factors and not solely on energy sustainability. A sustainable energy community has a greater potential to experience these benefits compared to traditional communities because they can fund improvements from their own energy savings.

Environmental Benefits

Energy efficient communities inherently generate less air polluting particulates and gases than energy inefficient communities. Cleaner air is a result because energy sustainable communities provide more opportunities to walk and use alternative transportation methods. Furthermore, these communities use less energy per capita for cooling and heating compared to energy inefficient communities.

Informational programs, such as the Utah Department of Environmental Quality (DEQ) alert program may further reduce concentrations of air pollutants. DEQ monitors air quality around the state and provides Utah citizens with daily air particulates and gaseous concentrations as well as advisory warnings. On occasion, locations in Utah, particularly along the Wasatch Front, exceed federally mandated air quality standards. The major sources of air pollution during the summer are from vehicle and industrial emissions, and other area sources associated with urban living. The major sources in the winter are from vehicle and industrial emissions, and smoke and gases from woodburning stoves and fireplaces. Wintertime temperature inversions exacerbate the concentration of these air pollutants. DEQ prohibits the burning of wood or coal on winter days in counties that register high in air particulates. DEQ also recommends driving less on any day in counties that register high.

The benefits of reduced vehicle emissions and fossil fuel air-borne pollutants by a single community in Utah not only affect the quality of life at the local level, but also at regional and global levels. Economic burdens related to health care of a local community decrease by reducing air quality related illnesses. The quality of life at the regional level improves by helping to protect view sheds near national landmarks, such as Zion National Park. The wellness of our

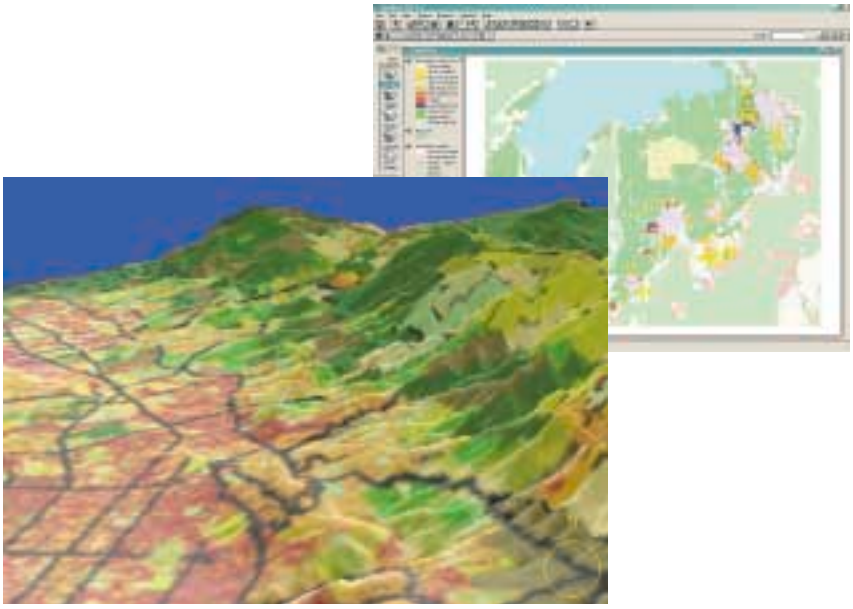
Salt Lake Valley on a clear day and on a summertime smoggy day.
(UEO/Nan Weber)

Computer modeling programs that use Geographic Information Systems can quantify the "ecological value" of various parcels of land. These programs use data to quantify and compare the energy and environmental impacts arising from different types of development. Assigning comparative ecological values to the actual costs of the different development plans could help steer development into the least sensitive parcels.

global economy and environment also improves by reducing Utah's contribution to the global greenhouse gases.

Social Benefits

Moving towards a sustainable energy community may boost social benefits. Traditional urban and suburban land-use patterns often create communities where citizens may feel detached with less sense of community. Communities that reflect the principles of energy sustainability benefit by: more citizen involvement in community affairs, increased interaction between citizens and neighborhoods, and a greater sense of community and social cohesion. These benefits occur because the recommended process for adopting and incorporating sustainable energy components in a community energy plan is citizen based. Community members willingly contribute ideas and support for community energy planning, which strengthens community continuity and spirit.



Three-D imagery and environmental modeling.
(EU/AGRC)

Steps to Draft an Energy Plan

Fundamental steps on assembling an energy advisory committee to present concepts of energy efficiency to the community and on creating a task force to draft an energy plan are below. These steps can be followed for creating community vision and planning energy efficiency into policies that can be carried out for individual projects such as new community developments, commercial buildings, housing projects, and transportation. The Department of Energy's Center of Excellence for Sustainable Development and the Rocky Mountain Institute offer more detailed information and instructional workbooks about planning energy town meetings and drafting energy plans.

Assemble an Energy Advisory Committee and Hold a Town Meeting

Step One: Assemble an energy advisory committee.
The committee develops an overview of issues and recommendations with respect to community energy-use patterns and transportation. The committee also plans an energy town meeting.

A mayor, county commission, or a well-known energy champion may assemble the energy advisory committee. The person or group that organizes the advisory committee invites a diverse group of people familiar with energy sustainability and sustainable development. The committee may include representatives from economic and community development departments, state and local governments, municipal planning officials, architect and engineering firms, educational institutions, environmental and civic organizations, the media, and energy officials.

Step Two: Invite the community to energy town meetings. The energy advisory committee presents the overview and creates vision at the energy town meeting. The committee also directs discussions to other energy-related matters such as the following:

- General plans of any proposed developments.
- Approximate physical boundaries of developments.
- Likely financial, political, and social barriers to increasing energy efficiency.
- Current municipal ordinances and actions for energy efficiency.
- Present energy supplies and consumption by the community.
- Potential incentives to include energy sustainability strategies into projects.
- Possible energy efficiency strategies for the community.
- Potential alternative energy resources available to the community.

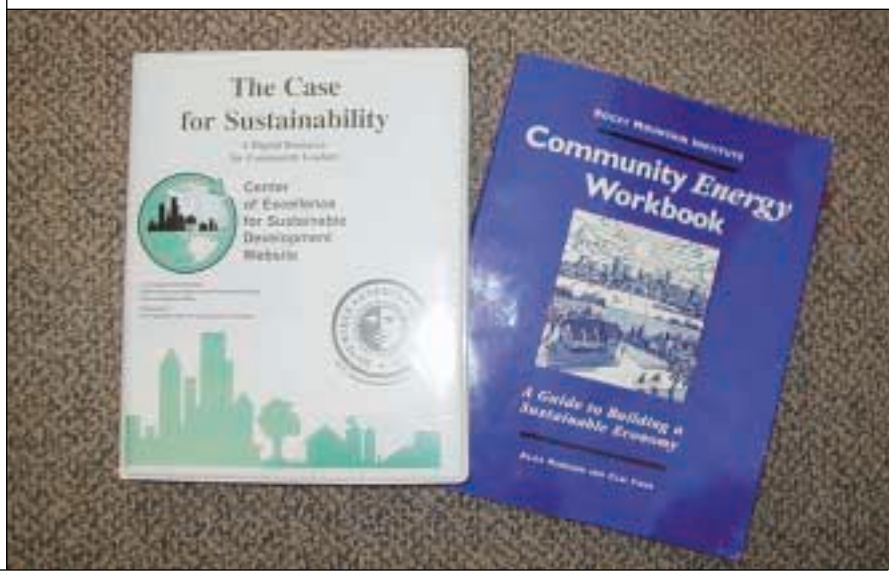
Community members discuss the effects of these energy-related matters on the sustainability of their local economy, environment, and energy-use patterns.

The committee introduces a plan to develop an energy task force to help guide the community towards energy sustainability.

The group provides suggestions of individuals or groups to serve on the energy task force as well as possible energy champions with administrative skills to lead the task force.

Department of Energy's Center of Excellence for Sustainable Development: A Digital Resource for Community Leaders

Rocky Mountain Institute Community Energy Workbook: A Guide to Building a Sustainable Economy
(UEO)



Assemble an Energy Task Force and Draft an Energy Plan

Step Three: Assemble an energy task force (ETF). The ETF should consist of involved members from the advisory committee along with representatives from construction firms, financial corporations, utility companies, transportation groups, building facility-management teams, and energy trade businesses. The ETF should also have members that lead the plan expeditiously through the political, planning, and implementing phases.

Step Four: Define the Scope of Work of the Energy Task Force. Energy-related concepts and strategies to include in the energy plan are provided in the section titled "The Energy Plan."

The ETF constructs a comprehensive and strategic energy plan. The plan should contain technical information that is current and dependable. Projects in the plan should include energy efficiency strategies and time-lines that are flexible and attainable. The energy plan can have breadth and cutting edge ideas and strategies by researching current case studies that demonstrate sustainable energy communities. Useful case study data includes the project goals, procedures, successes, and setbacks. Another way to identify possible sustainable energy strategies for the plan is to visit proposed project sites.

The ETF coordinates with different partners and stakeholders to draft the energy plan, details the respective goals of the participant groups, and identifies specific energy efficiency strategies that contribute to those goals. The ETF makes sure the plan offers alternative strategies, especially for major components of potential projects. These alternatives provide decision-makers with the opportunity to select the best strategies for implementing a community vision into any future development.

The ETF should present objectives of proposed projects as they relate to the energy plan to different levels of government. This presentation helps prevent uninformed decisions about the projects that would compromise implementation of energy effici-ency strategies. An executive summary of the energy plan as well as other pertinent information and special requests is an efficient way to inform officials.

Implementing the energy plan requires the support and collaboration of those involved in the project including planners, developers, financiers, and realtors. It is essential that planners, developers, builders, and project managers possess the skills and techniques required for planning, developing, or building for energy efficiency. These building-related groups must also appreciate the benefits of energy efficiency strategies, remain current on new technologies and actual costs of energy efficient products, learn about possible financial incentives for energy and location efficiency strategies, and

support change for outdated energy-related policy. For financiers and realtors, it is essential that they publicize and market energy efficiency mortgages, understand energy and location efficiency home mortgages, and sell commercial and residential buildings based on energy efficient features.

The Energy Plan: Components and Strategies

Each section below provides information and examples to stimulate innovative thinking about community energy planning. The sections also provide general information on policy, financial support, and education programs as well as the status on Utah building codes and energy efficiency technology. There are also a number of energy efficiency strategies included that may be evaluated for individual project applicability.

The energy plan should contain an energy status overview that describes energy-related matters in the community and tallies the estimated total energy consumed by a community. The following checklist identifies essential data to collect:

Energy Status Overview Checklist

1. Demographics
2. Transportation routes
3. Energy resources: traditional and alternative
4. Utility companies
   a. Present power company fuel sources, e.g., coal, hydro, nuclear, wind, solar, geothermal.
   b. Present power generation facilities, natural gas extraction sites, and transportation fuel and distribution centers.
5. Estimated total energy consumed = Sectors (in Btu) + Transportation (in Btu)

The following information details essential data to collect:

a. Sector energy consumed in Btu: Gather the data requested below to estimate total community energy consumed by the residential, commercial, and industrial sectors. To facilitate this step, it may be easier and more organized to prepare a spreadsheet for the data. Energy suppliers can provide the data requested below.

i. Input total amounts of all the different types of energy sold in conventional energy units (kilowatts and kilowatt-hours, therms, and other units of energy). Convert the conventional units to millions of Btu for ease of comparison among the different types of energy consumed.

ii. Input total amounts of all the different types of energy sold in dollars.

b. Transportation energy consumed in Btu: Gather the data requested and use the spreadsheet below to estimate total community energy consumed

▶ ENERGY PLAN OUTLINE

Separate the outline of the energy plan into major components. Each component should provide energy-related strategies, programs, and information. Major components may include the following:

Executive Summary
Town Meeting Results:
Community Energy Goals and Vision for Projects
Overview of the Energy Status
Energy Policy Recommendations
Financial Support Possibilities
Education Plans
Energy Efficient Strategies
Communities and Neighborhoods
Commercial Buildings
Residential Buildings
Transportation
Alternative Energy Opportunities
Follow-up and Analysis Measures
References and Resources [R/R]

EXECUTIVE SUMMARY OUTLINE

List of task force members

Overall objectives for community development

Energy efficiency strategies for development

Economic, environmental, and social benefits of the energy efficiency strategies

Correct and pertinent information about current energy matters

Details of the proposed support needed from individual resources

Possible resources may come from government, private, and nonprofit groups. The services these groups offer may include financial assistance to implement energy efficiency strategies and information on energy technology, policy, regulations, and permits.

by transportation.

i. Number of vehicles registered
ii. Average annual price of gasoline
iii. Location of vehicle fuel stations in relation to distribution center
iv. Average annual gallons of gasoline consumed per vehicle

c. Estimated total energy consumed = Sectors (in Btu) + Transportation (in Btu)

Total the amount of residential, commercial, industrial and transportation energy consumed in millions of Btu and dollars for the community. The total provides the estimated quantity and cost of energy consumed. The data is useful to help identify the effects of energy consumption on community economics and the environment. The task force can also use the data to prioritize energy efficiency strategies for achieving the greatest economic and environmental gains as well as to forecast future energy matters.

_____ Estimated number of local vehicles	x	1148 Average annual gallons per vehicle (estimate 2000 value for Utah)	=	_____ Total gallons consumed
_____ Total gallons consumed	x	_____ Average local price per gallon	=	_____ Annual transportation fuel bill
_____ Total gallons consumed	÷	42 (number of gallons in one barrel)	=	_____ Barrels of oil
_____ Total gallons consumed	x	125,071 Btu per gallon of gasoline (138,691 Btu per gallon of diesel)	=	_____ Transportation Btu

Spreadsheet to calculate the average annual transportation energy consumed. This spreadsheet was adapted from Hubbard A and Fong C 1995, The Community Energy Workbook, Rocky Mountain Institute, Pg 59.

Energy Policy Recommendations

Government Policy and Energy Efficiency

Utah communities can join the nation's leaders in sustainability by implementing progressive zoning and building energy codes.

Communities can incorporate into the energy plan, local codes that are more progressive than the State's energy codes.

Communities can suggest that local government and bordering school districts or individual schools also follow similar progressive codes.

The U.S. National Renewable Energy Laboratory (NREL) recommends that buildings can be built at least 50% more energy efficient than existing code allows, with little or no increase in the cost, by using better design and construction. Salt Lake City is one Utah community that is committed to making change towards sustainability. Salt Lake City's High Performance Building (HPB) taskforce is drafting policy intended to increase building energy efficiency and resource sustainability (See R/R). The HPB taskforce is referring to the concepts recommended by the Leadership in Energy and Environmental Design (LEED) program of the U.S. Green Building Council to draft the new policy.

Energy sustainability in Utah communities can increase by recommending, in the energy plan, flexible building permits and regulations designed to allow speedy inclusion for newly developed energy efficient technology. Many times policies are outdated and hinder implementation of innovative energy efficiency strategies. For example, one of the construction requirements of LEED is to recycle construction waste. Salt Lake City's adoption of the proposed HPB plan, therefore, creates a challenge because Salt Lake City does not have the appropriate recycling center. Supportive city officials of the HPB plan, therefore, are recommending a permit for a new recycling plant in Salt Lake City. Changing regulations and streamlining the permit process lifts the recycling barrier that could hinder the implementation of the innovative HPB plan.

One of the leading challenges to increasing energy sustainability in Utah is the actual enforcement of energy codes by the local enforcement agencies. One way to ensure energy codes are enforced, is to heighten awareness and understanding of the codes. The state of Utah currently provides education programs on local codes to code officials and the building community (see R/R).

An energy plan may include recommendations for local government to fund an energy code enforcement staff. Many cities in Utah established energy specialist positions following the 1970's energy crisis. These positions, since then, have slowly vanished.

▶ Utah state government improved the energy building codes by replacing the ASHRAE 90.1 Version 1989 commercial building energy codes with the Version 1999. The State has also committed to increasing energy efficiency by achieving an additional 25% above the ASHRAE standards in all state buildings. The Division of Facilities and Construction expects to save at least $0.25 per square foot per year out of the operating budget of each new state building. For residential buildings, the state of Utah has replaced the 1995 Model Energy Code with the 2002 International Energy Conservation Construction Code. The State's new building standards went into effect in January 2002. This helps ensure that new construction and major renovation projects include updated technologies for energy efficiency (see R/R).

Policy can limit subsidized sprawl by charging fees and taxes only to those who use the service(s). A community in Florida, for example, showed that sewer hookup to outlying subdivisions cost about $7,000 more than hookup fees for the adjacent city-center. Residents in the outlying area and adjacent city, however, were all charged $6,000 for connections (Longman 1998). In terms of economics, this fee meant that the people in the city were subsidizing growth to the outlying areas. In terms of the environment, this development pattern meant that land-use was not linked to energy sustainability.

For Utah cities to reinstate these positions, funding would need to be identified. Portland, Oregon, overcame a similar financial limitation by implementing a fee program administered to certain city government departments. These departments are charged 1% of their annual energy costs. The fee, however, can not exceed $15,000. The city invests this money for an energy manager to run a program to increase energy efficiency in Portland. Another benefit that arose from the Portland program is, departments that consume less energy contribute less to the pool that funds the energy program. For energy sustainability, Portland's solution was a win-win situation.

Other innovative policies to include in an energy plan relate to user fees, alternative energy production, and regional cooperation. A community can implement user fee programs for infrastructure to encourage consumers to balance their needs with the real costs of services. These fees can decrease demand by consumers, which leads to energy and cost savings for construction materials and daily operations. Another way to increase energy sustainability is to recommend local and state agencies purchase alternative energy in amounts equal to no less than a certain percent of total energy consumed. For example, a midwest city will purchase at least 20% of their total energy needs for streetlights, subways, and public buildings, in alternative energy sources. Energy sustainability can also be addressed regionally.

Neighboring communities can endorse similar, up-to-date energy efficiency standards. These standards may prevent project managers from selecting development sites in communities with the lowest energy building standards. Another interlocal agreement to endorse is to share growth-driven revenues between one city that encourages development and another that protects open space.

Utility Policy and Energy Efficiency

In the state of Utah, the Utah Public Service Commission (PSC) regulates privately owned utilities. The primary responsibility of PSC is to ensure safe, reliable, adequate, and reasonably priced utility service. The PSC has supported energy sustainability by allowing utilities to sell alternative energy supplies and energy efficiency strategies. The PSC does not regulate municipal utility companies. An energy plan, therefore, may include suggestions for elected officials of the local municipality to draft regulations for publicly owned utility companies similar to those implemented by the PSC. There are groups that provide answers to questions on policy for energy efficiency.

One local example of how regulation supports a utility company to sell alternative energy is Utah Power's Blue Sky℠ program. This program is a partnership between Utah Power and its consumers. Blue Sky℠ gives customers a choice in how their energy is produced. The program also gives consumers an opportunity to help increase the demand for renewable energy resources. Some consumers ask why Utah Power requests customer help to provide wind power? As a regulated utility, Utah Power is required to provide customers the least cost power available. On average, power from coal and natural gas is currently less expensive than renewable power. Through programs, such as Blue Sky℠, customers pay for the incremental difference between market cost energy and wind power, and associated costs for customer education.

Participation in Blue Sky℠ has been so great that last year, Utah Power purchased an additional three megawatts of wind energy from the Wyoming Wind Energy Project, located near Rawlins, Wyoming. This addition will produce enough clean energy for more than 1,550 average homes in the West. Since Blue Sky's launch in 2000, through December 2001, 2,849 Utah Power customers have signed up for Blue Sky energy. The purchase of 452,100 kilowatt-hours of new wind energy each month offsets approximately 3,796 tons of greenhouse gases per year. This offset has the same environmental benefit of not driving 8,136,000 miles or planting approximately 1,537 acres of trees. Customers' involvement directly helps increase the percentage of wind power on the grid system, provides environmentally friendly power generating sources and builds sustainable economies.

Financial Support Possibilities

Financial budgets of a community are one of the primary limitations to writing and implementing a community energy plan. The actual strategizing and writing of an energy plan may require commitment in time and resources. Implementing the energy efficiency strategies into projects may not necessitate financial expenditures or may require substantial financial support. Below are recommendations for possible financial support to include in the energy plan.

Financial support is available through many different organizations including agencies from state government. The Utah Energy Office, for example, helps public and private organizations by providing technical information and financial assistance, which is primarily met with partnerships brokered by the Utah Energy Office. The Utah Energy Office helped the University of Utah secure technical expertise, as well as helped secure $44 million in private sector funding, for an energy-related project. The University's project-derived energy savings helps pay

Wind farm in Wyoming.

for the private sector financing. As funding allows, the Utah Energy Office also provides no interest loans for state and local governments and school districts. Other low interest loans are available for public and private fleet purchase of alternative fuel vehicles. The Office also administers a renewable tax credit available for homeowners and businesses. When federal energy grants are available, the Utah Energy Office issues announcements through the local media and assists eligible applicants with their proposals.

Another state agency that provides energy funding assistance is the Utah Division of Community Development. This agency administers the low-income Weatherization Assistance and HEAT programs (see residential section below). The agency also provides funding for municipal energy projects through the Community Impact Fund and Community Development Block Grant program.

The Quality Growth Commission is one more example of a state entity that offers financial incentives. The Commission has two programs to help local communities' fund energy efficient growth. First is the planning grant program that is available annually to communities for quality growth planning. Projects funded vary by community, but they include regional open space and infrastructure plans, downtown revitalization plans, and walkable communities and transit oriented development plans. The commission also administers the Leray McAllister Critical Lands Conservation Fund. This fund is available to help local communities preserve or restore lands that are critical to their quality of life. Many of these projects include trails and other amenities including the Kays Creek Corridor project in Layton, the Dry Creek Restoration Project in Sandy, and the Jordan River Restoration Project in West Jordan. Preserving and restoring stream corridors helps reduce ambient air temperatures of surrounding areas, which then reduces energy consumption for summertime cooling. These corridors also provide transportation alternatives and walkable recreation options.

Many other state governments have adopted substantial incentive opportunities to help reduce energy consumption. The California Energy Commission, for example, approved a two million dollar Cool Communities Contract that is disbursed to contractors that retrofit roofs with reflective coating materials. The California Cool Communities campaign seeks to save a total of 200 megawatts during peak hours by providing incentives that average 10 cents per square foot of qualifying roofs. This incentive not only stimulates the economy, but also saves enough energy to light 1,000 average sized California homes.

There are conventional mortgage programs available that target energy and location efficiency. The energy plan could recommend these programs for business

and community members. Communities working with financial partners can make a number of financing options available to homebuyers interested in purchasing a home that is energy efficient, a home that would benefit from energy efficiency improvements, or a home located near public transportation. Additional financing options are available to homeowners who are refinancing their energy efficient home, refinancing to make their home energy efficient, or financing home improvement projects that increase energy efficiency, durability, and value (See R/R for more information).

Mortgage financiers, such as Ogden City, have energy efficiency mortgage packages that offer potential buyers greater purchasing power compared to conventional mortgage products. The power is "earned" from the savings predicted for energy efficient homes or from other financial incentives, such as down payment or closing cost assistance and an interest buy down.

The Wasatch Front is now among five nationwide communities participating in a location efficiency mortgage experiment. The Fannie Mae Utah State Partnership Office and Utah Transit Authority have begun work on an innovative "Smart Commute" program. This program will recognize home buyer savings resulting from the purchase of a home located in a densely populated community served by efficient public transportation, such as commuter rail, light rail, and bus services. The "Smart Commute" program is among a few homeownership initiatives to link housing with public transportation.

- **Additional financial support for planning and implementing an energy plan may come from the following:**
  - **Federal government: U.S. Department of Energy's Rebuild America program partners with the Utah Energy Office and interested communities to provide small grants and technical support to communities that plan to 'rebuild' sections of towns or renovate individual buildings.**
  - **State government: The Utah Division of Air Quality provides information on opportunities to finance energy efficiency and other sustainable energy programs through emissions trading. With emissions trading, business and industry offset air pollutants resulting from consumption of fossil fuels by funding energy efficiency and other strategies that reduce pollutants elsewhere in the community. See R/R for more information.**
  - **Utilities: Utilities often offer zero or low interest loans, rebates, and technical assistance.**
    - **Utah Power's FinAnswer™ program offers expert advice and cash incentives to help upgrade commercial or industrial heating, cooling, refrigeration, compressed air, lighting, pumping or industrial processes to the most energy efficient system available.**
    - **Questar Energy Services offers energy efficient products and services including financing and energy audits as well as emerging energy technology such as fuel cell, micro turbines and combined heat and power systems.**
  - **Nonprofit organizations: Many nonprofit organizations help community efforts in understanding the relationship between energy and development.**

- **Other successful partnerships include joint ventures between different government, private, and nonprofit groups and our children. These programs provide information about energy efficiency to our youth. The energy plan could include suggestions for partnerships between schools and any of the groups below:**
  - **Government**

    Kool Kids Program - Utah Energy Office

    K-12 Schools Program – Utah Energy Office

    Rebuild America's Energy Smart Schools – Department Of Energy (DOE)
  - **Public Utilities**

    Kid Power Program – Murray City Power

    Energy Education Program – Utah Municipal Power Agency
  - **Private Utilities**

    Rain Forest Van – Utah Power

    Do the Bright Thing – Utah Power and National Energy Foundation (NEF)
  - **Nonprofit**

    Utah LivingWise™ Program – NEF

    Academy of Energy Education – NEF

    Jordan School District Energy Action In Schools™ Program – NEF

    Salt Lake Clean Cities Coalition Education Outreach Program – NEF

    Utah's On-line Environmental Education Database – Utah Society for Environmental Education.

The energy plan could also include proposed support for schoolteachers who include energy efficiency in their curricula.

Education Plans

Education is essential to incorporate energy efficiency strategies into people's way of life. People provided with facts on energy sustainability have a better understanding of energy-related issues and are more likely to become part of the solution. The energy plan could include recommendations for education-related programs for the community. Workshops and conferences are probably the most direct path to inform significant numbers of people about energy concerns. Within the state of Utah, there is a wide range of instructional programs and workshops on energy-related matters. The goals of these programs and workshops range from providing technical assistance to professionals in the energy field to increasing public awareness on energy efficiency strategies. Government agencies, private corporations, nonprofit organizations, and educational institutions offer energy-related programs and workshops. News releases, newsletters, and websites offer listings of upcoming programs and workshops.

Often, greater numbers of people receive information if groups with

similar energy-related goals establish partnerships. The energy plan could include recommendations for education-based partnerships among groups within in the community. The Power Forward pro-

gram, for example, is a partnership between state government and private energy officials as well as media spokespersons. Their effort informs consumers, daily throughout the cooling season, to practice moderate (green day), cautionary (yellow day), or critical (red day) conservation strategies. Energy officials report that because of this program, 100 megawatts were saved during the four yellow days in the summer of 2001. This amount of energy saved is enough to power 51,300 average sized homes.

Additional ideas to include in the energy plan on educating communities about energy sustainability include the following:

- Recommend training seminars on energy sustainability directed primarily toward decision-makers and government officials.
- Provide continuing education courses on energy matters. Check with Continuing Education at the University of Utah and Salt Lake Community College for any special courses on energy efficiency and renewable energy.
- Plan and build demonstration projects ranging in size from single buildings to entire neighborhoods that easily illustrate energy efficiency strategies. A great arena to showcase energy efficient housing is the local Home Builder Associations' annual Parade of Homes. The probability of informing thousands of people in a short amount of time is high. Schedules of these events are available from the Utah Home Builder's Association or the Utah Energy Conservation Coalition.
- Recommend energy audits of residential and commercial buildings. Energy auditors provide data on energy inefficient locations as well as information of how to increase efficiency in those locations. Consumers should view the process of energy audits as personalized educational tours.
- Promote the use of clean fuel vehicle fleets and the opening of refueling stations.

▶ **The energy plan could include education programs that would be free to the public, such as the recommendations below:**

- **Suggest businesses in the energy trade offer mini-seminars introducing new technology to maximize energy savings.**
- **Offer mini-seminars at local home improvement centers and community centers to educate the public on energy efficiency strategies.**
- **Recruit the expertise of the media to help make energy issues and events newsworthy.**
- **Provide brochures and newsletters on energy matters, for example, Utah Power's Voices newsletter reaches 650,000 homes in Utah every month.**
- **Supply information that identifies the sources of supplied energy to consumers and explains environmental problems caused by energy production and consumption.**
- **Provide public service announcements that alert the community on possible energy supply shortages:**
  - **Explain reasons for the shortages**
  - **Forecast the degree of magnitude of the shortages**
  - **Provide energy efficiency strategies that may help reduce the magnitude of the shortages**
  - **Provide information that explains the consequences of maintaining the status quo**
- **Recommend local financial institutions offer information on the availability and benefits of energy and location efficiency mortgages.**

Information and Energy Efficient Strategies for an Energy Plan

Suggestions of energy efficiency strategies and energy-related considerations for general development, building design and transportation are below.

Communities and Neighborhoods

Many aspects of urban design usually show little energy-related consideration. An energy plan ensures that energy efficiency is included in all aspects of design and construction in new development as well as revitalization projects. Certain construction elements to consider for the plan include embodied energy, urban planning and land-use pattern, infrastructure and landscape design.

Embodied Energy

Embodied energy is the energy consumed by all the processes associated with production of a building, from the acquisition of natural resources to product delivery. The Architecture League of New York reports that the most common building material requiring the least embodied energy is wood. Wood consumes about 640 kilowatt-hours per ton, mostly from the industrial drying process, and some from the manufacture of and impregnation of preservatives. In comparison, all other building products require up to many times (X) more embodied energy than wood: for example, brick 4X, concrete 5X, plastic 6X, glass 14X, steel 24X and aluminum 126X. Although some of these products may be extremely energy efficient, the embodied energy consumed for those materials must be considered when analyzing the total energy budget of a project.

Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) suggests that in determining which materials to use for a project, consider additional energy consuming factors other than just absolute embodied energy values. Such factors include project design and configuration as well as material quantity, quality, and durability. For example, wood and concrete require relatively low embodied energy, but the total quantity used is typically high. The total embodied energy, therefore, for these two materials may be very high.

Analyzing only the energy used to operate a building is also not acceptable, especially if the building is highly energy efficient. Research by CSIRO showed that materials used in the construction of an average household contain about 1,000 gigajoules of embodied energy. This amount of energy is equivalent to about 15 years of operational energy.

Embodied energy for a project may be minimized by the following:

- Use local resources: Energy consumption is higher for transported materials than for local materials.

- Conserve and restore old buildings.
- Reuse old building materials: The reuse of building materials commonly saves about 95% of embodied energy. (CSIRO)
- Use recycled products: The use of recycled products may lower embodied energy if reprocessing and transportation energy consumption is low.

Urban Design and Land-Use Pattern

As America's urban communities spread over ever-wider areas, they contribute to loss of open space, expanding highways, and greater traffic congestion, all of which affect energy consumption, especially for transportation. There are two considerations to help mitigate the impacts of sprawl and decrease transportation energy consumption. One consideration is the drafting of zoning ordinances that do not isolate housing developments from employment sites and shopping centers. The second is to avoid low-density growth such as homes on large lots and widely scattered subdivisions. Both of these considerations can reduce the amount of vehicle miles traveled. Although 70% of the Wasatch Front's population desires and supports low density growth, strategies to introduce energy sustainability in these areas need to be explored.

For more information on urban design to minimize transportation-related energy consumption, see "Transportation" section of the Energy Chapter. For more information about land-use patterns and urban planning for resource efficiency, see "Open Space, Agriculture, and Quality of Life" of the Protecting Sensitive Lands Chapter in Envision Utah "Urban Planning Tools for Quality Growth."

Infrastructure

Counties, municipalities, and cities may want to adopt strategies and programs targeted toward infrastructures that reduce energy consumption. Counties could establish a program assisting cities in annexing that guarantees sufficient and sustainable energy infrastructure that supports proposed development. To accomplish this program, governments can require that future developments analyze and compare the costs of infrastructure as it relates to distance and accessibility between existing and future developments.

Urban sprawl creates energy inefficient communities.
(CRS Architects)

Geographic Information Systems (GIS) program applications such as ArcView's Spatial Analyst® can model direct route time and distance. GIS mapping can also help track existing infrastructure and capacity as well as determine whether future development in different areas could be absorbed without the need to build additional infrastructure. A partnership with the Utah Governor's Office of Planning and Budget and the Division of Water Resources has developed an infrastructure-costing model that evaluates the economic impact of expanded infrastructure associated with growth.

Adopting a water conservation program is another way to save energy. Energy is used to pump and heat water as well as to transport and treat wastewater. Reducing the demand for water reduces energy costs and associated emissions for both water and wastewater infrastructure. Lower water demand may postpone the need to expand facilities, resulting in additional energy and cost savings. The energy plan may include water conservation programs as well as partnership recommendations between the water and energy groups to share financial cost associated with implementing the conservation strategies.

Other strategies related to infrastructure that may reduce energy consumption include recycling and partnering. Recycling saves energy by reducing the transportation fuel used to haul materials to a landfill and by reducing embodied energy in recycled finished products. Reusing and reducing save energy by reducing the amount of energy used for production and consumption. Partnering with other organizations or government entities to share facilities may also reduce energy consumption for construction materials and daily operations.

Public and Residential Landscapes

Moderate to high density and mixed-use developments clustered with interconnecting greenspace is one strategy to help reduce the consumption of energy and other resources. A greenspace corridor reduces energy usage, in part by promoting walking within and among communities and lowering summertime urban temperatures. Local municipalities may want to include in an energy plan a strategy to combine land-use for utility corridors with greenspace.

Other strategies for the community energy plan are to increase tree and other plant coverage. These strategies may be facilitated by using City Green modeling software. This program is designed to add a "green layer" in land development decision making and encourage additional plant cover to increase air quality and to reduce energy consumption along with stormwater runoff.

Salt Lake City took action and adopted a landscape ordinance that requires all vehicle lots to landscape at least 5% of the lot's interior.

This green space does not include the required landscape around the perimeter. The Salt Lake City ordinance results in many new lots featuring islands with trees and shrubbery. For help with developing and evaluating tree ordinances, refer to the website phytosphere.com.

Plants are a relatively inexpensive way to reduce energy consumption and save money. DOE estimates that shade resulting from as few as three trees can save the average household between $100 and $250 annually in energy costs. Iles (1998) reports that plant canopies can reduce municipal energy costs up to 50% and 22% during the summer and winter, respectively. Energy savings similar to those reported are achievable in Utah through proper site and species selection. Below are, a few planting strategies to include in the energy plan that increase energy efficiency for homes and communities:

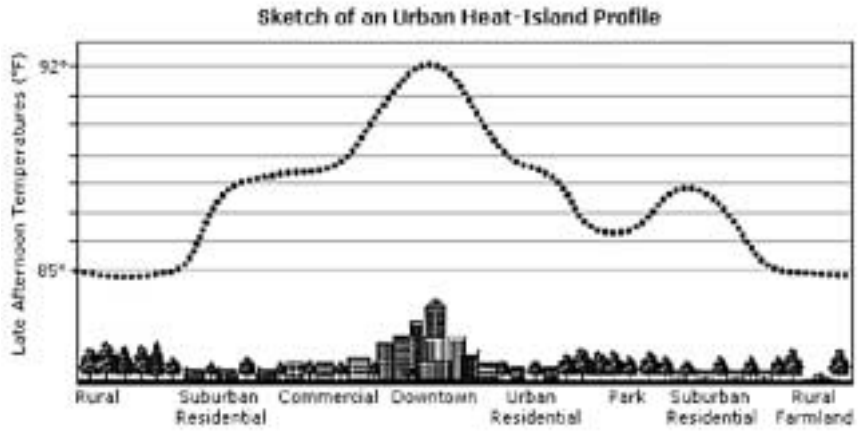
- Plant trees, shrubs, and woody vines to provide shade. Trellised vines are a great solution for areas with limited space.
- Shade the west- and east-facing sides of structures. Shading the west side of structures is the most important because afternoon heat is radiated to surfaces in two ways: direct radiation from the sun and radiation from surfaces that store significant amounts of heat throughout the day.
- Select deciduous woody species for the west and east sides of the landscape because they provide shade in the summer, yet allow solar radiation to filter through the leafless canopy in the winter.
- Plant at a distance such that the vegetation significantly casts shade on the buildings. In general, the taller the plant the further it can be planted from the building and still provide shade. Another general rule is to plant about 20 feet from windows and select species that grow at least 10 feet taller than the windows. Because no plant is able to significantly shade very tall buildings, the planting of trees insignificantly affects the overall energy budget for a high story building.
- Plant tall trees away from the south side of buildings. A tree in this location casts little shade because the solar angle is high in the summer. In winter, however, the same tree casts undesirable shadows on structures to the north for most of the day. If shade trees are already present on the south side, remove lower branches to permit more winter sunlight to reach the structure.
- Select evergreen trees for the north side of buildings to protect from prevailing winds during the winter. Trees planted as windbreaks can reduce wind speed for distances several times their height. Neighborhoods with canopy cover of more than 50% can decrease wind speed by half, therefore, decreasing wintertime energy consumption (DOE 1997).
- Plant trees or shrubs to shade central air conditioning units. A cool air conditioner consumes less energy for cooling the same volume of air compared to a hot conditioner. Note that air conditioner units are naturally cooler if

they are located on the north sides of buildings.

- Plant tall growing species away from power lines to reduce power outages and the need for costly tree trimming and removal. Utah Power has a program called "Plant the Right Tree in the Right Place" that teaches citizens the best species to select for areas near power lines.
- Contact local nurseries and university extension offices for more information concerning appropriate species selection.

Although it is advisable to plant woody species to reduce energy consumption, a word of clarification must be mentioned about the water they require. Utah is the second driest state in the United States, and we are justifiably reminded to conserve water. Most officials in the plant and water industries agree that improper irrigation procedure is the largest water waster in Utah. Although plants consume water, the amount of water used by plants is insignificant compared to the amount that ends up in gutters and sewers. By far, the most efficient way to save water is to properly irrigate, not to remove or reduce vegetation. Even if plants are removed, the amount of water saved would be insignificant compared to the amount of energy consumed by not maintaining plants.

Temperature comparisons among different types of communities.
(UEO)



Urban Heat Islands

Urban heat islands are urban areas that are hotter than surrounding rural areas. Factors that contribute to heat islands include the removal of local vegetation and natural surfaces as well as the addition of heat absorbing surfaces like dark roofs and pavements. Many US cities are urban heat islands with temperatures between 2 and 15° Fahrenheit hotter than their surroundings (*Akbari 1996*). Utah urban areas that are landscaped present a special case because much of the surrounding areas are actually dry, hot deserts. However, within Utah urban areas there are localized high-temperature patches caused by the same factors that cause urban heat islands.

Urban heat islands are expanding with spreading populations and new building construction. Since 1940, summertime temperatures of many cities have climbed steadily by 0.25 to 1 degree Fahrenheit per decade (*Akbari, 1994*). As temperatures increase, the need for air conditioning increases, this places more demand for power generation. Los Angeles, for example, experienced one of the largest ever observed heat island cause and effects. This city experienced a peak cooling demand increase of 1.5% for every rise of 1 degree Fahrenheit (*Akbari 1993*). Power plants must generate the additional

electricity to meet these peak-cooling demands, and in the process, they also produce air pollution. One of the main compounds released into the atmosphere, as a byproduct of power generation is the greenhouse gas, carbon dioxide.

The increase in temperatures also increases the rate of release of volatile organic compounds (VOCs) into the urban environment. VOCs enter the atmosphere as a byproduct of transportation and industry fuel consumption as well as from biogenic sources. Certain VOCs, when combined with nitrogen oxides (NOx) and in the presence of sunlight, react to form ground-layer ozone. This pollutant is a powerful oxidizing compound and is the major contributor to summertime smog. In the energy plan, suggest coordinating with air quality groups to develop control strategies for the State Implementation Plan that results in greater reductions in VOCs and NOx emissions.

Thermal image of Salt Lake City: Hot (red) downtown compared to cooler (blue/green) areas near UofU.
(NASA)

To decrease urban temperatures and prevent the consequences, an energy plan could include the following recommendations:

- Promote the use of light colored roofing.

  Modify building and residential codes to recommend roofing materials with a high albedo (or reflective in infrared wavelengths, such as Classic Products). Standards that are consistent with US Environmental Protection Agency's (EPA) criteria for Energy Star™ labeled roofing systems are a good guideline. Recommend that existing buildings are reroofed or topcoated following the new standards by a specific date. Recommend existing houses to use high albedo roofing materials when they have new roofs installed.

- Promote use of light colored pavement.

- Recommend a light colored aggregate chip seal on roads, new or resurface projects.

The Environmental Protection Agency and other partners funded the Marshall Space Flight Center's Global Hydrology and Climate Center's fly-over project, to locate hot spots in target cities. Salt Lake City was fortunate to be selected as one of the four target cities in the United States. In July of 1998, National Aeronautics and Space Administration (NASA) sent a Lear jet equipped with thermal (infrared) imaging equipment to take aerial photography of the Salt Lake City valley. The results of the data showed, in part, that it is cool near bodies of water, along roads that are tree-lined, and in areas that are significantly vegetated, such as Liberty Park and the Salt Lake City County Building. These cool temperatures ranged from about 60-70 degrees Fahrenheit. The results also showed that it is hot in vast asphalt paved parking lots (about 120 degrees Fahrenheit) and hottest on dark colored rooftops (exceeding 140 degrees Fahrenheit), such as the Salt Palace and Matheson Courthouse. These results generated by NASA and other heat island researchers, assist groups such as the Utah Energy Office to promote and implement Cool Communities strategies. Contact the Utah Energy Office to help forecast possible benefits of implementing Cool Communities strategies.

Energy efficient visitor center at Zion National Park.
(UEO)

- Recommend that parking lots are either cement or asphalt with a light colored aggregate chip seal on top.
- Amend current codes governing off-street parking facilities, including vehicle sales and lease lots, to recommend use of reflective asphalt emulsion sealcoats, pavers, turfblock, or whitetopping for reconstructed asphalt.
- Increase vegetation cover.

▶ **The Zion National Park Visitor Center and Comfort Station is a local example of a building designed for maximum energy efficiency. This complex was designed and built through a partnership among the National Park Service, NREL, and American Institute of Architects. NREL estimates that the Zion's Visitor Center will save $14,000 per year because of the energy-saving strategies. Some of these strategies include the following:**

- **Strategic site location of building and plaza for maximum summertime cooling and daylighting.**
- **Trombe wall for passive solar heating.**
- **Downdraft cooltowers for summertime cooling and natural ventilation.**
- **Thermal mass flooring for maximum wintertime heat gain.**
- **Photovoltaic system for supplemental power.**
- **Clerestory windows for natural daylighting.**
- **Energy efficient lighting system to supplement natural daylight.**

Other notable energy efficient buildings around the state include the Utah House in Kaysville (completion 2002), Skating Oval in Kearns, Department of Natural Resources State Office Building in Salt Lake City, and American Red Cross – Salt Lake City Chapter (planning in progress). These buildings are designed, in part, for visitors to gain information about energy efficiency strategies and resource efficient products.

Commercial Buildings

Buildings in the US use one third of all energy consumed in the US and two thirds of all electricity consumed in the US *(DOE 1997)*. A 30% increase in building energy efficiency could reduce consumer costs by $100 billion each year. To help reduce energy consumption and environmental impact, the building industry is beginning to practice "green" building design and construction. This type of building approach focuses on the whole building system as well as on the building process. Matters such as site placement, building materials, indoor air quality, and construction clean up are all considered in order to reduce energy and resource consumption during and after construction.

Energy efficient office building, Department of Natural Resources.
(UEO)

Many architects and building engineers are turning to the LEED rating system to design and construct commercial buildings. LEED provides a definitive standard for what constitutes a "green commercial building." It also provides detailed requirements, basic technologies/strategies, and information for each of the categories. It is designed to rate new and existing commercial, institutional and high-rise residential buildings. Buildings that meet the terms of LEED are rated as certified, silver, gold or platinum. In Utah, the Kearns Skating Oval is rated as "certified" and the American Red Cross has challenged its designers to achieve a LEED rating for its new Salt Lake City facility.

Details and recommendations for a green building design and construction are well covered in LEED and other documents, such as the Salt Lake City "High Performance Building Plan."

Residential Building Considerations and Strategies

Residential energy programs usually include a mix between voluntary standards and mandatory codes. Under voluntary standards, new and existing homes are rated for energy efficiency. In Utah, voluntary standards are set by the Utah Energy Conservation Coalition. That group provides "Home Energy Ratings" for residence based on the nationally recognized and accredited Home Energy Rating standards adopted by the Residential Energy Services Network, Mortgage Bankers Association, and the National Association of State Energy Offices. The incentive to build homes, voluntarily above the energy code, is customer driven with some incentives from lenders who take energy cost savings into account when underwriting mortgages.

Although mandatory codes set the standard and are enforceable, they can hinder implementing innovative energy efficiency strategies. An energy plan could recommend that mandatory codes provide flexibility for energy efficiency, yet assure compliance. Under the U.S. Department of Energy Building Standards and Guidelines Program there are four energy code compliance packages that can be used to demonstrate code compliance for residential structures, they are the following:

- Prescriptive compliance package – using a predetermined "package" of energy efficiency measures.
- Points compliance package – using simple tradeoffs of various energy efficiency measures, which are assigned point values.
- Performance compliance package – by modeling on a computer a proposed building's heating and cooling energy needs.
- Enforcement strategies that include financial penalties (*DOE/GO-10095-073*).

Energy Star rated home in Cottonwood Heights: 5 star rating.
(UEO)

Department of Energy and Environmental Protection Agency's Energy Star program.

Utah Energy Conservation Coalition conducting a home energy audit.
(UECC)

Community members should always require and inspect the inclusion of at least the following items for new developments or remodels:

- **Longest axis of the home is oriented east-west to maximize solar gain.**
- **Insulation for ceiling, walls, and floors is greater than energy code standards.**
- **Appliances installed are EPA Energy Star™ rated.**
- **Appliance size is appropriate for the need.**
- **Fluorescent lamp fixtures are the T8 models.**
- **Windows are double panes, low E glass.**
- **Water fixtures are efficient to conserve water and use less energy.**
- **Outdoor lighting is equipped with motion detectors to save energy.**

"Built Green Utah Checklist" provides information on energy efficient construction. In addition, DOE provides simple software that performs and analyzes energy efficiency for residences. See R/R for more information.

The energy plan should recommend building residential developments to the EPA Energy Star HOMES Program standard. This program ensures home energy efficiency is raised a minimum of 30% above the current energy code minimum standard. Homes are "labeled," which identifies them as more efficient by at least 30% than "standard" homes in the housing marketplace and industry. All homes are independently rated and analyzed according to either a Home Energy Rating System score or similar nationally recognized energy compliance package. See the EPA Energy Star website for additional benefits of energy rated buildings.

The energy plan should also contain recommendations to increase energy efficiency in low-income housing. Low-income households typically spend 14% of their total annual income on energy, compared with 3.5% for other households. The Utah Department of Community and Economic Development addresses this discrepancy by administering the DOE's Weatherization program. The major goal of this program is to enable low-income individuals and families (particularly the elderly and handicapped) to participate in energy conservation programs, which lessen the impact of utility costs. Participating households are averaging nearly 25% savings or about $300 per year. Some of the features of the Weatherization program include insulation installation, duct sealing, heating system repairs as well as client education on energy efficiency measures (see R/R for more information).

Transportation

Population growth and transportation should parallel in a sustainable energy planned community. Often, however, the building of transportation facilities does not keep pace with population growth and, the result is significant traffic congestion. For example, travel demand modeling and socioeconomic data projects a population increase of 71% along the Wasatch Front between 1996 and 2030 (Wasatch Front Regional Council 2001). The modeling also projects vehicle miles traveled (VMT) to increase 77%. Such an imbalance between population growth and VMT illustrates the necessity of long-range comprehensive transportation planning for communities. This planning helps improve air quality, reduce congestion, provide local energy security, and improve economic development as well as increase the quality of life.

The transportation sector includes surface transportation, federal highway system, aviation, motor carriers, railroads, maritime, and Coast Guard. These sectors devour 79% of all oil consumed in Utah. Because this consumption is so significant, it may be necessary to form a sub-committee of the Energy Task Force (ETF) to address energy efficiency specific to transportation. This sub-committee can recommend strategies

for sustainability and automobile reductions for their community. The Transportation ETF can also suggest a variety of transportation choices that reduce dependence on unpredictable petroleum sources. The Metropolitan Planning Organization (MPO) could include these recommendations into the Long-Range Transportation Plan (LRTP) to insure that the energy-efficient transportation goals and air quality standards are achieved.

Transportation Planning: Goals and Objectives

When the public helps plan for transportation matters, they provide input to the local Association of Government, in rural areas, or to the MPO in urbanized areas with populations over 200,000. These official groups may then integrate the public's ideas into the LRTP. Mountainlands Association of Governments (MAG) and the WFRC are responsible for coordinating and preparing the LRTP (2000 – 2030) for the Wasatch Front Counties. The current LRTP from the WFRC includes the following goals:

- Provide a balanced, interconnected transportation system with a range of convenient, efficient and economical choices.
- Increase transportation mobility and accessibility for persons and freight that promotes economic vitality in the region.
- Increase transportation safety and security for all modes of travel.
- Provide a transportation system that protects and enhances the environment, promotes conservation of energy, and improves the quality of life.
- Protect existing and future transportation systems through ongoing maintenance, preservation, or reconstruction.

The WFRC has a number of objectives to achieve the transportation goals in the LRTP, which include the following (see R/R for more information):

- Provide a system that integrates multiple modes of transportation

▶ The Transportation Energy Task Force's mission is to:

- **Identify local issues, priorities, and solutions for local transportation.**
- **Conduct research on transportation solutions.**
- **Establish partnerships with the public and private sectors.**
- **Exchange transportation and planning ideas with the community and local Governments.**
- **Present energy-efficient transportation strategies that illustrate quality of life.**

(Public Technology, Inc., Urban Consortium Task Force)

Salt Lake City Past: Wide Sidewalks, angled parking and trolley car.

Salt Lake City Present: Narrower sidewalks, minimal parking, and energy efficient trolley.
(CRS Architects)

Intelligent Transportation System (ITS) uses advanced computing, information systems, and communications technology and applies it to the control and management of traffic and infrastructure to achieve:

- **Safer transportation system**
- **Better informed travelers**
- **Improved traffic control systems**
- **Increased efficiency of transit systems and traffic infrastructure.**

The benefits of ITS include reduced congestion, fewer transportation-related deaths and injuries, and reduced energy consumption and pollution.

by connecting them for efficient transfer between modes.

- Use transportation system technologies that are innovative.
- Minimize travel time for both passenger travel and freight.
- Increase accessibility to employment districts, commercial and industrial sites as well as education, medical, and recreation centers for all persons in the region.
- Provide access to nearby developing areas.
- Improve safety for pedestrians and bicyclists.
- Provide a transportation system that serves and complements desired community development standards.
- Reduce the degree of air, water, noise, and visual pollution.
- Minimize the disturbances to the natural aesthetics and wildlife habitat of the region.
- Identify and protect corridors for future highway, transit, freight, or other transportation system requirements.

A community needs an energy efficient transportation plan to help direct future transportation demands as the community grows in a sustainable manner. Improved transit service, intelligent transportation systems, increased bicycle and pedestrian options, creative land-use planning, and public education programs are general concepts to all contribute to reducing VMT. Additional strategies that reduce VMT and urban impact, include:

- Build high-density developments with access to existing public transit.
- Establish a job-to-resident ratio that reduces VMT.
- Add to past investments through infill and brownfield redevelopments.
- Develop residential areas close to existing amenities.
- Institute incentive programs that increase public transit ridership and reduce VMT.
- Install Intelligent Transportation Systems to keep traffic moving.

Road and Parking Lot Design

Sustainable communities use road and parking lot design strategies that reduce VMT and environmental impact. The transportation subcommittee of the ETF may want to consider some of the following energy efficiency strategies for roads:

- Minimize the length of streets and highways.
- Design road width and configuration for specific needs, such as maintenance and snow removal, emergency vehicle access, and evacuation routes.
- Incorporate bikeways, walkways, carpooling links, and transit into roadway planning.
- Anticipate interconnectedness of future development to minimize road building.
- Include pedestrian right-of-way whenever possible to encourage walking.
- Design facilities for business and trucking operations for maxi-

mum transportation efficiency.

- Plan road construction activities and detours to limit congestion and reduce fuel consumption.
- Use energy saving materials and techniques during road construction, such as concrete and asphalt recycling.

Community energy planning should also contain recommendations for parking lots. Large parking lots are often built to entice customers with the notion of convenient parking. Studies show that suburban parking lots provide up to 36% more parking than the average peak demand. Land is too valuable to provide massive parking lots that encourage single-occupant driving when there are alternative modes of transportation available. Shared parking is one strategy for energy efficiency land-use planning. This type of parking allows two or more enterprises to share one parking area. The enterprises should have different hours of patronage to be most effective. For example, a bank whose peak hours of business are during the day might arrange to share parking with an adjacent apartment complex that primarily requires parking from dusk until dawn.

Communities that implement energy-efficient transportation strategies can also save energy used for lighting. Shorter roads and smaller parking lots naturally require fewer lighting fixtures than longer road and larger lots. Fewer fixtures mean less energy consumed for lighting. Building managers and road departments can also increase energy savings by eliminating unneeded lighting fixtures and reducing 20-30 light candle fixtures to 2-10 light candle fixtures. Increases can also come from using motion sensors to illuminate parking lots after hours as patrons approach and selecting energy-efficient light fixtures that direct light source only where needed.

E-BIKE: Electric bike with rechargeable battery, great for city commuting. (UEO)

Wide 6 lane road at 1300 East 2700 South in Salt Lake City creates a localized heat island. (UEO)

Trax commuter rail in residential area of South Salt Lake.
(Clean Cities Coalition Stock Photo)

Public and Traditional Transportation, and Alternative Fuels

Public transportation provides energy efficient travel for large numbers of people. The viability of public transit, however, is highly dependent on population density. Areas of higher density usually have more reliable and adequate public transportation service compared to areas of lower density. The community members of high-density areas that use public transportation save money and time. The community energy plan could recommend development patterns that are higher density to decrease transportation energy use.

For families that are unable to take advantage of public transportation, employers may be able to offer energy efficiency strategies for the daily commuter. These strategies can include offering premium parking spaces to employees that carpool, arranging for employees to work outside the office, and compressing workweeks. Another strategy is to offer the Utah Transit Authority Rideshare program.

Alternative fuel vehicles are another option for the daily commuter. The Clean Air Act Amendments of 1990 and the Energy Policy Act of 1992 encourage the use of alternative fuels for environmental, economic, and energy security reasons. Natural gas, propane, electricity, ethanol, and biodiesel are the most common alternative fuels and are obtained or produced in North America. Use of these fuels can bring energy security to a community as well as cleaner air.

Until a few years ago, alternative fuel vehicles were gasoline vehicles converted to run on a different fuel. Today, all auto manufacturers offer a wide range of AFV choices along with a full-vehicle warranty. AFVs do not experience loss of power, and start easily and run smoothly in all types of weather and terrain. AFVs emit less air pollution because the fuels have lower carbon concentration compared to gasoline.

▶ **A study in Southeastern Wisconsin shows the economic impact of transportation options for a family of four living in a single family dwelling (Alternatives to Sprawl in Southeastern Wisconsin by Citizens for a Better Environment).**

TRANSIT AVAILABLE	MODE OF TRAVEL (20 MILES)	GOODS AND SERVICES ACCESSIBLE BY FOOT AND BIKE	COST PER YEAR	HOURS IN TRAFFIC
None	2 cars	Poor	$10,010	1,430
Some	1 car 1 bus	Some	$ 5,525	715
Most	2 cars 1 bus 1 rail	Good	$ 4,050	415
All	1 bus 1 rail	Very good	$ 2,020	0

Natural gas and propane-powered vehicles use fuels that may not be readily available outside the I-15 corridor. The significant cost of the specialized fuel systems in natural gas and propane-powered vehicles is offset by the low cost of the fuels. Flex-fuel vehicles can be fueled by either ethanol or unleaded gasoline. Biodiesel, a cleaner burning alternative to diesel, can run in most diesel engines without any modifications or increased cost to the vehicle. (see R/R for more information.)

Utah has become a leader for encouraging the purchase and use of AFVs. The State of Utah offers a number of incentives that encourage AFVs. Another incentive includes a lower price for natural gas at the pump, and available funds through the local Clean Cities program. There is even an incentive that permits the right to use the commute or carpool lane of the freeway with only one occupant in the vehicle. Companies can also use AFV in their fleets. Successful AFV fleets in Utah are Newspaper Agency Corporation, Questar Energy Services, Jordan School District, Flower Patch, Park N' Jet, Salt Lake International Airport, and Danville Services Corporation (see R/R to review a list of incentives).

Transportation Funding

New transportation design features may be costly to implement. There are numerous grant solicitations for community revitalization projects that often include transportation improvements. Federal funds for transportation projects are available with government support:

TEA-21: Transportation Equity Act for the 21st Century funds many transportation projects. The state Departments of Transportation and the MPO direct the funds. Public input can ensure that MPOs fund projects that create more workable and livable communities. Government must sponsor projects that receive this funding.

FTA Section 5303 & 5313 Planning Programs: MPO prepares transportation plans for submission to UDOT for approval, which ties directly to apportioned FTA 5303 funds earmarked for each state. UDOT staff addresses statewide transportation planning needs outside of MPO boundaries

Compressed Natural Gas (CNG) vehicle being fueled by local fueling station.
(Clean Cities Coalition Stock Photo)

under FTA 5313. Federal Transit Administration awards the States.

CMAQ: Congestion Mitigation and Air Quality Program: A federal program formed by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) is designed to help states implement their air quality plans in conformity with the Clean Air Act Amendments of 1990 (CAAA). The energy task force may want to recommend these funding opportunities. (see R/R for more information.)

▶ The US represents only about 4-5% of the world population but consumes 25% of the world's energy resources. In a typical community, 40-50% of that energy use is due to the transportation sector (The Energy YardStick 1996). Because of this significant proportion, community members must know about energy strategies that help reduce vehicle fuel consumption, such as the following:

- **Ensure local governments know about intelligent transportation systems, sustainable mobility, and other transportation information technologies.**
- **Encourage the community to reduce VMT.**
- **Keep vehicles properly tuned for the most fuel-efficient operation.**
- **Maintain the recommended pressure in vehicle tires.**
- **Drive a commuter car that gets good mileage or uses alternative fuel.**
- **Disseminate the "10 tips for saving gas when driving" brochure.**
- **Expand driver education programs to cover energy efficient transportation.**
- **Encourage walking and biking in communities.**

Alternative Energy Opportunities

Strategies and Incentives

Communities can implement strategies to increase the reliance on renewable energy sources by adopting solar easements. These easements guarantee that as new developments arise, the preexisting structures that depend on the sun for heating or power are not shaded and do not lose access to the sun's rays. Another strategy applies to those communities with municipal utilities. These communities can adopt special green pricing programs where citizens voluntarily subscribe and purchase a portion of their monthly electrical consumption from renewable sources in turn acquired by the municipal power company. A third strategy is for communities to adopt performance standards for new buildings that require a percentage of a buildings annual energy use to be from renewable sources. Finally, some communities with municipal utilities have also set a renewable portfolio standard where a percentage of the total power grid is derived from renewable sources.

Utah offers an incentive in the form of a state income tax credit for renewable energy systems, such as solar, wind, biomass, and hydropower. The credit for residential systems is 25% of the equipment and installation cost, up to a maximum of $2,000. Commercial systems receive a

10% tax credit up to a maximum of $50,000. The Utah Energy Office administers the tax credit.

Another incentive that can be adopted and is being considered in Utah, is a net metering law. This law would require electric utilities to allow customers to connect generation systems to the grid for their own use and to supply excess electricity to the electric grid. The utility would "net" the customer's electricity use and production over a defined period of time, in essence, paying the customer retail price for the electricity they produce. Currently there are 34 states with net metering laws. Utah has a proposed net metering bill that will be considered in the 2002 legislative session. This bill, as currently proposed, states that if net metering results in excess customer-generated electricity during the billing period, the electrical corporation shall credit the customer for the electricity at a value that is at least avoided cost.

Definitions of Alternative Resources

Alternative energy resources can provide substantial and reliable energy supplies. Below are definitions of resources that may be encouraged in the community energy plan. Careful surveying and analysis helps determine whether alternative energy resources are available and economical for individual communities.

Wind

Wind turbines convert the kinetic energy of the wind into mechanical power that runs a generator to produce clean, nonpolluting electricity. There are three major factors to consider when determining whether a turbine is reasonable and cost effective. First, the building structure must be as energy efficient as possible before alternative energy resources are considered. Second, there must be ample windspeed to meet the power demand. Third, the results of an energy budget identify the size of the turbine required. A general rule of thumb for estimating the cost of a residential turbine is $1,000 to $3,000 per kilowatt.

Wind energy can provide a practical and economical source of electricity if

- Property has a good source of wind.
- Building is located on at least one acre of land in a rural area.
- Local zoning codes or covenants allow wind turbines.
- Average electricity bills are $150 per month or more.
- Building is in a remote location without easy access to utility lines.
- Finances can absorb long-term investments.

Geothermal

Geo (Earth) thermal (heat) energy is an enormous, underused heat and power source that is clean and reliable. This resource is converted into heat and electricity with little or no greenhouse gas emission, and is released or generated domestically, making us less dependent on foreign oil.

One technology that uses geothermal energy is geothermal heat pumps. In winter, heat from the relatively warmer ground is pumped through the heat exchanger into the house. In summer, hot air from the house is pumped through the heat exchanger into the relatively cooler ground. Heat removed during the summer can be used as no-cost energy to heat water.

A homeowner investing in a heat pump may pay $15 more per month for the cost of the system but may save more than $30 a month on their electricity bill.

Electricity use is reduced by 30% to 60% compared to traditional electric resistance heating systems, allowing system payback in 2 to 10 years. These low-maintenance systems can remain operable for 30 years or more. Where natural gas fired heating is used, the total energy bill may not be reduced by changing to a geothermal heat pump.

Photovoltaic

Photovoltaic (PV) panels convert sunlight to electricity, directly. PV panels vary in size ranging from a few square inches to about the size of a door. The largest panels generate 300 watts in full sunlight, which is equivalent to power one refrigerator or 12 - 25 watt compact fluorescent light bulbs. A PV system can provide enough electricity to power parking lot lights to large systems that power cities.

These systems have several advantages including no moving parts, low maintenance, and providing an alternative to utility line extensions. Photovoltaics may be preferred even in areas with utility service because electricity is produced without polluting the environment. The visitor center at Zion National Park, for example, has a PV system that contributes power to the building without affecting air quality.

Photovoltaic panels at Dangling Rope marina, Lake Powell.
(UEO)

Solar thermal

The sun heats solar collectors, which transfers gained energy to water or air in the collector. Because Utah has a high amount of solar radiation due to high elevation and many cloudless days, a solar thermal heating system can meet a majority of a home's water and interior heating needs.

Another solar thermal system consists of perforated panels attached to the south wall of a building with a few inches between the panels and the building wall. The dark colored panels absorb heat from the sun. The buildings heating system draws incoming air through the perforations and behind the panels where the air is heated before entering the building.

Passive solar

A passive solar design is one that permits direct sunlight to enter through windows to warm interior spaces. This design is intended to not overheat the building and to minimize heat lost through windows at night. Solar radiation passes through windows and is absorbed by interior materials such as stone and brick. These materials temporarily store the infrared radiation (heat) until the interior temperatures drop, then they reradiate heat back into the interior space. In Utah, 50 to 75% of total heating is achievable with these systems if designed properly.

Small-scale hydro

Hydropower plants convert the energy of flowing water to electricity and do not necessarily require large dams such as Glen Canyon. Diversion hydropower channels a portion of the water to a canal and through a turbine, from which power is generated. The water is later returned to the river, minimizing the environmental impact.

The economics of small-scale hydropower are site specific and can be very competitive with traditional electricity sources. The electric output is site specific and can vary from a few hundred watts to a megawatt or more. Utility connected hydropower can be a practical and cost-effective addition to the energy mix.

BioEnergy

Biomass to Energy (BioEnergy) is energy produced from any renewable organic matter including forest residues, agricultural crops and wastes, wood and wood wastes, animal wastes, livestock operation residue, aquatic plants, and municipal wastes. Examples of BioEnergy include using municipal wastes to produce methane, fermenting feedstock to ethanol, and converting animal fat waste to diesel fuel (BioDiesel). BioEnergy is successful primarily because it converts waste into useable forms of energy. New demonstration projects are coming on line as the need for energy rises.

Follow-up and Analysis Measures

Actual inclusion of energy efficiency strategies into a project may not occur even though officials and those involved in the project support the plan. The ETF, therefore, may want to revisit project managers during the implementation phase of the energy plan to monitor progress of development and individual projects. The ETF can provide suggestions or technical assistance to speed the process along.

Computer software modeling programs are an effective method to quantify existing and future impacts of development design. These programs rapidly produce images of design plans, which allow stakeholders to easily conceptualize recommendations and changes. Certain programs are designed to predict future energy demands, energy-related gas emission concentrations, and energy cost analysis of proposed projects (see R/R for suggested modeling packages).

As an ongoing activity, the ETF should quantify the energy benefits and savings in the community to evaluate the effectiveness of the adopted energy plan. After a particular community development or project is completed, an analysis between the forecasted and actual energy used quantifies success. For a renovation project, a comparative analysis between the amount of energy used before and after implementing energy efficiency strategies quantifies actual energy saved.

These evaluations give the ETF an opportunity to revisit existing strategies and modifying where necessary. The ETF can also incorporate new strategies as data warrants. Publicity of the overall savings in energy units and dollars helps maintain momentum for future sustainable energy projects.

Concluding Remarks

The dawning of the last century here in the United States saw the introduction of new products and technology, most of which are energy consuming. As these products and technologies became an integral part of our Utah communities, the entire economic health of each community and the quality of life of the citizens became dependent on the reliability, cost, and availability of energy sources. Events of 2000-2001 show that no community is immune from a regional or national energy crisis – these crises precipitate local problems. Rapid growth only exacerbates and compounds potential energy problems for our communities.

This Envision Utah Energy Chapter has discussed how each community can address present and future energy issues through "sustainability" – using resources wisely and efficiently in the context of community to create certain economic, environmental, and social benefits. Steps that Utah

Sustainable community design for downtown Ogden.
(CRS Architects)

communities can take to becoming "sustainable" have been presented along with the organizational elements needed for development of customized community energy plans. As each community develops a plan, this chapter can serve as a valuable resource for delineating strategies needed to meet the goals of the community energy plan.

The key to any community achieving sustainability is the synergy that develops as local officials, citizens, business, developers, and industry work together toward common energy goals. No great society was built upon the status quo. As individuals representing each of these sectors embark on this quest for sustainability, they will exemplify the best in leadership with vision for change and a commitment to success. We can make a difference for the better in Utah's communities and energy future.

8 Strategies for Walkable Commercial

Introduction

Traditionally, business districts were places where our cultural and economic lives united.

Shopping districts are one of the most significant parts of any community. Since the beginning of cities, shopping districts have been organized around areas where trade occurs. As in the design of the cities themselves, the location and design of these areas of trade changed based on the technology, the economic systems, and the customs and needs of the people they served.

Traditionally, markets, main streets, and business districts were integrated into the community – they were places where our cultural and economic lives were melded. During the last 50 years, primarily in the United States but also in the rest of the developed world, a form of retailing has occurred that is designed around the spread-out suburban world. While this new form of commercial development has taken many shapes – strip malls, regional malls, those that defy conventional retail categories (such as Wal-Mart), factory outlet stores – they all share a common purpose of catering to retail only.

Commercial areas can be integrated into primarily residential neighborhoods, such as this retail development with apartments above.

While this retail form has supported the growth of some of America's largest and most profitable corporations, segregating retail away from other parts of a community or neighborhood can cause problems. For example, congestion occurs in areas that depend heavily on retail services located along local arterials or freeway exits. More time must be spent driving to several locations rather than to a few close, convenient ones. Finally, many people object to the way auto-oriented retailing looks, and to the dependence it creates on the car as the sole mode of travel – reinforcing the tendency to make all trips by car, all the time, to the detriment of both our individual and our community's health.

During the last 50 years a new form of retailing has taken hold that is separated from other parts of a community's life.

This chapter explores urban design strategies that will retain the benefits of modern retailing, while also integrating commercial development into business districts so people can walk to visit several stores or retail services. By doing this, we can achieve a key strategy in Envision Utah's Quality Growth Strategy — the development of mixed-use centers. Through the strategies in this chapter, communities can realize the many benefits of a community where walking is a means of transportation and not something done just at the local health club.

Benefits of a walkable commercial area

When successfully established, a business district that is amenable to pedestrians can:

Increase accessibility of goods and services to the community.

An example of a retail development with little connection to the surrounding community.

Walkable commercial areas provide access through a variety of means, including transit, biking, walking or driving. This is especially beneficial for residents who are unable to drive. In addition, pedestrian-oriented shopping areas tend to be more successful when they are clustered together. The result is that residents can get to a variety of goods and services in one trip. Walkable commercial areas are not only more convenient for the pedestrian, but they also foster thriving businesses as areas become destinations and gathering places.

Become the hearts of our neighborhoods and cities.

Nearby neighborhoods and service businesses can thrive as a result of attractive shopping streets that are filled with pedestrians and often can become community gathering spaces. Walkable centers also create a safer environment because of the constant presence of people.

Help reduce traffic and congestion as trips made by car are replaced by walking and transit trips.

This is true even when people come to a pedestrian shopping area by car, because subsequent trips between stores are "captured" internally, thus avoiding additional auto traffic.

Help a community achieve the health benefits of more walking.

There is an increasing association between suburban design and obesity in America, which creates a

number of associated health risks.

Reduce the need for new land to accommodate new growth and satisfy the demand for additional transportation facilities.

A walkable district uses less land than one that is auto-oriented. Buildings are not necessarily bigger, but they are more compact, parking lots diminish or become part of a shared facility, and street sizes are reduced. This means more land is available for preserving open space and communities spend less money on costly infrastructure such as new roads and sewers.

Auto-oriented and walkable forms of development may seem entirely at odds. However, in the last 20 years many communities and businesses have developed new commercial businesses that successfully meet the needs of both the auto and the pedestrian. In fact, like so many things in life, there are many shades of gray between the prototypical auto-oriented design and the ideal pedestrian-oriented design. In this chapter of the toolbox, we will examine a variety of ways to increase the pedestrian attractiveness of several types of retail environments.

Basic Characteristics of Auto-Oriented Design

Much of today's retailing practice aims to create a prototype design that can fit into any suburban environment in the United States. Regardless of whether you're in Topeka or Santa Fe, certain retail chain stores will look essentially the same. This uniformity of design is important for retail corporations that have little time or expertise in customizing a store to a neighborhood. In most areas, this strategy provides a reasonable assurance of financial success. In these prototypes, everything is oriented to the private automobile — making sure cars have access and can find parking. These businesses perform best when they are visible and accessible along arterial streets with a lot of traffic. Parking is designed so that customers walk the minimum distance possible to their destination. In many cases, parking lots are designed to provide parking on the busiest day of the year — generally December 12 between 1 p.m. and 3 p.m. Buildings resemble large billboards, with simple box forms showcasing large distinctive graphics.

This business district in Colorado is the heart of the community.

▶ In 1977, children aged 5 to 15 years walked or biked for 16 percent of all their trips; by 1995, children made only 10 percent of their trips by foot or bicycle (Corless and Ohland, 2001). Meanwhile, the percentage of adults who are overweight or obese has risen from 47 percent in 1976 to 61 percent in 1999 (CDC, 2001).

■ In Utah, the prevalence of obesity among adults has also risen. In 1998, 16 percent of Utah adults were considered obese, up from 9 percent in 1991. (Utah Department of Health, Utah Health Status Update: Obesity and Overweight, December 1999)

In this environment, there must be very low density, and land costs must be relatively cheap. Shopping center developers use a rule of thumb that an acre of land is required for each 10,000 square feet of building – a floor area ratio (FAR) of less than 0.25. Most new shopping centers are built on land that has not been developed before – so-called "greenfield" development.

[1] *"Parking Requirements for Shopping Centers"; Urban Land Institute; 2000*

Basic Characteristics of Pedestrian-Friendly Commercial

On the other hand, successful commercial developments that depend on walk-in traffic – in main streets, entertainment districts, downtowns, and other pedestrian friendly districts – rely on advertising goods to passing pedestrians. Pedestrians typically arrive by car but abandon their car and then walk around visiting several stores or services. Good auto access is important, but traffic moves more slowly. Another important source of customers are the people who live or work nearby. Pedestrian-oriented commercial development can thrive in suburban or rural areas. If they are designed as a true commerical center, they become a destination for surrounding neighborhoods. These areas, like their auto-oriented cousins, depend on designs that attract shoppers into their stores. In fact, the interiors of enclosed malls have much in common with pedestrian-friendly shopping areas. They depend on attracting the eye of the slower moving pedestrian. Shop windows are crucial, as is the concentration of shopping opportunities along the pedestrian paths. Shop fronts display their most tan-

Designing for Redevelopment

Changes such as street improvements or zoning modifications can alter a site's surrounding characteristics over time. Therefore, it is often beneficial to plan for a higher level of walkability than the site currently supports.

Parking lots can be organized in a grid pattern with street right-of-ways in order to accommodate future pedestrian-oriented development that would redevelop portions of the surface parking.

Cascade Station, Portland, Oregon.

talizing merchandise, and displays change every 25 feet or so to create an ever-changing rhythm of goods. The presence of other pedestrians is an attraction and helps to foster a safer environment – the opposite of auto design, where the goal is to be a solitary driver.

Because the pedestrian moves at a slower speed and becomes bored quickly, the best pedestrian areas have a higher density of shops, each of which is smaller than the typical auto-oriented prototype. Even a large shop within a pedestrian area (such as a department store), must have display windows that follow the smaller format's rhythm. Because these many small stores depend on the health of the entire shopping environment, a certain "mass" of stores is required, unlike small neighborhood stores that can exist in isolation. Therefore, the business district as a whole frequently uses a common strategy to lure shoppers into the area, rather than relying only on each store's advertising efforts.

Because of the emphasis on creating a pedestrian environment, parking is never located between the building entrance and the pedestrian; instead, parking is along the street or in common parking areas in parking lots of structures that do not disrupt the pedestrian environment. The concept is to provide a convenient location where shoppers can leave their cars and get to areas for walking as soon as possible. The parking areas tend to be fairly inconspicuous, and the amount of parking supplied is usually less with a much more custom approach to the amount needed.

Redevelopment of Auto-Oriented Commercial

When auto-oriented commercial sites are redeveloped, it is an opportunity to incorporate walkable design. Strategies include introducing storefront commercial along the periphery of parking lots, opening a dying mall to the surrounding community through exterior entrances, and adding a mix of uses such as housing, office and entertainment in former parking lots.

An existing auto-oriented shopping mall.

The same site redesigned for pedestrian access and convenience. (Calthorpe Associates)

Design parameters of typical auto oriented development:

Building Design

- Typical auto-oriented buildings look like a single story "box" with little or no structural variation.
- Inexpensive construction methods, such as solid concrete brick walls, often are used even though they may not be architecturally interesting or pleasing to the eye.
- Often, there is only a single entry into a large building. Although the purpose is to control access in and out of the store, it is inconvenient and creates poor accessibility.
- Most buildings have few outside windows so that they can have more internal display space. The result is bulky and dominant blank walls.

Parking, plentiful and visible

- Parking is designed for the peak hours of the year (December 12 between 1 and 3 P.M.). This means that the parking lot has many vacant spaces for the other 3,000 hours a year a store typically is open.
- A common rule of thumb is to provide five parking spaces on site for each 1,000 square feet of building space, even though parking use varies greatly among suburban shopping centers.
- Vacant parking spaces are designed to be as clearly visible to passing motorists as possible.
- Diagonal spaces and wide aisles are designed for easy access for large vehicles.

Location

- Since these buildings are by definition auto-oriented, their locations, such as near freeway interchanges or on busy arterials, are designed to capture as much drive-by traffic as possible.
- Easy access for cars is considered essential for success.

Visibility

- Signs and building graphics are large and simple to catch the attention of high-speed auto traffic.
- Often, the sheer size and bulk of a building are intended to draw the eye of passing motorists. To take advantage of their size, many stores design their buildings to act as giant logos.

Connections

- Both auto and pedestrian connections to nearby developments intentionally are made difficult to navigate so that patrons of adjacent stores do not use their parking.

Density

- The net effect of the design parameters is a relatively low overall density – typically 0.25 FAR or less.

Design parameters of pedestrian-friendly stores:

Building Design
- Street-facing windows encourage window shopping and lure consumers inside.
- Narrow, repeated frontages encourage walking with the promise of the upcoming interesting things to see.
- Visible, friendly entrances into the stores' faces that are directly accessible from the main pedestrian path.

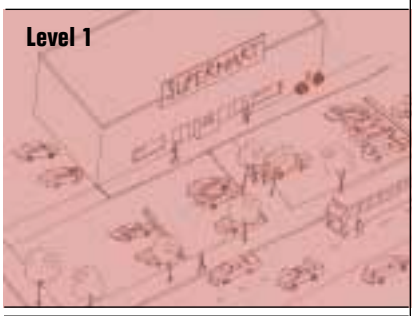
Parking
- Parking does not interfere with pedestrian traffic and often is behind buildings.
- There is a greater reliance on shared parking because it is more space efficient (see chapter 4).
- Consumers often park once and then shop in several stores on foot.
- The amount of parking supplied is decided on a case-by-case basis, eschewing national average parking standards.

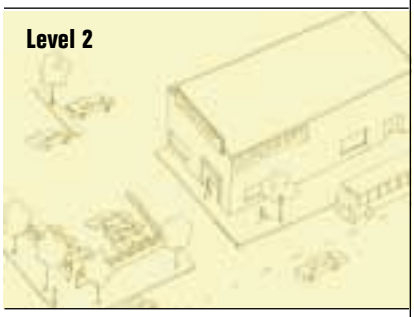
Location
- Stores thrive best when they are part of a business district that acts as an overall destination.
- Close proximity to residences and local workers means more walk-by traffic.
- Stores also benefit from auto traffic, but traffic must be at slower speeds to be compatible with pedestrians – i.e., collectors or slow, less busy arterials.
- Development often is compact and multi-stories to afford the most destinations with a pedestrian 'reach.'

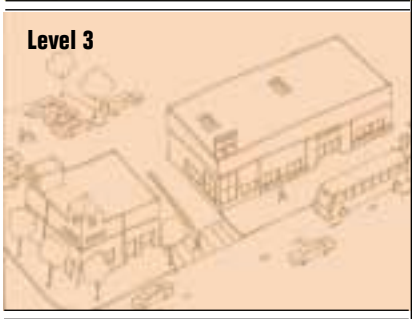
Visibility
- There should be two dimensions of visibility, in which stores lure from both pedestrians and slow-moving cars.
- A business' identity is tied to the overall business district in addition to the brand name of the store.

Connections
- The store and business district are connected with the surrounding neighborhood to increase pedestrian traffic.
- Connections with other businesses increase parking efficiencies.
- Connections with other businesses are vital in creating the business district as a shopping destination.

Density
- Usually there is multi-story development and less parking.
- Typical densities are at least 0.5 FAR for a common main street, but an FAR of 2 or higher is not uncommon.
- A variety of land uses often are located together on the same parcel or block.







Bridging the Gap: A Spectrum of Walkable Design

Auto-oriented and walkable forms of development may seem entirely at odds. However, in the last 20 years many communities and businesses have developed new commercial businesses that successfully meet the needs of both the auto and the pedestrian. In fact, like so many things in life, there are many shades of gray between the prototypical auto-oriented design and the ideal pedestrian-oriented design. In this chapter of the toolbox, we will examine a variety of ways to increase the pedestrian attractiveness of several types of retail environments.

These types of retail environments are divided into four levels as follows:

Level 1: Pedestrian Appliqué Design

Buildings and sites are designed with mostly auto-oriented characteristics but have added facilities for pedestrian access.

Level 2: Integrated Pedestrian Design

This includes buildings that have many auto-oriented characteristics, but the site design has been modified to better integrate into a pedestrian area.

Level 3: Prevailing Pedestrian Design

In this design, the interiors of buildings often conform to the design requirements of larger chain stores, but both the exterior of the buildings and the site design have been modified extensively to develop a pedestrian-oriented environment.

Level 4: Storefront Commercial

In this level, the traditional street-oriented design is primary. The focus is on the main street commercial development, with extensive modification to the interior and exterior of buildings.

Identifying A Suitable Site For Each Level

Selecting appropriate environments is the first important decision in developing pedestrian friendly areas. Requiring a Level 4 storefront commercial building on an isolated freeway interchange with no source of pedestrians would be a mistake. If the buildings were ever built, they would fail to attract much business. Indeed, many main streets have failed after their environment was disrupted by highway improvements. The following are essential elements to consider in deciding what level of pedestrian friendliness is appropriate.

Understanding the requirements of each level of design also tells us how to improve key areas and better fit one of the levels of walkable development.

The Walkability Survey

On the next page is a scorecard to use as a guide in determining how walkable areas in your city could be, based on current plans or those under consideration.

Source of pedestrians
One of the first decisions to make is where the pedestrian shoppers will come from. Choose the most prominent destination in the vicinity where pedestrians will most likely be coming from or areas where a source of pedestrians can grow; then score accordingly, not to exceed 4 points.

Transit service
Transit access and frequency can help determine the amount of pedestrian activity a development realistically can expect and reduces the need for parking. Since most riders walk to transit stops, pedestrians activity increases near transit service. Choose the following statement that best describes the development site, not to exceed 4 points.

Street connectivity
Determining the level of connectivity in an area will help establish a site's accessibility. Connectivity is the variety of ways and means available to reach a location. Calculate the number of intersections within a 1/2 mile radius that will exist after planned buildout of an area, not to exceed 4 points.

Traffic characteristics
It also is important to have traffic speeds that are conducive to safe walking. The faster traffic moves, the less pleasant the pedestrian environment. Choose the appropriate posted traffic speed, not to exceed 2 points.

Street characteristics
The physical make up of a street, such as sidewalks, street trees and on-street parking, is important in providing a safe and pleasant pedestrian environment. Add points for existing or proposed amenities, not to exceed 6 points.

THE WALKABILITY SURVEY

Use the survey to measure the effectiveness of the plan in creating a pedestrian-friendly environment.

PROXIMITY TO PEDESTRIANS

(Add together the points in this section)

Proximity to a college or similar:
within 2 miles 1
within 1 mile 2
within 1/2 mile 3
within 1/4 mile 4

Employees within 1/2 mile radius (500 acres):
500 to 1000 1
1000 to 2000 2
2000 to 4000 3
over 4000 4

Number of residences within 1/2 mile radius (500 acres):
500 to 1000 1
1000 to 2000 2
2000 to 4000 3
Over 4000 4

score: _____ *(6 points maximum)*

ACCESS TO TRANSIT

(Frequent =15 minute headways)

Frequent peak-hour transit service within 1/4 mile 1

All day frequent transit service within 1/4 mile 2

Adjacent to peak-hour frequent transit service 3

Adjacent to all day frequent transit service or light rail within 1/4 mile 4

score: _____ *(4 points maximum)*

STREET CONNECTIVITY

Intersections within 1/2 mile (500 acres)
40 to 60 1
60 to 100 2
100 to 140 3
over 140 4

score: _____ *(4 points maximum)*

APPROPRIATE TRAFFIC SPEEDS

Posted traffic speeds on primary streets:
35 m.p.h. or less 1
25 m.p.h. or fewer 2

score: _____ *(2 points maximum)*

ROW CHARACTERISTICS

Will connected sidewalks be present? 1
- 8 foot sidewalks? 2
- 12 foot sidewalks? 3
Will there be street trees? 1
Will there be on-street parking? . . 3
Will shared parking be available? 2
Will crosswalks be present and at minimum every 300 feet? 1
Will crosswalks be signalized or protected? 1

score: _____ *(8 points maximum)*

SCORING:

2-6 points . . . . . Plan supports Ancillary Pedestrian Level 1

6-12 points . . . . . Plan supports Integrated Pedestrian Level 2

12-18 points . . . . . Plan supports Prevailing Pedestrian Level 3

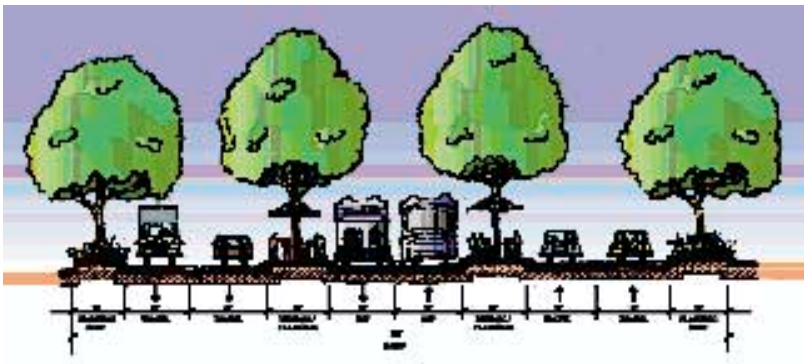
Over 18 points . . . . . Plan supports Storefront Commercial Level 4

Consider land and streets together

A walkable district cannot thrive unless there is a good fit between building and street design. This is because the way a street is designed has a great deal to do with the appeal of adjacent buildings. Pedestrians do not simply visit individual buildings; they experience the overall environment created by the design of both buildings and the street.

Much of this chapter addresses site design and building considerations, but streets must be designed to balance the needs of all forms of travel so that walking and as a result, transit use, are viable choices in getting from one place to another. Streets should be thought of as a conduit to move people, not just cars.

Some areas are good candidates for walkable commercial development at levels 3 and 4 except that the street right-of-way is a poor fit. In these areas, cities should consider modifications to the right-of-way to improve their ability to handle multiple forms of travel, especially walking. Chapter 3 has several examples of cross-sections that represent how the wide street rights-of-way typical in Utah can be modified to become attractive, pedestrian-friendly streets. Some of these options, such as a double-median boulevard, can maintain reasonable traffic flows and are therefore are suitable to state highways. Also see Chapter 9 for more information on street design.



Utah's wide right-of-ways have the advantage of being able to accommodate a boulevard or parkway design. Boulevards and parkways can have dedicated lanes for transit in addition to through-traffic lanes for long trips and local traffic lanes serving pedestrian-oriented buildings for shorter trips.

▶ TODAY'S PARKING REQUIREMENTS

Typical zoning and industry standards act to require enough parking that:

- **Parking is 50 percent vacant for 50 percent of the year**
- **Parking lots that are 85 percent full are "functionally" full**
- **Parking lots are "functionally" full only 20 hours a year (0.3 percent of the year)**

Parking demand myths

A common feature of modern zoning ordinances is that there is a minimum off-street parking requirement. These requirements usually are expressed as a ratio proportionate to the gross leasable area of the building. For example, a 1,000 square foot building may be subject to a standard of providing five spaces per 1,000 square feet. The ratios largely have been determined from "rules of thumb" that govern the real-estate industry for developing and using postwar buildings such as shopping centers.

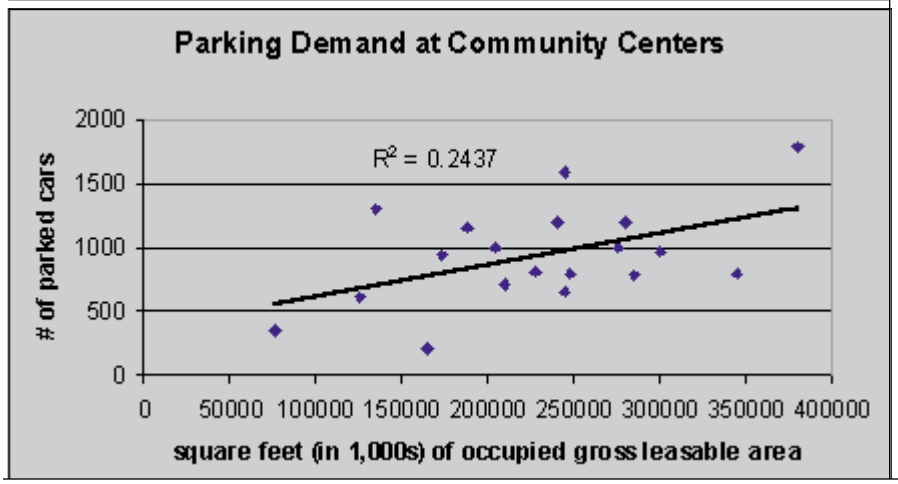
Industry standards

Since it is important for auto-oriented development to entice consumers with available parking, parking lots are designed so that they have capacity to accommodate the peak hours of the year, statistically December 12, from 1 to 3 P.M. – less than 1 percent of the hours a shopping center is open per year. During this time, the "functional capacity" reaches 85-95 percent – the standard in which patrons should be able to find a parking space as soon as they enter the parking area. This means that more than half the spaces are empty for 50 percent of the 3,000 hours a year a center is open — and are almost never actually used to 100 percent capacity. In a study by the Urban Land Institute (ULI), 43 percent of shopping centers reported that their parking lots were never full, and only 25 percent reported being "functionally full" for 10 days a year.

How does this standard compare with measurements of how parking is actually used? In a ULI national survey of parking use, shopping centers of fewer than 600,000 square feet were oversupplied by one parking space per 1,000, 50 percent had demand for fewer than four spaces, and 14 percent had fewer than three.

ULI data further shows that there is a very poor correlation between the size of a business and its parking demand. In regional centers, the standard relationship of parking spaces per square feet explained only 10 percent of the variation in the data (show graph). Clearly, there are better ways than looking at a building's size to estimate the amount of parking needed. There are many examples of pedestrian-oriented businesses and shopping areas that do quite well on 2.5 spaces per 1,000 or fewer—by having on-street parking, shared parking, and an environment that invites shoppers to walk.

In a national survey of Regional Shopping Centers, a standard parking ratio line explained only 9% of the variation in parking demand. (ULI, 1999)



New parking standards for pedestrian-friendly businesses

In areas where a local government wants to encourage pedestrian activity, it should adopt lower parking requirements. Even in Level 1 areas, parking requirements should be lowered from the 4.0 to 5.0 ratios predominantly in use today to acknowledge the way parking is actually used based on national surveys. Lower requirements do not necessarily mean less parking will be built, but they free developers to balance the needs of automobile users with the financial constraints of development and the desire for walkable site and building design.

Recommended basic parking requirements:

Level 1: 4 spaces per 1,000
Level 2: 3.5 spaces per 1,000
Level 3: 3 spaces per 1,000
Level 4: 2.5 spaces per 1,000 or less*

Standard parking ratios leave 50% of parking empty 50% of the year. (ULI, 1999)

Provisions for lower requirements

In addition to these reduced basic parking standards, local governments should give parking credits or should lower standards in certain instances, such as:

1] Adjacent on-street parking always should be credited toward meeting parking requirements.

2] Parking requirements can be partially or completely met through "in-lieu" fees earmarked for a future shared parking facility.

3] Lower standards should be applied when development is proposed near a shared parking facility. In some main street or downtown areas where there is sufficient public parking, no off-street parking should be required.

4] Lower standards should be applied if development is proposed adjacent to high-frequency transit or within one-half mile of a high-capacity transit station or transit center.

▶ WHY PARKING STANDARDS MATTER SO MUCH

■High parking standards can be devastating to the formation of a walkable district.

■First, large surface parking lots separate buildings and increase walking distances – people are much less likely to walk because of the inconvenience.

■Having substantial separation between buildings also works against the natural formation of a business district. Businesses seeking to relocate understandably do not view separated or spread-out commercial areas as a destination district where people will arrive and then visit multiple businesses. They see these areas instead as a collection of unrelated businesses.

■Surface parking competes against a building's footprint for the available lot area, reducing development intensities — the more surface parking on a site, the less room there is for a building. High parking requirements increase development costs by forcing a developer to find a larger site for a proposed building. Parking requirements are especially onerous for potential redevelopment projects that often are the best locations for walkable districts (see Chapter 4, Reuse and Infill).

Level 1: Pedestrian Appliqué Design

These strategies are best used in areas with heavy auto use and little potential for pedestrian activity. Traditionally, auto-oriented commercial structures created poor walking environments with vast parking lots and minimal or no sidewalks. However, new parking areas can be designed and old structures retrofitted to cater to the car while providing safe and attractive pedestrian access.

Sidewalks and crosswalks are essential in providing safe access for pedestrians. Perimeter sidewalks are the first step in allowing pedestrian access to a business. However, narrow sidewalks or sidewalks too close to a busy street will feel unsafe to pedestrians, and therefore are less likely to be used. Sidewalks should be at least five to eight feet wide and be set apart from streets with a planter strip or even a low decorative wall. In addition, if pedestrians must cross through busy, fast-moving traffic without a safe crosswalk, a perimeter sidewalk is meaningless. Even the most auto-oriented business has pedestrian activity generated from motorists getting out of their cars and walking into a store. Therefore, safe access needs to be provided through sidewalks and pedestrian amenities connecting parking areas and store entrances, such as wide raised walkways and ample landscaping.

Fred Meyer, Salt Lake City, Utah

- Adjacent to busy arterials on all sides, this large retail chain has still managed to provide some pedestrian amenities.
- Landscaped sidewalks surround the site, as well as two walkways that run through the parking lot, allowing safe pedstrian access from the street.
- The building has multiple entrances.
- Both structured and surface parking is available.

Design Principles:

- Appropriate for locations with large volumes of auto traffic, near busy arterials and at highway exchanges.
- Architecture is designed or modified to be at a comfortable scale for pedestrians, while still attracting attention from the street.
- There often is only one entrance.
- Parking is in front but is punctuated by landscaping in medians and along pedestrian paths.
- Parking supply: (4 spaces/1,000 square feet)
- Buffer developments from busy streets by placing smaller retail buildings along the perimeter of the parking lot.
- Landscaping includes street trees and landscape buffers between parking, pedestrian areas and the street.
- Streets should enable safe crossings for pedestrians through strategies such as medians for "pedestrian refuge" and wide visible crosswalks.
- Sidewalks should be wide, at least eight feet, and be buffered from busy streets.


Seattle, Washington


Draper, Utah


Portland, Oregon


Portland, Oregon

Level 2: Integrated Pedestrian Design

Integrated pedestrian design begins to treat pedestrians as equally important as the car. Although parking is still prevalent and visible from the street, walking distances have decreased substantially from Level 1 because the buildings are now adjacent to the street.

Building design has not changed substantially. There is still one primary entrance, and building architecture is similar to Level 1. However, the building has been modified to provide a comfortable pedestrian area along the street and sidewalk through display windows and appropriate landscaping. Parking most often is located to the side of the building, still fronting the street and sidewalk. Landscape buffers between parking and the sidewalk, such as shrubs or a low wall, are important to create a safe and pleasant environment for walking. Although parking is still prominent, fewer parking spaces are needed because there are more pedestrians in the area.

Integrated pedestrian design is realistic for areas with moderate pedestrian activity. It also can be a feasible solution for retrofitting existing commercial buildings. Adding smaller retail around the perimeter of a larger parking area can turn an under-utilized Level 1 commercial building into a more profitable and desirable retail environment.

Sugarhouse Commons, Salt Lake City, Utah

- The Commons, located adjacent to Interstate 80, is a retail shopping center which covers one full city block.
- The design includes pedestrian circulation and amenities, such as outdoor dining and sitting areas, a small open space and stream, and sidewalks connecting buildings within the project and adjacent uses.
- The parking areas and sidewalks are landscaped with attractive trees and shrubs.

The net effect of this building and site design is to create a built environment that is safer and much more convenient for walking.

Design Principles

- Appropriate locations include collectors and moderately busy arterials within walking distance to offices, business districts and residential areas, but not near freeway interchanges.
- Architectural details, such as walls facing the street, are broken up with openings.
- There usually is one entrance facing parking, but it often borders the sidewalk.
- Building orientation often is sideways, with one or more walls adjacent to the street.
- Parking is located on the side with buffers between parking and street.
- Parking supply: (3.5 spaces/1,000 sq. ft.), plus credits for on-street parking.
- Landscaping includes street trees and landscape buffers — in developed areas, short decorative walls often are more appropriate than trees or shrubs because they better maintain the character of a streetscape.
- It is necessary for the street network to include adequate access and connections should be provided to areas with high pedestrian volumes.
- Streets incorporate on-street parking, wide sidewalks and safe, efficient pedestrian crossings.


Bountiful, Utah

Denver, Colorado

Portland, Oregon

Salt Lake City, Utah

Level 3: Prevailing Pedestrian Design

Although prevailing pedestrian design is often found along relatively busy streets, the pedestrian realm is safe and inviting. Parking is no longer a dominant feature; it is located behind buildings with minimal curb cuts for increased pedestrian safety. The automobile is not the motivating force behind commercial design. Sidewalk widths are generous to accommodate a wide variety of activities, and store fronts are designed to welcome the passing pedestrian.

The interior layout of stores still mimics the traditional "big box," but exterior architecture is much more pedestrian-oriented. Prominent doors and display windows face the street and sidewalk, creating a "human scaled" design. Often the exterior façade is visually broken with vertical and horizontal architectural details, thus making a large solid wall appear less massive. This can create the illusion of smaller shop fronts. Another alternative is to actually line a larger commercial building with smaller shops. Regardless, the overall result is a less dominant and overbearing structure that is welcoming to pedestrians.

Redmond Town Center, Redmond, Washington

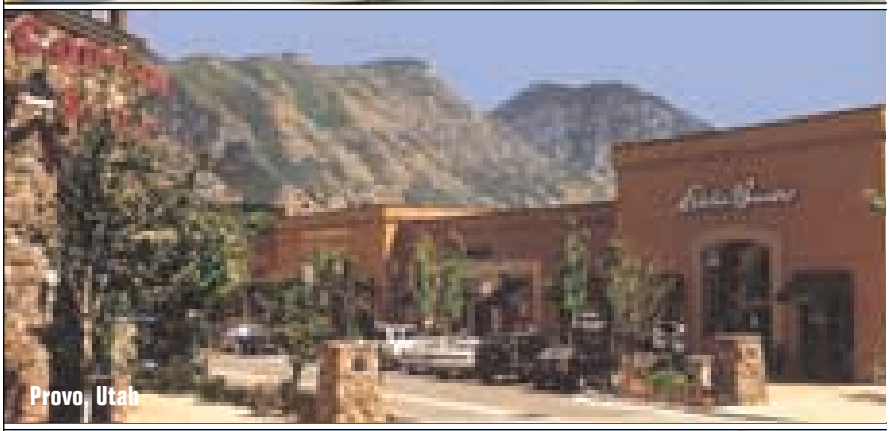
- The Town Center is an open-air mixed-use center comprised of 120 acres of retail, offices, and entertainment, as well as a 40-acre greenbelt.
- The project is designed to be an extension of the existing downtown corridor.
- Streets with the Town Center are laid out in a modified grid pattern, much like Redmond's existing street network.
- Parking is accommodated through structured parking as well as some surface parking located behind buildings.

Design Principles

- Locations include busy streets, but with increased pedestrian activity such as near business districts, residential and/or office. Sites also can be on the edge of a storefront commercial district.
- Architecture is human scaled with street/sidewalk facing windows, minimal blank walls and aesthetic interest.
- Entrances are prominent and street facing. There often are two entrances, a pedestrian entrance and an ancillary auto entrance. When one only entrance is provided, it faces the street.
- Buildings abut the street front and sidewalk on at least one side. Parking is located at the rear, although access to parking often is from the main street.
- There is no parking between the building and the street. On-street parking is beneficial for drawing patrons to individual business and the district; large parking areas are divided into traditional blocks sizes with sidewalks and pedestrian crossings.
- Parking supply: (3 spaces/unit) Credits and "in-lieu of" programs are encouraged, as are lower requirements near transit or shared parking.
- Landscaping includes street trees, landscaping and trees in parking areas and along bordering walkways.
- Street network design requires a connected street network with no "superblocks".
- Street design should incorporate wide sidewalks, pedestrian-friendly intersections, frequent crosswalks, traffic calming measures such as bulbouts and on-street parking.


Seattle, Washington


Portland, Oregon


Provo, Utah

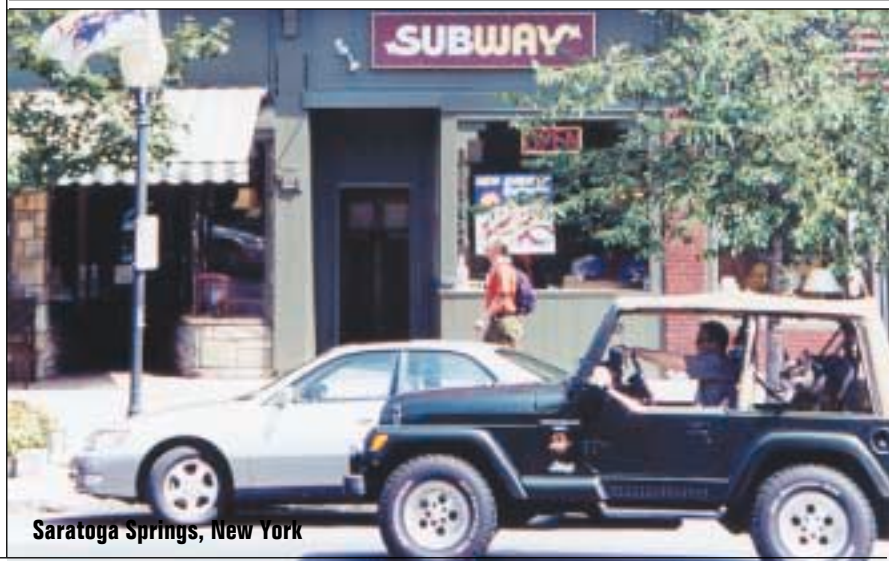
Seattle, Washington

Level 4: Storefront Commercial

Storefront commercial is the most pedestrian-friendly of the four design levels. New storefront commercial follows the model of cities' historic main streets. The setting is immediately engaging for both the motorist and the pedestrian. Narrow streets allow for safe pedestrian crossings and ample time for motorists to be enticed out of their cars by inviting shops and engaging streetside activities. Buildings front an ample sidewalk with room for outdoor seating, walking and window shopping among a lush canopy of street trees. Often, a community or developer has set aside space for plazas and courtyards where pedestrians can listen to a concert or sit and enjoy the outdoors. The physical landscape of a storefront commercial district is extremely important in attracting pedestrians. However, the district's proximity to stores and services that lend themselves to pedestrians (housing, employment, schools, other commercial centers) is equally important. In addition to providing adequate connections to adjacent districts, designing a mix of uses within a storefront commercial district can further ensure pedestrian activity. Historic main streets again can be a model for these "mixed-use" centers.

Traditionally, retail and commercial uses were located at street-level, where they could be the most visible. Residential units and offices were placed above or within short walking distance. Applying mixed-use design principles within a storefront commercial district will promote a vibrant, desirable pedestrian-oriented community.


Seattle, Washington



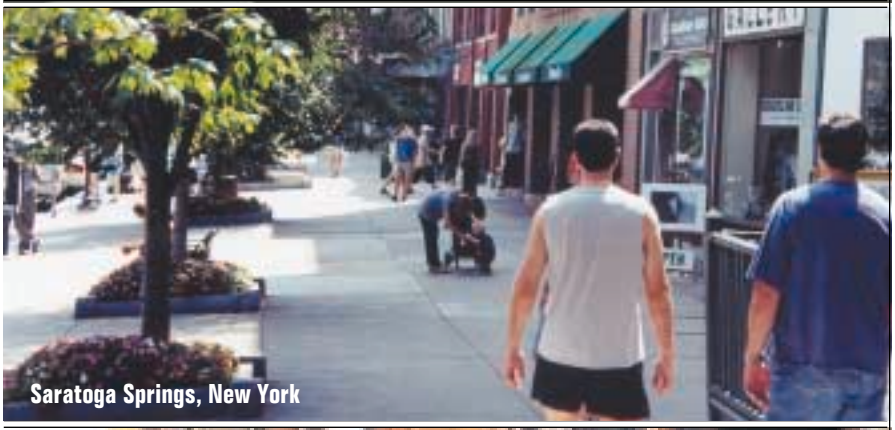
Saratoga Springs, New York

The Gateway: Salt Lake City
The 3.2-million square-foot project integrates residential, office, cultural, retail and entertainment uses on a 30-acre brownfield site, formerly a Union Pacific rail yard.

- Developers hope Gateway will initiate urban infill between central downtown and the project site, resulting in "a contiguous, vibrant, two-mile circulation loop and greater connectivity in the urban core."
- The project includes many pedestrian gathering areas, including a restored, historic railroad depot and an open-air plaza.
- An internal street creates a pedestrian-oriented atmosphere through architecture and sidewalk design, yet allowing for auto access and parking.

Salt Lake City, Utah


Orenco Station, Oregon


Saratoga Springs, New York


Chicago, Illinois

Design Principles

- Appropriate located along narrow, slower speed streets within a business district, close to offices, residential, or near any area with high volumes of pedestrian traffic.
- Architecture should be human scaled with plenty of widows facing streets and sidewalks and no blank walls. The design should be consistent with surrounding architecture and create visual interest by using horizontal planes and vertical articulation (this can be accomplished through the illusion of multiple storefronts).
- Prominent, multiple entries.
- Businesses are oriented to the sidewalk and street front, providing easy access for pedestrians, transit riders and cars.
- Parking should be located to the rear of buildings, or under, if feasible. It should be accessible but not a prominent focal point.
- Parking supply: (2.5 or fewer spaces/1,000 sq. ft.) The number of parking spaces can be reduced greatly through credits and "in-lieu of" programs, nearby transit and shared parking with adjacent businesses or nearby parking facilities.
- Basic landscaping should include street trees and any needed buffering, such as between sidewalks and parking lots.

- Street network design should provide connectivity to adjacent uses, neighborhoods, districts and arterials; no barriers should exist between parking of adjacent firms.
- Street design encompasses narrow streets with large three-zoned sidewalks (sidewalks include a facilities zone for street trees, benches and transit shelters; a wide travel zone for walking; and a frontage zone for outdoor seating, signage, displays or widow shopping). Traffic calming measures such as bulbouts, pavement variation, raised crosswalks and on-street parking calm traffic to keep speeds moderate and provide a safe pedestrian environment.


Redmond, Washington


Seattle, Washington


Portland, Oregon


Jackson Hole, Wyoming

Planning for Walkability

The most effective method to create pedestrian-friendly districts is to use a three-pronged approach to implementation: regulation, public infrastructure and partnerships between private organizations and public agencies. Regulations are tools that shape the form of private investment, such as the location of buildings and parking, the form and size of buildings, and basic design features such as the size and location of a garage door. Regulations can affect the likelihood that development will occur where it is wanted and can discourage incompatible development; however, they alone do not directly alter the built or natural environment.

On the other hand, public investments are direct expenditures that change the form of the built or natural environment, such as changes to the street right-of-way. Public investments can improve an area single-handedly and also can change the climate in which private decisions are made (more information in Chapter 4, Reuse and Infill).

Partnerships involve a sharing of efforts, money, or expertise between a local government and either another governmental agency, a business entity or private person, or a nonprofit organization. Partnerships can accomplish a wide array of goals, such as developing the land, providing pedestrian amenities and street improvements, and ensuring adequate housing near a business district.

The first step is to identify the areas within a city with the best characteristics or most potential to support pedestrian-oriented commercial districts. The walkability index is a tool available to identify these areas. An important note is to use the scorecard considering both what exists now and how the area could be reasonably modified.

Our physical environment is shaped by private investment that is regulated by the public, public infrastructure and by partnerships.

Comprehensive planning

Once a community has identified strategic locations for walkable development, these areas should be identified in a comprehensive plan. The next step is to support the envisioned character of each area with public investments and revised regulations.

Public Investments

Public investments and public investment policies are key in ensuring that changes to public infrastructure support a walkable community. Without them, street rights-of-ways may either stay incompatible with pedestrian-friendly development, or incompatible public infrastructure could be built that disrupts the walkable character of an area. Public investments to encourage walkable development include:

Right-of-way improvements

- Sidewalk widening
- On-street parking
- Street trees
- Sidewalk bulbouts and median pedestrian refuges
- Street beautification

In some instances, disconnected streets, such as dead ends, can be connected. This often is quite expensive and generally applies only where potential connections rest on vacant land. Where costs are prohibitive to connect existing roads, pedestrian connections accomplish many of the same benefits but at a reduced cost.

Traffic calming devices are sometimes appropriate to lower traffic speeds enabling pedestrian traffic to flourish. Traffic calming devices are discussed in Chapter 3, "Making our Community a Good Place to Walk."

Shared parking facilities are invaluable public investments in pedestrian districts partly because they mean landowners do not have to provide large amounts of off-street parking.

Regulations

After updating the comprehensive plan, a city should support or initiate zone changes to help create a walkable commercial district or actively pursue zone changes. What follows are specific zoning ordinance strategies:

■ *Zoning*

●*Land use modifications*

Walkable commercial districts are created not just through the design and land-uses of the immediate district, but they also must have a market of potential pedestrians within walking distance. Existing commercial zoning in these areas always should allow residential development. In more vibrant pedestrian areas, residential land use should not be allowed on the first floor. In addition, overly large commercial districts that act to discourage the development of nearby housing and office uses should be divided into a core commercial district with surrounding residential, office or more mixed-use zoning.

In many cases, busy collector streets that run through predominantly residential areas may be appropriate for the location of small pedestrian neighborhood

centers. Zoning for these centers should allow only low intensity structures to ensure a relatively low impact on surrounding neighborhoods.

Because offices, college campuses and hospitals provide a viable source of pedestrian-oriented consumers, walkable commercial districts are an excellent fit with these land uses. Another popular reason for pedestrian-friendly areas are tourist locations and specialty shopping districts (such as antiques, ethnic goods or art). Areas with appropriate street design and traffic characteristics are excellent places to encourage new pedestrian districts.

Architectural compatibilty can help a large retail store, such as this one in Salt Lake City, retain the character and pedestrian scale of the surrounding commercial district.

■ ***Development standards***

●*Maximum intensities*
The private sector almost always is the primary engine behind creating a walkable business district. Therefore, it is important to allow enough development intensity to make new development in these areas financially viable. This is especially important in built-up areas where more expensive redevelopment will be the primary method through which change will occur (more in Chapter 4, Reuse and Infill).

●*Minimum intensities*
In vacant areas where a new walkable commercial development should be encouraged, zoning standards should specify either a minimum FAR (preferred) or maximum parking standards to ensure new development is compact enough.

Code Strategies

Envision Utah's website is a source of zoning code strategies for walkable commercial districts. The document "Urban Planning Codes for Quality Growth" is an additional source.

Generally, if a community feels that the underlying zoning in an area is generally appropriate to the allowable land use mix and building sizes and scales, the adoption of a "pedestrian overlay zone" is a straightforward and relatively painless approach to creating the regulatory environment for a walkable commercial district.

A pedestrian overlay zone acts to modify the base zone. Examples of what a pedestrian overlay might include are:

- A set of superseding site design standards such as those listed below:
- Provisions for housing density bonuses.
- Lower parking requirements and a parking credit mechanism.
- Minor modifications to allowable land uses.
- Minimum FAR requirements.

If the overlay zone is used to create wholesale modifications to the underlying zone, a better approach would be to reexamine and modify the base zone itself or change the base zone designation.

Design standards that work

Design standards that are written clearly and unambiguously, based on measurement that can be made on a drawing of the proposed project, tend to be effective on many fronts. First, these standards tend to be more defensible legally and carry more legal weight. Second, they offer developers more certainty about the effect of standards. Often the uncertainty about these effects becomes more problematic to developers than the actual reality of meeting the requirements — making it essential to communicate clearly with the development community. Finally, objective standards are relatively efficient, both in terms of time and resources, to administer by small or large jurisdictions.

Objective architectural and site design standards for a walkable business district are included in "Model Codes and Ordinances for Quality Growth." Examples include:

- PARKING LOCATION: Parking areas shall be located behind buildings.
- ORIENTATION: Buildings shall have their primary orientation toward the street rather than the parking area. This primary entrance must be readily apparent as a prominent architectural component.
- BUILD-TO LINES: At least 60 percent of the street frontage shall have buildings within 10 feet of the front property line.

Athough it is located on a busy street, this Salt Lake City Starbucks provides pedestrian amenities such as a street front entrance, outdoor seating and landscaped sidewalk.

Although too much parking can kill walkability, too little stifles business. On-street parking has many advantages. On-street spaces are extremely visible, and they are used more efficiently than off-street spaces.

- WINDOWS AND OPENINGS: Any wall that is within 30 feet of the main street, plaza or other public open space shall contain at least 50 percent of the wall area facing the street in display areas, windows, or doorways.
- STREET TREES: One street tree shall be placed for each 30 feet of frontage for that portion of the development fronting the street.
- PEDESTRIAN SHIELDS (SYN): Buildings shall incorporate arcades, roofs, alcoves, porticoes and awnings that protect pedestrians from the rain and sun.

This Level 4 Fred Meyer in Seattle, Washington successfully blends into a neighborhood shopping district.

Partnerships

Partnerships are a valuable tool to help spark new, lively, pedestrian-friendly districts or to help create new momentum in an older district. A new project, if successful, can change market perceptions and thereby generate additional private development. In "hot" real estate areas, partnerships also are useful in providing land uses that the market would not provide. One example is housing, including for those with moderate incomes, in areas such as downtown where the market would provide only retail and office development.

Partnerships with groups of existing land and business owners can be used to finance the necessary right-of-way improvements to turn a potentially good walkable district into a great one. An example of a financing mechanism to accomplish this is a Local Improvement District, or LID. LIDs help properties finance needed capital improvements by forming special assessment districts. LIDs permit improvements to be financed and paid for over a period of time instead of in an up front lump sum. These districts have been used in various U.S. cities to finance wider sidewalks with bulbouts, remove medians to make room for on-street parking, and even build modern streetcars. Partnerships are detailed more fully in Chapter 4, "Reuse and Infill."

Conclusion

As automobile use unquestionably has grown in America over the decades, it has become an everyday part of life for many citizens. Accommodating those automobiles into our communities has been a challenge that many local governments have addressed forthrightly with requirements for street design that accommodate traffic and parking.

This chapter outlined strategies that will accommodate the needs of both cars and pedestrians. The goal is to show that the two needs are not mutually exclusive. Instead, strategies that address both people and cars can mesh together quite well, as many communities are finding successfully. In our efforts to integrate walking back into our communities as one of our primary forms of transportation, we should address the safety, convenience, and amenities needed by pedestrians — just as we have done in past decades for car use. Communities should not feel reluctant to require pedestrian-friendly design in areas where pedestrian activity is expected and encouraged. Street and building design to accommodate pedestrians is as equally justified as parking requirements and traffic accommodating streets — and a bonus is pedestrian requirements tend to be less expensive.

Walking is that vital transportation link that starts and ends every trip, whether it be by car, by transit, or simply a longer walk. If we can successfully bridge the gap between modern business models and pedestrian-friendly design we can build buildings, streets, and communities that accommodate many different means of getting from place to place.

The capacity of a street to move people can be very different depending on the form of travel. Pedestrians, bicyclists and buses occupy much less room than automobiles.

9 Public Safety and Residential Street Design

Introduction

A residential street serves a variety of purposes. These include providing access to homes and properties, the delivery of goods and services, the circulation and movement of vehicles, vehicle parking, allowing opportunities for interaction between neighbors, encouraging pedestrian and bicycle travel, and space for neighborhood amenities such as street trees, sidewalks and lighting that add charm and character to the neighborhood. Residential streets are corridors throughout neighborhoods linking properties and providing space for use by motor vehicles, pedestrians, bicyclists, and other uses. Recognizing the various purposes of residential streets, there should be an awareness that streets must function to meet the needs of the neighborhood. The design of residential streets offers opportunities to achieve a balance between motorized traffic and non-motorized travel with the promotion of an attractive and safe residential setting. These opportunities often focus on reducing the predominance of motorized vehicles, and correspondingly reducing vehicle speeds and traffic volumes.

Residential street design concepts that seek to reduce traffic volumes and traffic speeds are the foundation principles of neighborhood "traffic calming." This chapter focuses on balancing the purposes of residential streets and achieving a street environment where motorized and nonmotorized travel modes can harmoniously exist.

This chapter also reviews design opportunities to enhance the residential amenities of existing residential streets and identifies appropriate design criteria for new residential street construction. For existing residential streets, the installation of traffic calming measures may be appropriate to lower traffic speeds and volumes. For new residential streets, and to avoid future traffic speeds and volume problems, it may be necessary to modify existing residential street design and construction standards which balance vehicle mobility with the other purposes of the street. Residential street design has a significant influence on vehicle and pedestrian safety and neighborhood quality, stability and desirability.

Figure 1: Residential streets must serve a variety of purposes.

One definition of transportation is "the movements of goods and/or people from where they are, to where they have a higher value or want to be."[1] An efficient transportation system is a prerequisite for the efficient functioning of many social and economic activities.

Streets and The Neighborhood

The construction of wider and bigger roads has often been a response to meet the demands of the increasing numbers of vehicles within our communities. The construction of wider and bigger roads often means the acquisition of additional road right-of-way (ROW). A lesson learned by many cities is that if insufficient road ROW is available for road widening, additional ROW must be purchased, often at significant costs, which may include the purchase of structures and buildings within the ROW that must then be removed. A national trend has been to build bigger, wider roads to meet the needs of future traffic while still preserving additional ROW. While this may be wise for collector and arterial level roads, it usually only creates additional problems for residential areas. Wider streets mean increased traffic speeds and volumes with accompanying increased traffic noise and the loss of safety in the neighborhood.

A number of surveys indicate that residents believe street noise and heavy traffic in neighborhoods compromise the safety, amenity and quality of the street on which they live.[2] Other problems reported include:[3]

Traffic Accidents –The occurrence of accidents, or the fear of accidents occurring on residential streets in the neighborhood. Residents express a desire for residential streets less prone to accidents.

Noise, Vibration and Air Pollution – These aspects are felt to have a serious negative effect on the quality of life in a neighborhood.

Traffic Speed – Residents object to high traffic speeds because of less safety and increased traffic noise.

Traffic Volume – High traffic volumes are related to other issues including a loss of neighborhood safety and increased noise, vibration and air pollution.

Traffic Composition – As a reaction to noise residents complain specifically of trucks, buses and motorcycles in neighborhoods.

Appearance, Identity, and Maintenance – Increased traffic in residential areas is perceived to detract from the quality and appearance of the neighborhood.

Reduction of Street Activity – With high traffic volumes and associated noise the opportunity for neighbor interaction declines.

Impact on Land Use and Social Stability – High traffic volumes may lead to neighborhood instability and encourage land use changes to commercial and other nonresidential uses.

Neighborhood Crime – Streets with greater auto accessibility may be more susceptible to residential crime.

Figure 2: A major residential street located in Salt Lake City providing center medians, street trees, on-street parking and bike lanes.

Residents' concerns with traffic on residential streets seem to indicate a conflict between the expectations of vehicle drivers on the street and the expectations of those who live on the street.[4] "Residential street designs that promote moving vehicles over the other purposes of the street add to the potential for conflicts between the vehicle and the other residential values and amenities provided by the street."[5]

Balancing the Purposes of Residential Streets

Moving cars and trucks will always be a purpose of roads and highways. However, for residential streets, the recognition should be that cars and people share the space of the street.

The safest way for vehicles and non-motorized travel to exist together is to minimize their interaction using various techniques such as grade separation and other barriers that eliminate interaction between the different travel modes. While philosophically easy, the reality is there will always be a need for interaction. Whether crossing at a signalized intersection, or walking from the store to the car in a parking lot, vehicles, pedestrians and bicyclists will interact. To minimize vehicle, pedestrian and bicyclist conflicts it is necessary to consider and identify conflict solutions at several levels. These may include:

Education

Promotion of the concept that vehicles, non-motorized travel, and residents share the street. This may be achieved through community awareness campaigns including signage, advertising, public radio and television announcements. It is important that drivers of motorized vehicles be aware that others use the street and understand the needs of pedestrians and bicyclists using the street. Similarly, pedestrians and bicyclists must be aware of their environment. Accidents often occur because pedestrians and bicyclists do not obey traffic signals or do not look before crossing. Both groups must be aware of the other.

Minimizing Interaction

By reducing street crossing widths, for example, the interaction time between vehicles and pedestrians is reduced. Studies have shown that shorter crossing distance correlates to fewer accidents. A reduction in street crossing distances can be achieved by reducing the curve radius and cross-section of the residential street.

Visibility

Drivers typically expect pedestrians at intersections. For areas where pedestrians may be present, methods to improve driver awareness and the visibility of the pedestrian are important. While signing is the oldest method to inform drivers of a pedestrian crossing, drivers often become desensitized to signs, reducing their effectiveness. Actuated signage provides a dynamic indication when a

The Institute of Transportation Engineers (ITE) has defined "traffic calming" as "a combination, of usually physical measures, that reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users."[8]

pedestrian is in the area. In Boulder, Colorado, for example, dynamic flashing devices located on pedestrian cross walk signs and in-ground pavement lights are activated by pedestrians. Dynamic signage and messaging is effective in improving driver awareness to the presence of pedestrians. Other techniques of dynamic messaging to increase pedestrian visibility and driver awareness include the use of crossing flags by pedestrians and crossing guards.

Reducing Speeds

The ability of a vehicle to stop is related to its speed. If a vehicle's speed can be reduced by 50%, the distance necessary to stop can be reduced by as much as 200%. Reducing vehicle speeds is critical to making residential streets safer.[6]

For residential streets, a variety of options are available to allow a more harmonious environment for both vehicles and pedestrians. There is a need to balance residential traffic flow with local access and non-motorized travel. The approaches to balance the needs of the vehicle with the other purposes of the street often focus on techniques to reduce vehicle speeds and volumes. For residential streets, actions directed at reducing vehicle speeds and volumes are identified as "traffic calming."

Residential Streets and Neighborhood Design - History

Traffic calming is defined as being "any action or program that reduces street traffic and slows vehicles within residential areas and makes neighborhoods safer and more people oriented."[7] Traffic calming seeks to reduce traffic speeds and volumes to an "acceptable level."[9] For the residential street, reductions in vehicle speed and volume can lead to other benefits such as increased pedestrian activity, street safety and street life. Traffic calming techniques focus not only on improving the overall safety and livability of new residential streets, but also on identifying options to improve the safety and residential values of existing residential streets. Traffic calming concepts also encourage nonmotorised mobility in the neighborhood and the replacement of some vehicle trips with non-vehicle trips.

Early traffic calming techniques sought to promote pedestrian amenities and safety. By the 1930's, newly developing residential areas sought to enhance the safety of residents living on the street.[10] Perry, for example, writing in the early 1930's, suggested that "children should never be required to cross a main traffic street on the way to school."[11] By the early 1950's, several communities in the US, including Montclair, NJ,

Grand Rapids, Michigan, and Berkeley, California had installed traffic volume and speed reducing devices to protect residential neighborhoods from increasing vehicle speeds and volumes.[12]

In the 1970's, the Netherlands sought to take back the residential street from the exclusive use of the automobile and identified the concept of "shared space." Shared space is that place where residents and the automobile seek to co-exist.[13]

In the 1970's, Seattle, Washington, commenced experimenting with traffic calming devices in an effort to reduce traffic volumes in residential neighborhoods. Included in this testing was the Stevens neighborhood of Seattle, where various traffic control devices were installed in an effort to reduce cut-through traffic in the neighborhood. With the installation of a variety of permanent traffic control devices the Stevens neighborhood experienced significant reductions in traffic volumes, a fifty-six percent (56%) decrease in neighborhood traffic, and a corresponding and dramatic decrease in neighborhood traffic accidents.[14]

According to the Federal Highway Administration (FHWA), the objectives of traffic calming include:[15]

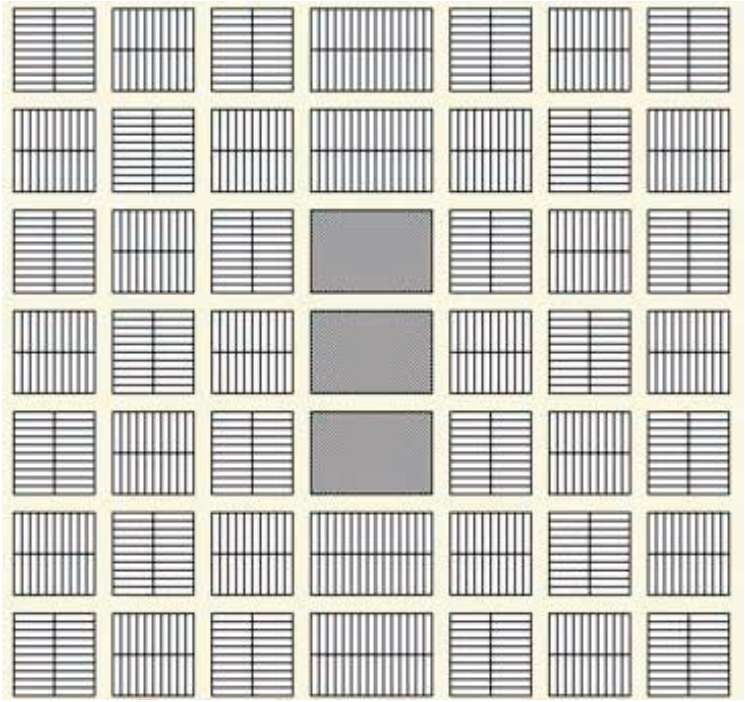
- Reductions in vehicle speeds.
- Safe and pleasant conditions for motorists, bicyclists, pedestrians, and residents.
- Improvements in the environment and livability of neighborhood streets.
- Improvements to the real and perceived safety for non-motorized users of streets.
- Discouraging the use of residential streets by cut through vehicular traffic.

Residential Streets in Utah

Utah communities typically have a street pattern based on the historic grid pattern. As originally planned, the design for Utah communities required that street ROW be 132 feet wide, bordering city blocks of 10 acres, measuring 660 feet square. The community and street pattern required that the length of each block did not exceed five (5) times the street width.[16]

Commencing with Salt Lake City in 1847, these community design

Figure 3



principles have now been applied, in some form, in virtually every Utah community. Although the width of blocks and street rights-of-way (ROW) may vary, the grid street pattern, at some scale, is the predominant development pattern of Utah communities.

The great advantage of the historic grid street pattern is that it disperses traffic and provides many direct routes of travel.[17] Because of these advantages, grid street systems encourage walking and biking. The contemporary residential street pattern in Utah communities today however typically employs large blocks, curvilinear streets, and a branching street pattern. These street systems seek to encourage lower traffic volumes. Both street patterns have advantages and disadvantages for traffic flows, pedestrian and biking activities and neighborhood safety and livability.

Many communities are now seeking to combine the advantages of the grid pattern and curvilinear residential street pattern. A residential street design pattern is emerging that includes the connectedness and direct routes of the grid system with the safety of the contemporary system.[18]

Providing safe residential streets in Utah is particularly important. Utah ranks first in the nation with the highest proportion of children in the population. Approximately 33% of the residents of a community are 0-17 years. The available forms of independent travel for this age group is either walking or biking. If Utah communities do not provide safe routes for walking and bicycling, a large proportion of the population are unsafe as they walk and bike within their community, or they must rely and become be dependent upon parents, or others, for transportation.

Narrower Residential Streets

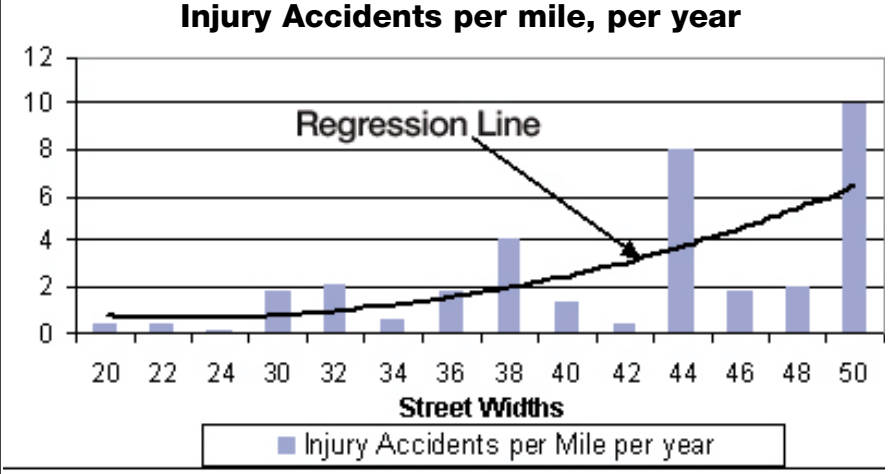
Narrower residential streets than generally accepted today were allowed in Utah communities at an earlier period. Many older, and some of the most desirable residential areas within Utah communities, were laid out with relatively narrow streets. This trend continued up to the early 1940's and 1950's when requirements for wider residential street ROW and pavement widths became the norm.

Several national organizations including the American Society of Civil Engineers, The National Association of Home Builders, and the Urban Land Institute are questioning the wisdom of communities continuing to require wide residential streets. "The tendency of many communities to equate wider streets with better streets and to design traffic and parking lanes as if the street were a 'micro freeway' is a highly questionable practice."[19] The design of a residential street that recognizes the various purposes of the street may occasionally require one driver to slow down or even pull over to let an oncoming vehicle pass. Residential streets should be

designed to have a human scale where pedestrians and residents feel "comfortable" on the street. Residential streets, which define the space for use by vehicles, and which must be crossed by pedestrians, should not be larger than is actually required. Wider streets than required to support local residential traffic also add to the long term street maintenance costs incurred by the community. Existing research demonstrates that vehicle speeds decline as street cross sections are narrowed. Working in the City of Longmont, Colorado, Swift and Associates looked at 20,000 automobile accident reports. The study, "Residential Street Typology and Injury Accident Frequency" determined that "the most significant causal relationships to injury and accident was street width and street curvature."[20] Accidents per mile per year exponentially increased with increasing street widths. Swift and Associates, using the accident information from Longmont, Colorado determined that the safest residential street width is 24 feet (measured from curb face). On the narrower streets, 20 and 22 feet, the number of accidents reported was low, but because a number of these streets were "half streets" other factors potentially contributed to accidents, independent of street width. (The results of the Swift and Associates study for streets narrower than 24 feet remain as inconclusive.) Figure 4 provides a summary of the findings of "Residential Street Typology and Injury Accident Frequency."

Pedestrian activities on narrow streets are also encouraged. "More elderly users, more people out walking pets, and more pedestrians crossing back and forth all attest to a level of comfort with traffic on narrow streets."[21] With the accompanying neighborhood benefits of narrower residential streets and the knowledge that wide residential streets encourage higher traffic volumes and speeds, resulting in less safety on the street, why have communities not universally accepted narrower residential streets? One answer may be that many neighborhood streets are designed for infrequent access by large vehicles, including trucks and emergency vehicles. Other communities may be concerned about encouraging activities on the residential street, including walking, jogging, and bicycling that may raise liability issues. Street designers may also design the residential street from the "center-line out" and often simply run out of available street ROW before bike lanes, sidewalks, landscape areas and other residential amenities are provided.[22]

Figure 4



Swift and Associates, "Residential Street Typology and Injury Accident Frequency."

"Bicycle and pedestrian ways shall be established in new construction projects and reconstruction projects in all urbanized areas with few exceptions." [72]

Recognizing the benefits of narrower residential street designs, communities across the nation are now revising residential street standards to require narrower street pavement widths and designing the street to accommodate everyday use, while still protecting emergency vehicle access.[23] It is interesting to note that with the need remaining to provide emergency vehicle access, residential street designs in British and Australian communities allow, or require, narrower pavement widths and tighter curve radii than typically allowed in US communities.[24]

The benefits to a community of allowing narrower residential streets include:[25]

- Increasing vehicular and pedestrian safety, and encouraging bicycling and walking as a viable transportation method.
- Adding to the safety, amenity and value of the neighborhood.
- Encouraging efficiencies in land use, and allowing areas that would have been paved to provide space for other uses and activities, including landscaping and sidewalks.
- A reduction in water runoff, and pollution, with less hard surfacing.
- A reduction in street maintenance costs.
- Reductions in the initial street construction costs.

Some of the community initiatives for safer residential streets include:

- Requiring narrower pavement widths to create a sense of place.
- Requiring street amenities and furniture, such as benches and pedestrian-scale street lighting.
- Providing wider park strips to encourage the establishment of large street trees.
- Requiring roundabouts at higher volume intersections, and requiring short curve radius, bends, and other slow points in the residential area.
- Providing necessary street connections, bicycle and pedestrian access.
- Establishing maximum block and cul-de-sac lengths.

A consideration of narrower residential streets should occur within the context of total street design, ensuring the purposes of the street continue to be met.

Options for Street Design to Enhance Safety

Peaceful, quiet residential streets and neighborhoods are the desires of citizens. To achieve these goals the design of the residential street should place a priority on moving low levels of traffic in an environment of quiet and safety. Improving the residential amenity of the residential street can be strengthened if it is treated as a residential place, with amenities being provided for

pedestrian use, such as adequate and connected sidewalks, street trees, pedestrian scale signage and lighting, benches and other features. Priority should be given to the non-motorized forms of travel and the residential setting in which the street is located. Any negative effects to the residential setting, as the result of traffic, should only be allowed to the extent such traffic is necessary to support the neighborhood.[26]

A reduction in traffic speeds and volumes is key to making residential streets safer. Traffic calming techniques can assist in achieving traffic speed and volume reductions. Traffic calming techniques can be broadly classified as:[27]

- Physical Methods, including speed bumps, speed tables, traffic diverters, narrower street widths, short road lengths, traffic circles and roundabouts. Physical traffic calming methods are "self-enforcing" and generally do not require enforcement.
- Streetscape Enhancements, that impose the feeling of narrower lane and street widths by the use of street edge and landscaping treatments. Streetscape enhancements, such as street tree plantings, also usually seek to improve the attractiveness of the residential environment and the aesthetic values of the street.
- Regulatory Techniques, such as signs including stop, yield or speed signs. Regulatory techniques provide the advantages of a low capital cost but they require enforcement to be truly effective in reducing traffic speeds.

Examples of Traffic Calming Devices[28]

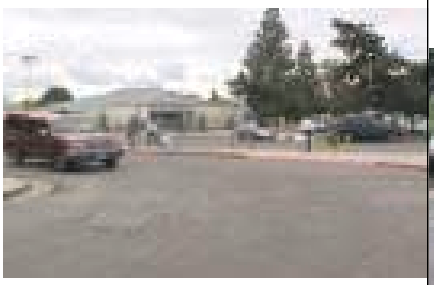
Bike Lanes – A portion of a roadway which has been designated by striping, signing, and pavement markings for the preferential or exclusive use of bicyclists.

Bulbouts/Neckdowns/Chokers – Curb extensions at intersections that reduce curb-to-curb roadway travel lane widths.

Center Islands – Raised islands located along the centerline of a roadway that narrow the width at that location.

Chicanes/Lateral Shifts – Curb extensions that alternate from one side of the roadway to the other, forming s-shaped curves.

Closures – Barriers placed across roadways to completely close through vehicle traffic.



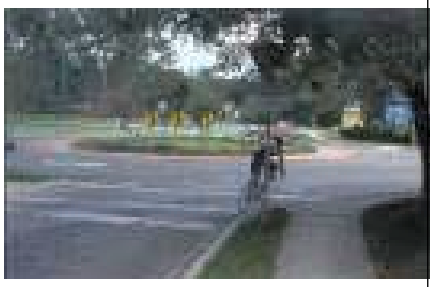
Diverters – Barriers placed diagonally across an intersection, blocking certain traffic movements.

Forced Turn Lanes – Raised islands located on approaches to an intersection that block certain movements.

Median Barriers – Raised islands located along the centerline of a roadway and continuing through an intersection to block cross traffic.

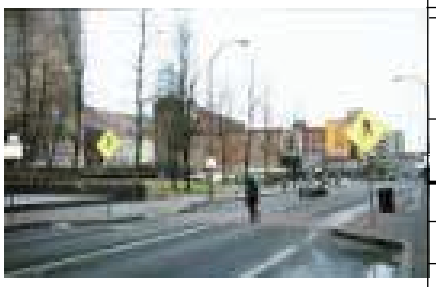
Realigned Intersections – Changes in alignments that convert T-intersections with straight approaches into curving roadways meeting at right angles.

Roundabouts / Traffic Circles – Barriers placed in the middle of an intersection, directing all traffic in the same direction.



Speed Bumps – Rounded raised pavement devices placed across roadways to slow and/or discourage traffic.

Speed Tables/Textured Pavement/Raised Crossings – Flat-topped speed bumps often constructed with a brick or other textured material to slow traffic.



Making Residential Streets Safer

Residential street designs that promote and maintain low traffic volumes and speeds will encourage the safety and attractiveness of residential areas.

Traffic Speeds

Reducing vehicle speeds on residential streets will increase safety on the street. By reducing vehicle speeds, shorter vehicle stopping distances are required and the driver has more time to respond to any vehicle, pedestrian, bicycle or other movements occurring on the street. Slower vehicle design speeds should be required on residential streets in order to encourage a street environment conducive to all forms of transportation, including all non-motorized and motorized transportation modes.

Table 1 highlights required stopping distances at selected vehicle

Table 1: Speed, Reaction Time and Required Stopping Distances

Speed (mph)	Total Perception and Reaction Distance (feet)	Required Stopping Distance (feet)	Total Required Stopping Distance (feet)
10	37	8	45
15	55	18	73
20	73	33	106
25	92	55	147
30	110	86	196
35	128	120	248
40	147	167	314

ITE, "Traditional Neighborhood Development – Street Design Guidelines."

speeds.[29] Stopping distances increase dramatically as vehicle speeds increase. For example, total required stopping distance increases from 106 feet to 248 feet (an approximate 230% increase) when vehicle speed increase by 75% from 20 miles per hour (mph) to 35 mph (Table 1). Clearly, vehicle speed has a significant effect on the safety of both motorized and nonmotorized users on the street.

Traffic Volumes

The number of traffic accidents occurring on the street is closely related to traffic volume. As traffic volume increases, more accidents are expected. For residential streets, traffic volumes should be low to increase safety for all users and the residential qualities of the street.

Transportation is a response to development and therefore traffic volumes increase because of adjoining land uses. Proper land use planning in residential areas understands the land use – transportation relationship. Permitting only land uses and activities on residential streets with low trip generation potentials, limiting street access points, and requiring a street designed for low traffic volumes will protect the functioning of the residential street, minimize neighborhood cut-through traffic, and preserve residential values.

Accidents

During 1999, 83,000 pedestrian-vehicle accidents occurred in the United States, accounting for 12% of fatalities occurring on US roads.[30] Of the 83,000 pedestrian-vehicle accidents in 1999, 20,000 or nearly 24% resulted in incapacitating injuries. Children under 16 years of age killed in pedestrian-vehicle accidents represented 12% of the deaths while the elderly, over 65 years, represented 22% of the deaths occurring in pedestrian-vehicle accidents. Pedestrians struck by a car traveling at 40 mph have a 15% survival rate. At 30 mph survival increases to 55% and a pedestrian struck by a car, moving at 20 mph, has a 95% chance of survival.[31] A reduction in traffic speeds on residential streets has a dramatic influence on pedestrian safety.[32] The influence of traffic speed on street safety is identified in Table 1, related to required vehicle stopping distances.

In Utah for 1991 - 2000, vehicles hit 8,610 pedestrians (54% were children 0-19 years) with 398 pedestrians killed.[33] Approximately 36% of those killed were children 0 - 19 years old. (The loss of children in vehicle – pedestrian accidents in Utah, 1991 - 2000, was twice (2x) the national average.) The majority of the vehicle - pedestrian accidents occur on two (2) lane streets, relatively close to home.

There were 7,755 vehicle - bicycle accidents, 1991 - 2000, in Utah, with 71 bicyclists killed. The majority of bicyclists killed or injured were children (0 - 19 years). Of those injured 68% were children 0 - 19 years.[34]

Fire and Emergency Medical Services

Recognizing the goal of providing low traffic volumes and low traffic speeds on residential streets, residential street designs must continue to allow necessary access for emergency vehicles. Traffic calming measures that are effective in reducing traffic speeds can have the same effect on responding emergency vehicles. The concerns of fire and emergency medical agencies with residential street designs that aim to reduce traffic volumes and speeds can be summarized as: (1) potential effects on response times, and (2) effects on the mobility and maneuverability of fire apparatus at the incident scene.[35]

While recognizing the values of traffic calming for increased safety in neighborhoods, fire departments are concerned about any traffic management action that may slow or inconvenience fire equipment and ambulance services. The larger and heavier vehicles used by fire departments must slow down more than private passenger vehicles and light trucks in order to negotiate a number of traffic calming devices.[36] Traffic calming devices, such as traffic humps and bumps, can also have a slowing effect on ambulances transporting patients.

Impacts on Fire Department Response Times

Fire response time is the time from when the fire call is first received by a dispatcher to the commencement of fire extinguishing operations at the scene.[37] Response time has a relationship to accomplishing actions related to saving lives and limiting property damage. Residential street patterns and designs can affect response times. The results of studies identifying the impacts of traffic calming actions on response times are presented in Table 2.

Communities where residential streets are designed to encourage lower traffic volumes and speeds have found that effects on emergency vehicle response times can be minimized by certain actions.[38] These include:

1] Close consultation with emergency response personnel in any residential traffic plan.

2] Providing that physical barriers are traversable by emergency vehicles.

3] Requiring that any primary response routes remain open.

4] Providing additional fire hydrants within the residential area and adjacent to any physical barriers.

5] Requiring multiple access routes in neighborhood street patterns.

Get to know your Fire Chief! Over the last decade, many designers, engineers, developers, local officials, emergency response personnel, and neighborhood residents have found themselves struggling over seemingly competing objectives when it comes to good street design. Ultimately, however, among the many values at stake in street design, public safety always emerges as the final arbiter. But even within this incontestable objective, a conflict has emerged that has only recently been thoroughly defined and studied, and is starting to be addressed: the seeming conflict lies between the need for rapid emergency responses to any location and acheiveing slow, safe everyday neighborhood streets.[73]

Fire agencies are also concerned with street designs that narrow street pavement widths. Many Fire Departments fear that narrow residential streets will also negatively effect response times and the ability of the Fire Department to establish fire suppression activities at the scene. The Uniform Fire Code, Section 902, requires that "fire apparatus access roads… shall have an unobstructed width of not less than 20 feet."[39] Fire access roads are to be constructed to provide an all-weather surface (*Uniform Fire Code, Section 902.2.2.2*). The Uniform Fire Code, Section 902.2.4.1, provides further clarification and identifies that required fire accesses shall not be obstructed "in any manner, including parking of vehicles." Clearly, the Uniform Fire Code requires that no residential street, providing fire access, would be less than 20 feet wide, and constructed to provide an all-weather driving surface.

Designing the street for the occurrence of on-street parking and assuming a width of a full size car to be 6 feet, a minimum street width of 26 feet (curb face to curb face) is sufficient to accommodate on-street parking and comply with the requirements of the Uniform Fire Code. A residential street pattern designed with low volume streets and multiple accesses to all properties can improve emergency vehicle response times from those achieved with contemporary street patterns with limited access points to properties.

Many Fire Departments are recognizing the value of narrower residential street designs. Boulder, Colorado, for example, has revised their neighborhood street standards to allow residential streets 26 feet wide with on-street parking.[40] In Portland, Oregon, various modifications have occurred to allow residential street designs, identified as "queuing streets," and allowing 26 feet street widths with parking allowed on both sides of the street.[41]

During the study period of "Residential Street Typology and Injury Accident Frequency" there was one serious fire and a number of smaller fires. No injuries or fire equipment access problems were

Table 2: Fire Response Times and Selected Traffic Control Devices

VEHICLE*	DEVICE A Time Delay (seconds)	DEVICE B Time Delay (seconds)	DEVICE C Time Delay (seconds)
Engine 18	1.7	2.3	4.3
Rescue 41	0.0	1.7	2.3
Squad 1	1.0	4.1	2.4
Truck 1	1.4	4.9	6.4
Truck 4	3.4	4.9	6.2
Truck 41	4.8	4.7	5.2

Summarized from *The Influence of Traffic Calming on Emergency Response Times*, ITE Journal, August 1997, Crystal Atkins and Michael Coleman.

Notes:
1. a. Device A = 22 foot Speed Bump; Device B = 14 feet Speed Bump; Device C = Traffic Circle
2. Delay is calculated with the desire to maintain a 30 mph Response Speed.
   Time Delay is the additional time required to respond due to the traffic control device. As a comparison, stop signs can add an additional 6 to 11 seconds to Response Time depending on the type of response vehicle.
3. Table 3 identifies Fire Vehicle Specifications

Table 3: Fire Vehicle Specifications

VEHICLE	TOTAL LENGTH (ft)	WHEELBASE (ft)	WEIGHT (lbs)	HORSEPOWER (HP)
Engine 18	29'10"	15"5"	34,860	185
Rescue 41	21'0"	11"6"	Na	185
Squad 1	27'0"	14'6"	23,170	275
Truck 1	48'0"	21'0"	53,000	450
Truck 4	57'0"	13'0"	53,960	450
Truck 41	37'6"	16'9"	42,100	350

The Influence of Traffic Calming on Emergency Response Times, ITE Journal, August 1997, Crystal Atkins and Michael Coleman.

reported, with the serious fire located on a 28 foot wide street.[42] For the study period there were a total of 227 automotive accidents with injuries reported. "Residential Street Typology and Injury Accident Frequency" identifies that "0.32 automotive injury accidents can be anticipated per year per mile on a 24 foot-wide street, compared to 1.21 on a 36 foot-wide street." "Even if narrow streets did create a moderately greater fire injury risk, they would be safer than wide streets, because the risk of automotive injuries is so much greater than fire injuries."[43]

Police Services

Police Departments usually express no opposition to traffic calming devices and residential streets designs to reduce traffic volumes and speeds because of the corresponding increase in street safety. Sometimes however, concerns are expressed with any physical barriers that minimize or eliminate access. The concerns of police agencies to traffic calming initiatives may be categorized as;

1) Physical barriers increase the difficulty of police surveillance by adding obstacles to access.

2) Traffic barriers hamper police pursuits.

3) Barriers can negatively affect police response times to calls for service.[44]

However, information from Minneapolis, Minnesota, does not support these concerns.[45] In Minneapolis residential blocks with lower accessibility, a characteristic typical of locations where calming is established, experienced lower residential crime rates than residential areas with greater accessibility, with similar crime-related social variables.[46] A study conducted in Berkeley, California, with various traffic calming devices reported that
traffic control devices did not negatively affect police surveillance in residential areas.[47]

Figure 5: Providing emergency vehicle access (25 foot pavement).

Figure 6: Residential street (26 foot pavement).

Figure 7: Residential streets must provide for a variety of vehicles.

Crime

A reduction in neighborhood crime should also be a goal of residential street designs. Studies conducted in Hartford, Connecticut and St. Paul, Minnesota indicates that the incidence of street crime is reduced in neighborhoods with street patterns and designs that reduce traffic volumes.[48]

Crime Prevention Through Environmental Design (CPTED) suggests that crime can be reduced in neighborhoods by designing residential streets to encourage surveillance by residents and others of the street space ("eyes on the street") and to create difficulties for entry and escape from the area. Residential street designs that encourage street activity and resident interaction, minimize neighborhood cut-through traffic, and provide complexity in the street pattern also discourage neighborhood crime.[49]

Noise

Traffic speeds and traffic noise are directly related. Experience indicates that lower traffic speeds will also lower traffic noise.[50] As a rule, resulting traffic noise is related to the square root of traffic speed. Residential street designs that lower traffic speeds will have a significant effect on reducing traffic noise in the neighborhood.

Traffic calming measures designed to reduce vehicles speeds will generally have the effect of reducing neighborhood noise levels. However, increased noise levels have been reported with some vertical deflection devices, such as humps and bumps, due to vehicle noise associated with traveling over the device and vehicle acceleration after the device.

Snow Removal

Some traffic calming actions may have an effect on the winter removal of snow and ice. Coordination with road maintenance and snow removal operators on traffic calming strategies will ensure any negative effects on snow removal are minimized and snow removal operations perform efficiently.

A number of communities, located in snow areas, have successfully incorporated traffic calming measures into traffic management and road maintenance programs.

Effects of the Traffic Calming Devices to Reduce Traffic Speeds and Volumes

While traffic calming is recognized as being a method for reducing speeds and volumes, it is appropriate to consider the effectiveness of the various traffic calming techniques. Some of the very questions of how and where to apply traffic calming were asked and answered in a August, 1997 Institute of Transportation Engineers (ITE) Journal article entitled "Urban Traffic Calming Treatments: Performance Measures and Design Conformance."[51] The article sites the various traffic calming devices and their conformance to the national guidelines from an opera-

Table 4: Influences of Traffic Calming Devices

	DIRECT TRAFFIC EFFECTS						
DEVICES	Volume Reductions	Speed Reductions	Directional Control	Change In Vehicle Mix	Noise	Safety	Emergency & Service Access
Physical Controls							
Speed Bumps	Possible	Inconsistent	Unlikely	Unlikely	Increase	Adverse effects	Some problems
Undulations	Possible	Yes	Unlikely	Unlikely	No change	No problems documented	No problems documented
Rumble Strips	Unlikely	Yes	Unlikely	Unlikely	Increase	Improved	No problems
Diagonal Diverters	Yes	Likely	Possible	Possible	Decrease	Shifts Accidents	Some constraints
Intersection Cul-De-Sac	Yes	Likely	Yes	Possible	Decrease	Shifts Accidents	Some constraints
Midblock Cul-De-Sac	Yes	Likely	Yes	Possible	Decrease	Shifts Accidents	Some constraints
Semi-Diverter	Yes	Likely	Yes	Possible	Decrease	Shifts Accidents	Minor constraints
Forced Turn Channelization	Yes	Likely	Yes	Possible	Decrease	Improved	Minor constraints
Median Barrier	Yes	On curves	Possible	Possible	Decrease	Improved	Minor constraints
Traffic Circle	Unclear	Minor	Unlikely	Possible	Little change	Questionable	Some constraints
Chokers and Road Narrowing	Rare	Minor	Unlikely	Unlikely	Little change	Improved ped. crossing	No problems
Passive Controls							
Stop Signs	Occasional	Site reduction	Unlikely	Unlikely	Increase	Mixed results	No problems
Speed Limit Signs	Unlikely	Unlikely	Unlikely	Unlikely	No change	No change	No effect
Turn Prohibition Signs	Yes	Likely	Yes	Possible	Decrease	Improved	No effect
One-Way Streets	Yes	Inconsistent	Yes	Possible	Decrease	Possible imp.	No effect
Perception Controls							
Transverse Markings	No change	Yes	No effect	No effect	Possible red.	Possible imp.	No effect
Crosswalks	No effect	Unlikely	No effect	No effect	No effect	Ineffective	No effect
Odd Speed Limit Signs	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Novelty Signs	No effect	Undocument.	No effect	No effect	Unlikely	No effect	No effect

Federal Highway Administration, 2000

tional approach. A Federal Highway Administration (FHWA) report on "Improving Residential Street Environments" also addressed the issues of effectiveness.[52] Quantifiable results of the traffic calming impact on speeds, volume and safety are also identified. Table 4 and Table 5 provide information on the effects of various traffic calming devices.

Table 5: Other Characteristics of Traffic Calming Devices

	OTHER CHARACTERISTICS			
DEVICES	Construction Efforts & Cost	Landscape Opportunity	Site or System Use	Maintenance & Operational Effects Index
Physical Controls				
Speed Bumps	Low	None	Both	Snowplow problems
Undulations	Low	None	Both	No problems noted
Rumble Strips	Low	None	Site	Snowplow problems
Diagonal Diverters	Moderate to high	Yes	Usually system	Vandalism
Intersection Cul-De-Sac	Moderate to high	Yes	Both	Vandalism
Midblock Cul-De-Sac	Moderate to high	Yes	Both	Vandalism
Semi-Diverter	Moderate to high	Yes	Both	Vandalism
Forced Turn Channelization	Moderate	Possible	Both	No unusual problems
Median Barrier	Moderate	Possible	Both	No unusual problems
Traffic Circle	Moderate to high	Yes	Both	Vandalism
Chokers and Road Narrowing	Moderate	Yes	Both	No unusual problems
Passive Controls				
Stop Signs	Low	No	Both	No unusual problems
Speed Limit Signs	Low	No	Site	No unusual problems
Turn Prohibition Signs	Low	No	Both	No unusual problems
One-Way Streets	Low	No	Usually system	No unusual problems
Perception Controls				
Transverse Markings	Low	No	Site	No unusual problems
Crosswalks	Low	No	Site	No unusual problems
Odd Speed Limit Sign	Low	No	Site	Vandalism
Novelty Signs	Low	No	Site	Vandalism

Federal Highway Administration, 2000

A similar method for identifying the effectiveness of the various traffic calming techniques is shown in Table 6 provided from the Pennsylvania Department of Transportation.[53]

Table 6: Effectiveness of Traffic Calming Techniques

	Volume Reductions	Speed Reduction	Conflict Reduction	Emergency Response
Horizontal Deflection				
Bulb-out/curb extension	□	▲	▲	□
Chicane	▲	▲	□	▲
Gateway	□	□	□	□
On-street parking	□	▲	□	▲
Raised median island/pedestrian refuge	□	▲	▲	□
Traffic circle	▲	▲	■	▲
Vertical Deflection				
Textured crosswalk	□	□	□	□
Speed hump	▲	■	▲	■
Raised crosswalk	▲	■	▲	■
Raised intersection	□	▲	▲	■
Physical Obstruction				
Semi-diverter	■	▲	▲	▲
Diagonal diverter	■	▲	▲	▲
Right-in/right-out island	▲	□	▲	▲
Raised median through intersection	■	□	▲	■
Street closure	■	▲	■	■
Signing and Pavement Markings				
Speed limit signing	□	▲	□	□
Multi-way stop control	□	▲	▲	▲
Turn prohibitions	▲	□	▲	□
One-way streets	■	□	▲	▲
Commercial vehicle prohibitions	▲	▲	□	□
Roadway narrowing with edge lines	□	▲	□	□
Transverse markings	□	▲	□	□

Minimal or no effect □ Moderate effect ▲ Significant effect ■

Pennsylvania Department of Transportation Traffic Calming Handbook (January, 2001)

Quantifiable benefits of various calming techniques including reductions in speed and volume and accidents are shown. Table 7 shows the benefits from empirical information collected at locations throughout the US.

Table 7: Effects of Traffic Calming Measures on Speed, Volume and Safety

Speed Impacts of Traffic Calming Measures

	Sample Size	85th Percentile Speed Afterward (mph)	Average Change in 85th Percentile Speed (mph)	Average % Change
12' Humps	179	27.4	-7.6	-22%
14' Humps	15	25.6	-7.7	-23
22' Tables	58	30.1	-6.6	-18
Longer Tables	10	31.6	-3.2	-9
Raised Intersections	3	34.3	-0.3	-1
Circles	45	30.2	-3.9	-11
Narrowing	7	32.3	-2.6	-4
One-Lane Slow Points	5	28.6	-4.8	-14
Half Closures	16	26.3	-6.0	-19
Diagonal Diverters	7	27.9	-1.4	-0

Volume Impacts of Traffic Calming Measures

	Sample Size	Average Change in Volume vehicles per day	Average % Change
One-Lane Slow Points	5	-392	-20%
Full Closures	19	-671	-44
Half Closures	53	-1611	-42
Diagonal Diverters	27	-501	-35

Safety Impacts of Traffic Calming Measures – Average Number of Collisions

	Number of Observations	Before Treatment	After Treatment	% Change in Collisions
12' Humps	49	2.7	2.4	-11%
14' Humps	5	4.4	2.6	-41%
22' Tables	8	6.7	3.7	-45%
Circles	17	5.9	4.2 -	29%

Revised from Traffic Calming State of the Practice, ITE/FHWA, August 1999

Residential Street Designs in New Developments

> **Great towns, villages and cities in all parts of the world are based on simple, easily understood principals. The people who built these great places had ordinary minds. They worked as much from common sense and their hearts as anything else. Once we understand these principals, we know what kind of streets to provide.**[73]

Recognizing that residential streets are used for variety of purposes, it could be expected that the design of new residential streets would balance the purposes of residential streets. However, the majority of streets in new residential areas and contemporary street designs require residential streets with the primary goal of moving traffic. Many Utah communities continue to require minimum street pavement widths greater than required to support the needs of local traffic. Many Utah communities typically require street pavement widths of 36 feet, or more, for local residential streets.

The Wilmington Delaware Area Planning Council (WILMAPCO) provides an example of a local initiative to identify a residential street design that recognizes and balances the purposes of the residential street.[54] The Wilmington Delaware Area Planning Council has recommended residential street design standards for communities within their area based on the following design criteria:

- A design speed of 20 mph.
- The residential street design vehicle is a 266-inch wheelbase school bus.
- Local residential street designs should recognize the needs of pedestrians.

Based on these design criteria, Table 8 highlights how the WILMAPCO design standards deviate from the American Association of State Highway and Transportation Officials (AASHTO) guidelines.

Table 8: Wilmington Area Planning Council

Residential Street Design Recommendations

Design Standard	AASHTO Local Urban Street Standard	WILMAPCO Local Street Standard	Rationale for WILMAPCO Standard
Design Speed	20-30 mph	20 mph	20 mph is safe for pedestrians and is acceptable to most residents. 30 mph is not.
Right-of-Way Width	50 feet	41 feet	41 foot right-of-way is consistent with individual cross sectional elements.
Pavement Width	26 feet	18 feet	One clear travel lane is sufficient on streets carrying less than 500 vehicles per day. On street parking on only one side is sufficient with ample off-street parking.
Travel Lane Width	9-12 feet	9 feet	Equals AASHTO minimum.
Pavement Edge Treatment	Normally 4 inch to 9 inch vertical curb	6 inch or 8 inch vertical curb	Greater than AASHTO standard. Higher curb discourages parking on planter strips and enhances pedestrian safety

Design Standard	AASHTO Local Urban Street Standard	WILMAPCO Local Street Standard	Rationale for WILMAPCO Standard
Horizontal Curve Radius	100 foot minimum	90 foot minimum when curve is unsigned. 45 foot minimum curve is signed as a traffic calming measure.	Less than AASHTO standard. Sufficient for the design vehicle.
Vertical Curve Length	60 foot minimum at the 20 mph design speed.	Same as AASHTO when curve is unsigned. When signed as a traffic calming measure and marked - no requirement.	Proposed standard exempts AASHTO standard in traffic calming situations.
Sidewalks	On both sides of streets used to access schools, parks, etc. On one side in other locations.	On both sides of streets with densities 2 plus units per acre. On one side at densities 1-2 units per acre.	A small cost increment to enhance pedestrian amenity.
Sidewalk Width	4 foot minimum	5 feet with planting strip. 8 feet without planting strip.	5 foot width is comfortable for pedestrians walking in pairs and passing other pedestrians. Provides greater separation for traffic with no planter strip.
Planting Strip Width	2 foot minimum	5 foot minimum	Normal minimum to sustain street trees and provides adequate separation between pedestrians and vehicles.
Corner Radius	15 foot minimum	25 feet (local-local) 30 feet (local-collector) 40 feet (local-collector without parking lane.	Greater than AASHTO standard to accommodate design vehicle.

Wilmington Delaware Area Planning Council

Of particular interest in the Wilmington Delaware Area Planning Council (WILMAPCO) recommendations is the recommendation for residential street pavement widths of 18 feet. Designed to accommodate a school bus, this recommended pavement width is nearly half of the pavement widths required by many Utah communities.

Traffic Calming Implementation Strategies

The evidence is that traffic calming has a positive impact on:

- Reducing accidents on residential streets.
- Decreasing traffic speeds and volumes.
- Enhancing pedestrian safety.
- Increasing the residential quality of the neighborhood.

Impacts to noise, crime, and emergency vehicle response times vary by calming technique.

Understanding the benefits and weaknesses of each traffic calming action helps determine which calming approach is most appropriate for a given condition. It is important to:

1] Identify if a problem exists by speed, accident and volume data. A point system such as shown in Table 9 from Pennsylvania Department of Transportation recommends methods that may be applied.[55] Salt Lake City, Utah also has a ranking technique for prioritizing needs throughout the City.

2] Propose and test the calming method with community involvement.

3] Community acceptance of traffic calming measures is often related to achieving other neighborhood goals, including reducing neighborhood crime and noise,

Table 9: Project Ranking System

Criteria	Points	Basis for Point Assignment
Speed	0 to 30	Extend by which 85 percentile speeds exceed posted speed limit; 2 points assigned for every 1 mph.
Volume	0 to 25	Average daily traffic volumes (1 point assigned for every 120 vehicles). Crashes 0 to 10, 1 point for every crash reported within past 3 years.
Elementary or Middle Schools	0 to 10	5 points assigned for each school crossing on the project street.
Pedestrian Generators	0 to 15	5 points assigned for each public facility (such as parks, community centers, and high schools) or commercial use that generates a significant number of pedestrians.
Pedestrian Facility	0 to 10	5 points assigned if there is no continuous sidewalk on one side of the street; 10 points if missing on both sides.
Total Points Possible	100	

Pennsylvania Department of Transportation Traffic Calming Handbook (January, 2001)

minimizing street maintenance costs, and improving neighborhood character and desirability.

Safe Routes to School

It is not long ago when children routinely made their way to school by walking or bicycling. However, because of the lack of safe routes, including the lack of sidewalks and bike lanes, and high traffic volumes and speeds in neighborhoods parents are now reluctant to allow their children to walk or bike to school. For these reasons, many parents drive their children to virtually all activities outside the home, including school. Parents driving children to school may account for up to 25% of neighborhood traffic. Where nearly 7 out of 10 children walked or biked to school in the early 1970's now only 1 out of every 10 children walks or bikes to school. The loss of safety on residential streets has severely eroded the freedoms of children.[56]

Increasing the safety of residential streets through reductions in traffic volumes and speeds, and providing pedestrian and bicycle facilities in street designs, can again encourage children to walk or bike to school. Communities across the nation are embracing "Safe Routes to Schools" initiatives to make streets safer forpedestrians and bicyclists.[57] In Utah, the need for communities and school districts to work cooperatively together to provide safe routes to school is critical. Utah has the highest proportion of any State for school-aged children 5 to 16 years.

Too often school locations are selected without consideration for safe pedestrian and bicycle access. Even years after school construction, children are still required to find their way to school on routes that do not have sidewalks, sidewalks that remain inadequate and unconnected, or sidewalks located immediately adjacent to fast moving traffic. Examples exist of schools sited in locations separated by busy highways and arterial roads from the neighborhoods they serve. To provide convenient and safe walking and bicycling routes to schools will require the coordinated and continued efforts of school districts and local governments.

The laws of the State of Utah, Section 10-9-106(2) and Section 17-27-105(2), Utah Code Annotated (UCA) provide and establish that a school district is subject to a municipality or county land-use regulations, with some prescribed limitations. A municipality, or county, may impose regulations on a school district in order to avoid unreasonable risks to health or safety. For example, a municipality, or county, may require a school district to participate in the cost of a sidewalk, if the sidewalk is necessary for the safety of school children, and is located on or adjacent to school property, or is required to connect an isolated school site to an existing road, Section 10-9-106(2)(b) and Section 17-27-105(2)(b), UCA. A school district is also required to coordi-

nate the siting of new schools with local governments to avoid or mitigate existing or potential traffic hazards and maximize school safety, Section 10-9-106(3) and Section 17-27-105(3), UCA. Additionally school districts are required to notify local governments prior to the purchase of a school site and discuss with the local government (municipality or county) any concerns, including any potential community impacts, Section 53A-20-108(1) and Section 53A-20-108(2), UCA. Clearly, the State of Utah expects, and requires, that school districts and local jurisdictions coordinate and work together to protect the safety of children as they make their way to and from school.

Residential Street Design Standards for Utah Communities

There exists within our communities a variety of residential street types. Some residential streets function to meet the needs of the urban residential neighborhood, while others meet the needs of the suburban neighborhood.

Residential streets are also required to serve residential areas, located within a rural setting.

Figure 8: Routes to school (children must compete with school buses and other vehicles, walking in storm water drainage facilities, to make their way to school).

Recognizing the various roles and purposes of a residential street, the following information is provided, as a discussion guide, for the design and construction of residential streets in Utah communities. The location and design of the residential street is determinative of the attractiveness, functioning and desirability of the residential area. The long-term functionality, safety, and attractiveness of the neighborhood and the street requires the identification of appropriate street design principles and design criteria. Pedestrians, bicyclists, private passenger vehicles, trucks, school buses, emergency vehicles, and others must share the space of the residential street. The needs of the various users of the residential street must be recognized and balanced in the street design.

General Design Principles for Residential Streets

Connected Pedestrian Facilities

Residential streets must provide for pedestrians. All lots and spaces within the neighborhood should be connected via linked pedestrian connections. As a basic design principle, "residential street design and scale should favor the nonmotorist and accommodate the motorist."[58] In his book "Great Streets," Allan B. Jacobs identifies that "every [great] street is one that invites walking."[59] A residential street should invite walking. Significant numbers of neighborhood residents walk for the purposes of exercise and walking is an independent travel mode for children.

Sidewalks, if provided at all on residential streets in Utah communities, are often typically three (3) feet wide. To promote the functioning of the sidewalk for pedestrian activity it is recommended that sidewalks be a minimum width of five (5) feet. Although more expensive than three (3) foot sidewalks, (5) foot sidewalks invite walking and provide a comfortable space for pedestrians, allowing pedestrians to walk together.[60] The more interesting and inviting the street the more pedestrians will use it. Areas of the neighborhood that cannot be accessed via a street with sidewalks can continue the pedestrian network by a trail, eventually being connected back to a residential street with sidewalks.

Bicycle Facilities

Bicycling is a viable form of transportation and must be considered in the design of the residential street. Not only is bicycling a viable travel option for children, but bicycling is one of the most popular forms of recreational activity. On higher volume residential streets bicycle routes may be required to be separated from motorists. On residential streets designed to encourage low traffic volumes and speeds there is usually no need to identify separate bike lanes.[61]

Street Connectivity

To promote neighborhood connections and encourage resident interaction within the neighborhood, residential streets should be connected, as practical. For reasons of neighborhood safety, and to provide necessary motorized and non-motorized circulation, all properties within the neighborhood should be capable of being accessed from multiple directions. Because of site topography, or other site constraints, there may be times when this goal cannot be achieved. This should be the exception rather than the rule. Connected residential streets provide appropriate travel and emergency routes and encourage non-motorized travel. With multiple travel routes available, vehicle trips are spread throughout the neighborhood, and drivers may consider a non-motorized mode of travel mode. The challenge for city planners and street designers is to provide a residential street pattern that allows efficient circulation within the neighborhood while discouraging unnecessary neighborhood cut through traffic.

There will always be significant volumes of traffic in our communities, with the need to move safely and quickly, at higher design speeds than are appropriate for neighborhood residential streets. Highways and arterial and collector roads, with peak hourly traffic flows of 300 vehicles, or greater, will carry significantly more traffic than is acceptable in a neighborhood.[62] These roads act as barriers to nonmotorized travel and should be located on the edges of the neighborhood. The design of the neighborhood streets system should provide efficient connections to the community's collector and arterial road system provided with safe and convenient pedestrian and bicycle crossings.

Design Speed

The goal of residential street design is to balance the purposes of the street. Residential streets must encourage and preserve low vehicle speeds. Low vehicle speeds will be achieved through the selection of street design criteria such as pavement width, curve radii, whether on-street parking is permitted, and other criteria.

Typically, the design speed for a residential street should not exceed 20 mph.[63] Increased vehicle speeds leads to increased vehicle noise and required stopping distances, and sight distances. Table 1 has identified the relationship between vehicle speed and total stopping distance. From Table 1 the total required stopping distance increases by an additional 141 feet from 20 mph to 35 mph.

On residential streets, a design speed of 20 mph should be applied. A maximum design speed of 20 mph encourages a feeling of safety for pedestrians and bicyclists.[64]

"The risk of very serious injury to pedestrians increases dramatically as the speed of the impacting vehicle exceeds 20 mph."[65] Research

has shown that pedestrians are not usually seriously injured when struck by a vehicle moving at less than 20 mph.[66]

Street Width

Conventional traffic engineering requires that vehicles should travel streets without interruption, or with limited interruption. A residential street that balances the purposes of the street, including providing a space where motorized and nonmotorized travel can safely coexist together, will require this premise to be revised. A residential street providing safety, comfort, desirability, and aesthetics for all users will require that vehicles on the street recognize the other users on the street. A street width that balances the needs of all activities on the street, including motorized and nonmotorized travel, must be established.

Examples of attractive and desirable residential streets can be found in many older residential areas of our communities. These areas are often the preferred residential areas over newer subdivisions. Many of the established and older residential areas in Utah communities have street widths much less than 30 feet (curb to curb). These streets also are examples where vehicles recognize other users on the street, and where vehicles must occasionally stop to allow other vehicles to pass. For residential streets, the occasional stop should be accepted by street designers and motorists. The American Association of State and Highway Transportation Officials (AASHTO) accepts that "the level of user inconvenience occasioned by the lack of two moving lanes is remarkably low in areas [of] single family units."[67] Designing residential streets for uninterrupted traffic flows will result in providing a street that is wider than necessary. On such a street, vehicle speeds will be higher than accepted by the other users and residents on the street.

As found by Swift and Associates in Colorado, street width has a significant influence on vehicle speeds, and consequently pedestrian and bicyclist safety.[68] A clear relationship exists between street width and vehicle speeds. Reducing street widths will reduce vehicle speeds and the dominance of vehicles on the street.

Considering the work of Swift, it is recommended that a street pavement width of 26 feet (curb to curb) be considered for residential streets in Utah. This recommendation considers the need for winter snow plowing activities and the requirements for emergency vehicle access. Typically, development requirements work to minimize on-street parking, since single family units regularly provide off-street parking for at least four (4) vehicles (2 garage or carport spaces plus 2 spaces provided in a driveway) and multi-family residential units are regularly required to provide 2 off-street parking spaces per unit, plus additional visitor parking.

Centerline Radius

The Institute of Transportation Engineers (ITE) in "Traditional Neighborhood Development – Street Design Guidelines" identifies a minimum street centerline radius of 89 feet for a street with a design speed of 20 mph.[69] Consistent with this recommendation and the recommendation of WILMAPCO, it is recommended that for residential streets (with a 20 mph design speed) a centerline radius of 90 feet be considered.

Curb Return Radius

"When the curbed street meets another, the curbs at the sides of each street are joined by a curved section of the curb known as the curb return."[70] As the curb return radius increases, the length of the distance at cross-walks increases, requiring additional time for pedestrians to cross. The shorter the curb return radius the shorter will be crossing distances and the more the street intersection will act as a "slowing point" in street design. Communities should consider and select an appropriate curb return radius for residential streets based on traffic volumes, traffic types, sidewalk and park strip requirements, and other street design criteria, and considering the influence curb return radius will have on traffic speeds, turning movements, street safety and street crossing distances.

Street Right-of-Way Width

A typical residential street right-of-way for many for Utah communities is 60 feet. Within this right-of-way. communities may often require street pavement widths well in excess of 30 feet for the "narrowest" residential streets.

Street right-of-way can be considered a function of several street design criteria including pavement width, sidewalk and park strip widths, and utility requirements. With a street pavement width of 26 feet, and including 5-foot sidewalks and 6-foot park strips, existing community requirements of 60 foot street rights-of-way are more than sufficient to accommodate the street design guidelines suggested here.

On-Street Parking

The presence of on-street parking will slow traffic on the street and provides an additional separation between moving vehicles and pedestrians. It is recommended that on-street parking be allowed on both sides of the streets on residential streets with pavement widths of 24 feet or greater. A recommendation to allow parking on residential streets recognizes the fact that single-family homes and multi-family developments, by way of zoning and development requirements provide significant areas, onsite, for the parking of vehicles.

Figure 9: On-street parking (historically parking has been allowed on Utah streets).

Park Strips and Street Trees

Park strips sized to allow the planting and growth of street trees will provide an attractive edge to the street and provides a separation between vehicles and pedestrians. For Utah communities, and recognizing that park strips also function to provide snow storage areas, park strips of not less than six-feet should be provided. For higher traffic volume streets, and to add attractiveness to the streetscape, wider park strip areas may be required. As evidenced in many neighborhoods, street trees enhance the aesthetics and environment of the street, encourage pedestrian activity and add residential amenity, value and desirability to the neighborhood.

Street Lighting

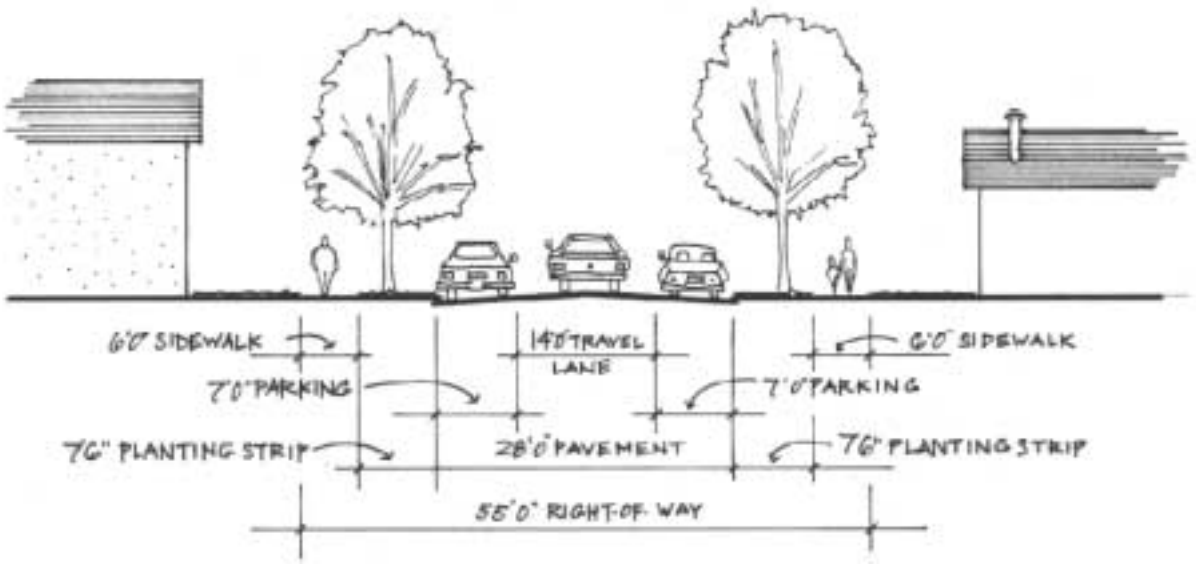
To provide an attractive element to the residential streetscape, as well as providing street and pedestrian lighting, streetlights should not exceed 12 feet in height, and be placed so as to avoid the conventional practice of providing fewer and higher lights with more intense lighting.

Figure 10: Street trees provide character and beauty to a neighborhood.

Table 10: Residential Street Design Guidelines for Utah Communities A Summary

Residential Street Design Criteria	Recommended Standard
Design Speed	20 mph maximum
Street Width (pavement width)	26 - 28 feet maximum
Centerline Radius	90 feet
Parking	Allowed on both sides
Sidewalk Width	5 feet minimum
Park Strip Width	6 feet minimum
Connections	Provide multiple access points. Multiple accesses will provide alternative emergency response routes. As the number of intersections and blocks increase the number of walk trips increase.

Figure 11: Residential Street Design



The residential street design guidelines for pavement width and sidewalk and park strip widths are consistent with suggestions provided by the State of Utah, Governor's Office of Planning and Budget, for residential streets and identified in Figure 11.[71]

Figure 12a: The residential street (designed generally to the suggested standards).

Examples of attractive, safe and functional residential streets can be found in our communities. Figure 12a and 12b present existing residential streets, meeting the residential street design guidelines suggested here, and functioning to provide the purposes of a residential street while adding quality, safety and amenity to a neighborhood. With thoughtful design decisions, and the goal of balancing the needs of the various users on the street, residential streets can once again become attractive and inviting spaces within our neighborhoods.

Figure 12b

Our thanks to the members of the Toolbox Committee for their assistance in developing the 1st Edition of Urban Planning Tools for Quality Growth.

Committee Co-Chairs

Dan Lofgren
Prowswood Boston Financial Companies

Gary Uresk
Woods Cross City

Committee Members

Gerry Adair
Utah House of Representatives, Roy

Donald Adams
City of Riverton

Todd Adams
Division of Water Resources

Bryce Armstrong
Utah County

Rick Bangerter
Centerville City

Craig Barker
Weber County Planning

Des C. Barker
Utah Openlands

Ralph Becker
Utah House of Representatives, Salt Lake City

Mark Bedel
Governor's Office of Planning and Budget

Joseph Borgione
Utah Automated Geographic Reference Center

Tim Boschert
Utah Department of Transportation

Brody Bovero
Utah League of Cities and Towns

Barbara Brown
University of Utah

Camille Cain
Weber County

Nicole L. Cline
Tooele County

Larry Ellertson
Lindon City

Lynn Ellis
Plain City

John Flagg
Able Construction

Sydney Fonnesbeck
Utah League of Cities and Towns

Scott Frisby
Governor's Office of Planning and Budget

Paul Gillette
Division of Water Resources

Natalie Gochnour
Governor's Office of Planning and Budget

Glen Graham
City of Taylorsville

Drew Hall
Overlake Development

John B. Harr, Jr.
Utah County Association
of Realtors

Michael Hansen
Utah Transit Authority

Jeffery Harris
Utah Transit Authority

Bob Heddens
Western Fiberglass Group

Roger Henrikson
Parr, Waddoups, Brown,
Gee & Loveless

Rick Horst
City of South Jordan

Jamie Hyde
Governor's Office of
Planning and Budget

Andrew Jackson
Mountainland Association
of Governments

Aric Jensen
Davis County

Anthony Kohler
Wasatch County

Paul Larsen
Brigham City

Doug Little
Sunrise ECOPOLIS Foundation

Sandra Lloyd
City of Riverton

Bill Marsh
City of Holladay

Dave McArthur
Home Builders Association
of Greater Salt Lake

Mark McGrath
Taylorsville

Brent Nelson
Benchmark Properties

Cal Schneller
Salt Lake County

Rob Scott
Ogden City

JoAnn Seghini
Midvale City

George Shaw
Sandy City

Soren Simonsen
Cooper-Roberts Architects

Wilf Sommerkorn
Davis County

Ritchie Taylor
Utah Department of Transportation

Edward A. Tugaw
Tugaw Realtors

Gerry Tully
Proterra Companies

Kort Utley
Governor's Office of
Planning and Budget

Blaine Walker
Utah Association of Realtors

Bruce Wasden
City of Taylorsville

Bill Wright
Sear Brown

Amy Zaref
Carter & Burgess

Water Conservation Chapter Committee Members - 2000 Edition

Larry Anderson
Department of Natural Resources

Kathleen Clarke
Department of Natural Resources

Greg Graves
Bingham Engineering

Carl Hanover
City of West Jordan

LeRoy Hooten
Salt Lake City Department of Public Utilities

Paul Larsen
Brigham City

Fred Liljegren
U.S. Bureau of Reclamation
Salt Lake City

David Ovard
Jordan Valley Water Conservancy District

Sumner Swaner
Swaner Design, LLC

TOOLBOX PROJECT STAFF
Principal Authors

John Fregonese, Principal
Ted Knowlton, Associate
Fregonese Calthorpe Associates

Matthew Taeker, Principal
Diana Marsh, Project Manager
Calthorpe Associates

Gene Carr, Community Advisor
Center for Public Policy and Administration

Georgia Barker
(Water Conservation Chapter)
Community Links of Utah

Our thanks to the following individuals for their assistance in developing the 2002 Supplement for Urban Planning Tools for Quality Growth.

Water Conservation Chapter Committee Members - 2002 Supplement

Larry Anderson
State of Utah
Division of Water Resources

Mike Bobinski
Draper City

Steve Brenchley
Nolte Associates

Stephanie Duer
Salt Lake City Public Utilities

Tage Flint
Weber Basin Water Conservancy District

Drew Hall
Overlake Development

Nancy Hardman
Central Utah Water Conservancy District

Leroy Hooton
Salt Lake City Public Utilities

Cheryl Izatt
Jordan Valley Water Conservancy District

Kelly Kopp
Utah State University

Nancy Mesner
Utah State University

Paula Mohadjer
Jordan Valley Water
Conservancy District

Jeff Niermeyer
Salt Lake City Public Utilities

Dave Ovard
Jordan Valley Water
Conservancy District

Scott Paxman
Weber Basin Water
Conservancy District

Gene Shawcroft
Central Utah Water
Conservancy District

Soren Simonsen
Cooper Roberts Simonsen Architects

Lyle Summers
State of Utah
Divison of Water Resources

Molly Waters
State of Utah
Division of Water Resources

Urban Forestry Chapter Committee Members

Lars Anderson
Utah Department of Transportation

Jennifer Ault
Riverton City

David Bell
Utah State University

Rich Buelte
Utah Power

Scott Bunker
Provo City

Nicole Cline
Tooele County

Nathan Cox
South Salt Lake

Max Darrington
Brigham Young University

Tony Dietz
Department of Natural Resources
State of Utah

Stephanie Duer
Salt Lake City Public Works

Diane Jones
Utah Nursery Landscape Association

Kelly Kopp
Utah State University

Mike Kuhns
Utah State University

Brook Lee
Department of Natural Resources
State of Utah

Mark McGrath
City of Taylorsville

Meryl Redisch
Tree Utah

Bill Rutherford
Salt Lake City

George Shaw
Sandy City

Jan Streifel
Landmark Design

Bruce Wasden
City of Taylorsville

Energy Efficiency Chapter Committee Members

Principal Author

Jerriann Ernstsen, Ph. D.
Sustainable Development and Cool Communities
Utah Energy Office
Department of Natural Resources

Lowell Alt
Utah Public Utilities

Georgia Barker
Community Links of Utah

John Bennett
Utah Advisory Council on Intergovernmental Relations

Tim Brown
Utah Society for Environmental Education

Julie Bond
Utah Transit Authority

Roger Borgenicht
Assist Inc.

Joe Borgione
Utah Automated Geographical Reference Center

Paula Carl
American Institute of Architects

Mark Case
Etc Group, Inc

Nicole Cline
Tooele County

Bob Dalley
Utah Division of Air Quality

Sunny Dent
National Energy Foundation

Duane Devey
Jordan School District

Nina Dougherty
Utah Sierra Club

Orrin Farnsworth
Intermountain Solar

Val Finlayson
Utah Department of Community and Economic Development

Renee Gluch
Brigham Young University

Doug Hattery
Wasatch Front Regional Council

Kimball Hansen
Utah Power

Marc Heileson
Utah Sierra Club

Brent Jensen
Utah Department of Transportation

Brock LeBaron
Utah Division of Air Quality

Dave Logan
Dimension Construction

Grantly Martelly
Utah Transit Authority

Barrie McKay
Questar

Beverly Miller
Salt Lake City Clean Cities

Neil Morkel
Onaroc

Scott Niclos
Utah Transit Authority

Bim Oliver
Utah Department of Community and Economic Development

Smokey Peck
Waste Management

Mark Renda
Utah Department of Community and Economic Development

Greg Rutledge
Utah Power

George Shaw
Sandy City

Ken Snyder
United States Department of Energy

Amber Sundin-Debirk
Recycling Coalition of Utah

Sumner Swaner
Swaner Design

Bruce Wasdon
Taylorsville City

Ivan Weber
Planning Consultant

Dave Wilson
Utah Energy Conservation Coalition

Betsy Wolfe
Salt Lake Community Action Program

Sara Wright
UE3

Major Contributors

Denise Beaudoin Brems
Energy Program Grant Manager, Utah Energy Office

Gina Fleischer
Information Specialist, Utah Energy Office

Mike Glenn
Manager, Utah Energy Office

Dave Lochetfeld
Energy Engineer II, Utah Energy Office

Bernell Loveridge
Local Government Energy Efficiency, Utah Energy Office

Lora Reese
Administrative Assistant, Utah Energy Office

Soren Simonsen
Cooper Roberts Simonsen Architects

Christine Watson
Energy Engineer, Utah Energy Office

Lisa Yoder
Alternative Fuels and Transportation, Utah Energy Office

Project Support -Water Conservation, Urban Forestry and Energy Chapters

Kathy Hajeb
Senior Project Manager
Psomas

Strategies for Walkable Business Committee Members

Principal Author
John Fregonese, Principal

Ted Knowlton, Associate

Kristy Lakin, Associate
Fregonese Calthorpe Associates

Don Adams
Riverton City

Dama Barbour
Harmons Corporation

David Baxter
Entranco

Scott Carter
Layton City

Nicole Cline
Tooele County

Shawn Guzman
Springville City

Drew Hall
Overlake Development

Michael Hansen
Utah Transit Authority

Hal Johnson
Utah Transit Authority

Mark McGrath
City of Taylorsville

Bruce Parker
Planning and Development Services

Duaine Rasmussen
Johanssen Thackery

George Shaw
Sandy City

Soren Simonsen
Cooper Roberts Simonsen Architects

Lew Swain
The Boyer Company

Nate Swain
The Boyer Company

Ed Tugaw
Tugaw Realtors

Gerry Tully
Proterra Inc.

Bruce Wasden
City of Taylorsville

Sandy Weinrauch
Utah Department of Transportation

Wade Williams
Smith's Food & Drug

Public Safety and Residential Street Design Chapter Committee Members

Principal Author
Bruce W. Parker, Principal
Planning and Development Services

Co-Author
Joseph Perrin, Principal
A Trans Transportation Engineers

Dan Andrus
Salt Lake City Fire Department

Tim Boschert
Utah Department of Transportation

Gordon Haight
Salt Lake City Corporation

Phillip Hill
Midvale City

Aric Jensen
Davis County

Jody Knapp
West Valley City

Kurt Larson
Salt Lake City Corporation

Jane Lambert
Utah Department of Health

Terri Payne
West Valley City

Phil Roberts
Murray City Fire Department

Rick Wixom
Ogden City

Kevin Young
Salt Lake City Corporation

Envision Utah Staff

Stephen Holbrook
Executive Director

Alex Beseris
Lead Staff for Toolbox Development
Project Manager

Christine Collins
Lead Staff for Toolbox Development
Planner

Matthew Whinery
Lead Staff for Toolbox Development
Planner

Bob Terragno
Government Relations Coordinator

Kristin Thompson
Public Relations Manager

Kevin Fayles
Development Director

Anita Plascencia
Business and Office Manager

Jarret Whicker
Assistant Planner

HOME OWNERSHIP OPTIONS

Section I Community Lending, Innovative Mortgage Solutions

Community Lending Products:
An issue of concern is the availability and affordability of affordable housing, particularly for first time homebuyers. Several new mortgage products and location based mortgage experiments have been designed to remove the two primary barriers to homeownership - lack of down payment funds and qualifying income. These loans have down payments as low as 1 to 5 percent, and require less income to qualify and less cash for down payment and closing costs than conventional mortgages. When leveraged with other funds and purchasing in designated areas, buyers can sometimes become homeowners for as little as $500. These products can be effective tools in increasing home ownership rates and stimulating rehabilitation in older suburban neighborhoods, targeted urban areas, as well as encouraging mixed income communities. You can call 1-800-7FANNIE for more information about specialty mortgage products in local Utah markets or get consumer information regarding Fannie Mae via the Internet by going to the web site at fanniemae.com. The Utah Fannie Mae Partnership Office, in conjunction with our lender partners, are also available to discuss specific needs and work on finding appropriate mortgage product solutions in your community.

Community Land Trusts:
Community land trusts can be formed to provide and preserve long-term affordable housing for low- and moderate-income families. Typically, a private nonprofit corporation acquires and holds land for the benefit of the community, often in an urban in-fill area. The community land trust retains title to the land but sells the improvements (the homes) and leases the land (under long-term group leases) to low- and moderate-income families at affordable ground rents. This tool is effective for promoting new construction in in-fill areas and helping to meet affordable housing targets for communities.

FannieNeighbors®:
FannieNeighbors is a nationwide, neighborhood-based mortgage option designed to increase mixed-income homeownership and revitalization in designated areas by removing income limits if the house is located in a HUD-designated central city or underserved area, or in an eligible minority or low-income census tract. Eligible FannieNeighbors communities in Utah presently include Clearfield, Ogden, Provo, Salt Lake City and West Valley City.

Historic Tax Credit (HTC) Investments:
Many underserved areas have historic properties that, once rehabilitated, can provide dramatic visual and community improvement and promote further reinvestment. Certified historic properties are eligible for historic tax credits when redeveloped according to federal restoration guidelines. The American Communities Fund (ACF) provides capital to qualified developers that undertake restoration in return for the federal historic tax credit. In certain circumstances, ACF will provide development equity in addition to HTC equity.

MULTI-FAMILY FINANCING OPTIONS

Section II Multi-Family

Fannie Mae works with a variety of partners including lenders, syndicators, investors, investment bankers, developers, property owners, property managers, nonprofit organizations, faith based organizations, foundations, and federal, state, and local governments to deliver tailored financing through debt, mortgage revenue bond purchases, Low Income Housing Tax Credits, and equity investments in rehab or new properties to provide affordable rental housing.

Low Income Housing Tax Credits (LIHTC):
Legislated into existence in the 1986 Tax Reform Act, low income housing tax credits serve as incentives for corporations to invest in low-income rental housing. Fannie Mae serves previously underserved markets characterized by very low incomes, HOPE VI public housing replacements, and persons with special needs.

Multifamily 3 MAX EXPRESS (All loans on all properties under $3 MM):
As communities look for new options to increase density, promote infill and walkable communities, they now have new options in financing small multifamily properties of $3 MM or less. These properties account for approximately one-third of the total multifamily market. Financing options are now available to streamline the underwriting process, reduce transaction costs and data requirements, while reducing and sometimes eliminating out-of-pocket costs for the borrower. Under a delegated underwriting partnership (DUS), underwriting, commitment, closing and servicing may be delegated to a DUS lender partner, spreading the risk of underwriting smaller properties among the primary and secondary lending markets, increasing liquidity and making more financing available to both local developers and community housing organizations seeking to finance or re-finance smaller multifamily developments. For a list of DUS lenders participating in the 3 MAX EXPRESS program or specializing in larger project transactions (entailing credit enhancements, long term debt, or direct bond placements) you can go to the internet and search the web site at fanniemae.com.

Multifamily Rehabilitation:
Investment funds are available to help finance multifamily projects that are suffering from deferred maintenance and in need of capital improvements. Potential partners must have a proven track record in rehabilitation projects and must be capable of co-investing with local lenders. By providing funds to preserve and extend the life of multifamily properties and to maintain them as affordable housing, increased affordable housing opportunities are made available. For more information about the American Communities Fund, contact your local Fannie Mae Partnership Office.

Particular financing is available for low-moderate income multifamily properties in need of moderate or substantial rehabilitation. The initiative provides for rehabilitation dollars in an amount not to exceed $15,000 per unit.

BUILT GREEN UTAH

Section III Fannie Mae's Housing and the Environment Initiatives

National initiatives with local impact:
Fannie Mae is piloting a variety of initiatives in conjunction with multiple partners to explore ways to provide incentives to reduce residential energy consumption for the

benefit of homeowners and the environment. Our Smart Commute℠ Mortgage rewards home buyers who choose to live near public transit by giving these borrowers an income credit for their reduced commuting costs. The Fannie Mae Energy Efficient Mortgage (EEM) similarly credits home buyers who purchase an energy efficient home or retrofit an existing home. Our Residential Emissions Trading pilot program seeks to quantify the reduction in pollution as a result of energy efficiency improvements and sell these reductions in the emerging international greenhouse gas markets.

Built Green Utah Task Force:
The Built Green Utah Task Force was put together in the fall of 2000 by the Fannie Mae Utah Partnership Office. It was created to bring together the collaborative efforts of the Coalition for Utah's Future / Envision Utah, Quality Growth Efficiency Tools (QGET), Utah Home Builders Association, Utah Mortgage Lenders Association, Realtors, Utah Energy Office, Utah Association of Municipal Power Systems, E-Star Home Energy Rating Program, Public Utilities, Local Water Conservancy Districts as well as numerous building industry representatives and regional energy and environmental consultants to expand the state's supply of environmentally-sensitive homes. Built Green Utah Task Force Members are working to develop a comprehensive Built Green Program that encourages and streamlines green building, while leading the way in measuring and recognizing the savings and value that are derived from homes that are built to more stringent energy, water and resource-efficiency standards.

The goals of the Built Green Utah Housing Forum include:

- Creating market distinction for builders who implement the encouraged practices.
- Creating market demand for green and energy efficient building practices.
- Utilizing market forces to encourage industry practices.
- Demonstrating that an industry-initiated voluntary program can utilize market pressures to positively affect energy- and environment-related practices.
- Educating the home buying public that homes built to green standards may be more affordable, due to lower operating cost and higher performance, and may also offer home buyers greater comfort, reduced maintenance cost and higher resale value.
- Bringing a home mortgage pilot to the market that provides underwriting variances that recognize the added value of energy, water and maintenance savings in the form of additional mortgage funds.

As a voluntary program, Built Green Utah, will encourage home builders to use technologies, products and practices which:

- Provide greater energy efficiency.
- Reduce resource depletion and pollution.
- Protect indoor air quality.
- Conserve water.
- Protect the natural features of the building site.
- Result in a more durable, comfortable home.

When a builder enrolls in the program they may choose to participate at whatever level best suits their market. The program will provide a range of technical support and training opportunities to assist builders in making their check list choices, as well as follow up support. A third-party verification is an extremely important component of the program, bringing enhanced credibility to the overall program impact.

The Built Green Utah Mortgage Pilot can assist in: (1) eliminating the requirement for additional money down, thus allowing 100% financing of the energy, water or resource efficiency improvements; (2) recognizing multiple rating methods and prescriptive programs to determine the efficiency of a home; and (3) developing sample ratings of like-built properties for new construction projects, thus reducing the "per house" cost for efficiency ratings.

Under the pilot, Fannie Mae will allow approved lenders to use the estimated monthly savings in qualifying borrowers for additional funds. Approved lenders may incorporate the benefits of higher performing measures into most Fannie Mae first mortgage products, including conventional fixed-rate and adjustable-rate mortgages.

Features for the Built Green Pilot can include: (1) qualified borrowers of all income levels; (2) borrowers getting "more" house while reducing monthly expenses; (3) combining existing Fannie Mae mortgage products such as new and existing one- to four-family properties, availability for purchase or refinance, and properties that are energy-efficient in their current state as well as properties that add energy improvements after closing.

The alliances between these organizations will give the program strength, credibility and promote access to a broad base of technical expertise in Built Green Program related areas. In addition, the adoption of a Built Green checklist and standards will further support a common message to the consumer and the building industry about energy, water and durable products. But perhaps most importantly, the home buyer will appreciate knowing that their Built Green purchasing decision is a demonstration of their concern for the environment, the future and improving the way we live. For more information on Built Green Utah call the Utah Fannie Mae Partnership Office directly.

Flexible & Community Home Performance Power:
Home Performance Power Flexible and Community 100 Mortgages are zero down payment mortgages that are available to borrowers of varying incomes (80% and above or 80% and below). It also offers the borrower greater buying power by adding projected energy and water savings to the borrower's income in the mortgage qualifying process. Three percent borrower contribution can come from the borrower's own funds, gifts, a grant or other sources. Borrowers can use the Home Performance Power Community 100 if the home they are purchasing meets the requirements of the local green building program or the home's energy efficiency exceeds the model energy code by 30 percent and water conservation is designed into the property.

Built Green Utah Mortgage Pilot:
The Utah Built Green Mortgage Experiment, available in 2002, includes a $3 million dollar allocation of funds for the local housing market. The product permits a minimum down payment from the borrower to be the lesser of 1% or $500 (the difference coming from alternative sources) on an EEM. Community Seconds are allowable up to a combined loan to value (CLTV) of 105%. Borrowers must make less than 100% of the area median income, except when the home is located in a FannieNeighbors community where there are no income restrictions.

Location Efficient Mortgage:
The Location Efficient Mortgage (LEM) is a $100 million experiment that is the first homeownership initiative to link housing with efficient public transportation. It is also a tool that can be used to revitalize urban communities. The LEM recognizes home-

buyer savings resulting from the purchase of a home located in a densely populated community served by efficient public transportation. The idea is that borrowers purchasing homes near efficient public transit are more likely to utilize it, thus saving money that might otherwise be spent on automobile upkeep. The LEM recognizes a portion of these potential savings and adds it to the home buyer's qualifying income - increasing the borrower's home-buying power. The Fannie Mae Partnership Office in conjunction with the Utah Transit Authority are presently mapping Salt Lake County's local transit systems, including bus lines and light rail (TRAX) to determine eligible areas and program features for implementation of a new LEM pilot program in 2002. The goal of the partnership is to bring on additional geographies as the transit system grows.

AMERICA'S LIVABLE COMMUNITIES

Section IV Livable Communities

National initiatives with local impact:
Some Utah communities are eligible to participate in a $30 billion leveraged public/private community development investment fund targeted towards 300 communities around the nation. This community development initiative supports revitalization efforts in targeted communities to help local partners achieve their vision for a revitalized neighborhood. Regional Community Development teams and local Partnership Offices work with lenders and community partners to strategically utilize debt, investment and service vehicles to advance local housing and community development goals and promote livable communities.

Fannie Mae's tool chest for this effort consists of an array of investment vehicles such as the American Communities Fund, Multifamily and Public Finance, mortgage products, rehabilitation products, technology, market research techniques and Geographic Information Systems. By leveraging the inherent strengths of inner city locations and older suburban neighborhoods, such as proximity to jobs, transportation network, and untapped economic wealth, local partners can produce visible, tangible, and sustainable economic development results in underserved neighborhoods.

Employer Assisted Housing:
Strong economic growth increases demands for affordable housing. Utilizing alternative sources for down payment funds are one key to increasing homeownership rates. One untapped source of funds is Employer Assisted Housing (EAH).

EAH is an employer-provided benefit that helps employees purchase a home. The most common EAH benefits are grants, forgivable loans, deferred or repayable loans, matched savings, interest rate buy downs, and/or home buyer education provided by an employer-funded counseling agency. In return for this benefit, employers can realize increased employee loyalty and morale, decreased turnover rates, and decreased training costs. The savings realized from the decreases in turnover rates and training costs are often more than sufficient to cover the costs of providing an EAH benefit. In addition, a company that offers an EAH plan as part of its benefits package stands apart from its competitors when recruiting new employees. EAH plans can also be combined with efforts of local housing authorities, governments, and non-profit organizations to revitalize specific areas of a community. By providing additional incentives for employees to own homes in areas that need revitalization, communities are strengthened. EAH provides a "win, win, win" scenario: employees win by achieving the dream of homeownership, employers win by enhancing their financial

strength, and communities win by reaping the benefits of increased homeownership levels in their communities.

An EAH plan can be easily customized to meet the unique needs and circumstances of an employer's overall recruitment, retention, benefits, and community strategies. While many EAH plans have similar features, there is no "master plan" that a company must utilize. Each plan is uniquely designed to meet the company's specific goals and to help the company save money. Fannie Mae and its lender partners can assist employers in creating the best EAH structure to support the company's employee and community strategies.

An EAH case study:
Company A with 1,000 employees is currently experiencing a turnover rate of 20%. Each worker has an average salary of $30,000. When filling new positions, 75% of the hires come from outside the company. The average cost of recruiting and training a new employee is $2,000.

In an effort to reduce turnover, the company decides to offer EAH as a benefit. Eligible employees receive a five-year forgivable loan of $4,000 to help with the down payment and closing costs on a new home assuming that the employee remains in good standing with the company and remains in the home for that amount of time. The employee is required to make interest only payments for the life of the loan at 7%. Assuming that each year, only 6% of eligible employees use the benefit, the company realizes a decrease in turnover by 2%. If this occurs, the company would still experience a net savings of over $65,000 the first year, and $400,000 over 10 years. The net present value of each year's savings over 10 years, is over $300,000. If turnover declines by more than 2%, then the savings increase even more dramatically. Clearly, EAH is a valuable and cost-effective tool for employers to recruit and retain good employees.

The Fannie Mae Utah Partnership will offer technical assistance in designing a program and provide a software analysis consultation for interested companies, organizations or governmental entities and/or municipalities.

UTAH PARTNERSHIP OFFICE ASSISTANCE

Section VI Summary:

The Fannie Mae Utah Partnership Office is ready and willing to support Utah communities and citizens in their efforts to expand the reach of homeownership and affordable housing in Utah. In particular, we seek to support Utah cities and towns, community lenders, borrowers, non-profit organizations and, developers and home builders as they plan and create additional homeownership and rental housing opportunities. We believe that strong communities are created when Utahns have a safe place to live, thus strengthening families, communities and our state as a whole. For more information or assistance please feel free to call us any time at 801.715.6860.

Chapter 1

For Envision Utah, Wirthlin Worldwide conducted in-depth research in March-May 1997 to identify what Utahns value about living in Utah and their concerns in the face of current growth trends. Contact Envision Utah at 801-973-3307

Chapter 2

"Greater Wasatch Area Housing Analysis," Econorthwest, 1999
Utah Automated Geographic Referencing Center (AGRC), Fregonese Calthorpe Associates, and Econorthwest, joint research conducted in 1998. Contact AGRC for more information

Chapter 3

Traditional Neighborhood Development Sales Comparison Trends, Market Perspectives, Roseville, CA. February 22, 1999.

Envision Utah Quality Growth Strategy and Technical Review, 1993

"Memorandum to Route 9/100 EIS Citizens Advisory Group," Vanesse Hangin Brustlin, Inc. August 29, 1994, cited in Conservation Law Foundation, below.

The Effect of Neotraditional Neighborhood Design on Travel Characteristics, Fehr & Peers, 1997.

Explaining Urban Density and Transit Impacts on Auto Use. Holzclaw, J Sierra Club and Natural Resources Defense Council, 1991.

"The Impacts of Mixed Use and Density on the Utilization of Three Modes of Travel: The Single-Occupant Vehicle, Transit, and Walking. L. Frank and G. Pivo. Transportation Research Record 1466: 44-52, 1994.

"Mass Transit for High-Rise, High Density Living," Wilbur Smith, Journal of Transportation Engineering, Vol. 110, No. 6, 1984.

"Regional Transit Corridors: the Land Use Connection." Parsons Brinckerhoff Quade & Douglas, Inc., Robert Cervero, Howard/Stein-Hudson Associates, and Jeffrey Zupan. The National Research Council, TRB, TCRP H-1. Washington DC, 1995.

Public Transportation and Land Use Policy. Boris Pushkarev and Jeffrey Zupan. Bloomington, IN: Indiana University Press, 1977.

Kassowski, Kevin, "The Costs of Sprawl, Revisited." Developments, 1992. Cited in Tools for Reducing Vehicle Trips Through Land Use Design, San Diego Air Pollution Control District, January 1998.

Burchell, Robert W., et al. Impact Assessment of the New Jersey Interim State Development and Redevelopment Plan, Report II: Research Findings. Report Prepared for the New Jersey Office of State Planning, Trenton, 1992.

SOURCES, GRAPHIC AND PHOTO CREDITS (courtesy of the authors except the following):

p.24
Reprinted from "Greater Wasatch Area Housing Analysis," Econorthwest. 1999

p.26
Reprinted from "Households and Housing," Clark, William A.V. and Frans M. Dieleman. 1996.

p.48
Developed by Steve Price "in association w/ Dover Kohl & Partners "& Glatting Jackson"for Johnson City Tennessee

p.56
Glatting Jackson

p.71
Developed by Steve Price "in association w/ Dover Kohl & Partners & Glatting Jackson" for Johnson City Tennessee

p.222
Sugarhouse Commons Site Plan courtesy The Boyer Company

p. 224
Redmond Town center site courtesy LMN Architects

p.224 and 229
John Gallagher Photography

p.227
Gateway Site Plan courtesy The Boyer Company

Chapter 4

Urban Land Institute. Shared Parking, 1983.

Chapter 5

Envision Utah Quality Growth Strategy and Technical Review, 1999.

American Water Works Association: Handbook of Water Use and Conservation, 1993.

Utah's Water Resources: Planning for the Future, 2001.

Environmental Protection Agency's Statement of Principals on Efficient Water Use, www.epa.gov, 2001.

Municipal Industrial Water Supply and Uses, 2000.

Chapter 7

Energy Resources

Department of Energy 1997. Tomorrow's Energy Today: Energy Solutions for Cities and Counties.

Hubbard A and Fong C 1995. The Community Energy Workbook. Rocky Mountain Institute. Pg 59.

U.S. Department of Energy: Energy Information Administration: www.eia.doe.gov.

Center for Energy Efficiency and Renewable Technologies http://www.sustainable.doe.gov.

Energy Efficiency and Renewable Energy Clearinghouse: http://www.eren.doe.gov.

National Renewable Energy Laboratory (NREL): http://rredc.nrel.gov.

Energy Efficiency and Renewable Energy Network (EREN): www.eren.doe.gov.

American Council for an Energy-Efficient Economy: www.aceee.org.

Association of Energy Services Professionals International: www.aesp.org.

Association of Professional Energy Managers: www.apem.org.

The EPA Energy Star: http://energystar.gov.

Energy Star Program.

EPA Energy Star HOMES Program.

The Utah Department of Natural Resources: www.nr.uta.gov/energy .

The Utah Department of Environmental Quality: http://www.eq.state.ut.us/eqamc/amc.htm.

The Utah Department of Community and Economic Development: www.dced.utah.gov DOE Weatherization Program and other community grants and loans

Utah Power www.utahpower.net (or PacifiCorp www.pacificorp.com).

Queststar www.questar.com.

British Columbia Energy Aware: http://www.energyaware.bc.ca/about.htm.

Bioenergy: http://www.westbioenergy.org.

Codes and Ratings

Utah Model Energy Code: http://www.eren.doe.gov/buildings/codes_standards/buildings/states.

Utah Engineering Experiment Station (801-581-6348).

Utah Energy Coalition (1-800-550-8322).

U.S. Green Building Council U.S.: Green Building Council Leadership in Energy and Environmental Design (LEED).

Salt Lake City's High Performance Building Task Force: www.HPBtaskforce.com.

Utah Energy Conservation Coalition: Home Energy Ratings.

Environmental Protection Agency: www.epa.gov/air/data/sources.html.

Marsico, Dale J. "Improve the Delivery of Transit Services by Easing Regulatory Burdens." Community Transportation Association of American www.pti.org.

Green Builders in Utah

Call Utah Energy Coalition (1-800-550-8322) for a list of builders for your area.

Financial Resources

Utah's Quality Growth Commission: www.governor.state.ut.us/quality.

Leray McAllister Fund 801-538-1571.

Fannie Mae: Utah State Partnership Office: www.Fanniemae.com 801-715-6860.

Plants

Akbari H 1993. Monitoring Peak Power and Cooling Energy Savings of Shade Trees and White Surfaces in the Sacramento Municipal Utility District Service Area. LBL 34411.

Akbari H et.al. 1996. Policies to reduce heat islands. Proceedings of the 1996 ACEEE summer study on energy efficiency in buildings.

Akbari H 1994. CBS Newsletter. Pg. 7 LBL.

Developing and evaluating tree ordinances: http://www.phytosphere.com.

Transportation

Alternatives to Sprawl in Southeastern Wisconsin. Citizens for a Better Environment: www.cbew.org.

Urban Consortium Task Force. Public Technology, Inc.: www.pti.org.

Surface Transportation Policy Project: www.transact.org.

Wasatch Front Regional Council: www.wfrc.org.

A Policy on Geometric Design of Highways and Streets "Green Book", 2001.

American Association of State Highway and Transportation Officials (AASHTO): www.aashto.org/publications/bookstore.nsf:.

EPA Publication 231-R-01-002, Our Built and Natural Environments, A Technical Review of the Interactions between Land Use, Transportation, and Environmental Quality, 2001 www.smartgrowth.org.

Flexibility in Highway Design: www.fhwa.dot.gov/environment/fhd.htm.

Bicycling and Pedestrian Resource Guide and Program: www.dot.utah.gov/progdev/bike/ResourceGuide.htm.

Argonne National Laboratory Transportation Technology Research and Development Center: www.transportation.anl.gov.

Utah Department of Transportation: www.dot.utah.gov/ops/its/its.

National Clean Cities Coalition: www.ccites.doe.gov.

US DOE - Office of Transportation Technologies Alternative Fleet Buyers Guide - How Can I Buy An AFV? www.fleets.doe.gov/.

Chapter 8

Center for Disease Control and Prevention. Creating a Healthy Environment: The Impact of the Built Environment on Public Health, 2001.

Ohland G. Caught in the crosswalk: Pedestrian safety in California [Online]. Available: http://www.transact.org/ ca/caught99/caught.htm [2001, August 6].

Urban Land Institute. Parking Requirements for Shopping Centers, 1999.

Urban Land Institute. Shopping Centers and Other Retail Properties, 1996.

Utah Department of Health. Utah Health Status Update: Obesity and Overweight, December 1999.

Chapter 9

1. Garber and Hoel, Traffic and Highway Engineering, West Publishing Company, St. Paul, MN, 1988.

2. FHWA (United States Department of Transportation, Federal Highway Administration), State of the Art: Residential Traffic Management, 1980, p. 10.

3. Ibid, p. 10.

4. Ibid, p. 13.

5. Grava, S. Traffic Calming. Can it be Done in America? Transportation Quarterly, No. 47, 1993, pp. 483 – 505.

6. ITE (The Institute of Transportation Engineers), Traditional Neighborhood Development – Street Design Guidelines, Proposed Recommended Practice, ITE Transportation Planning; Council Committee 5P-8, June 1997, p. 14-16.

7. ITE/FHWA (Institute of Transportation Engineers/Federal Highway Administration), Traffic Calming: State of the Practice, August 1999.

8. Ibid. p. 2.

9. Ibid. p. 3. "Acceptable Level" is identified by ITE/FHWA as the "speed and volume of traffic for the functional class of [the] street and the nature of the bordering activity."

10. FHWA, supra, p. 3.

11. Ibid, p. 3.

12. Ibid, p. 3.

13. PDOT (Pennsylvania Department of Transportation), Traffic Calming Handbook, January, 2001, p. 2.

14. ITE/FHWA, supra. pp. 14-15.

15. FHWA, supra. p. 14.

16. Reps. John W. Plan for the City of Zion, formatted as a web page, Department of City and Regional Planning, Cornell University, www.library.cornell.edu/Reps?DOCS/smith.htm.

17. FHWA, supra, p. 12.

18. ITE, supra, p. 2.

19. Traffic Calming, Selected Practices, Lessons Learned. Center for Urban Policy Research, Rutgers University, 2001.

20. New Urban News, Narrow Streets are the Safest, Volume 2, No. 6., November-December, 1997, p. 1.

21. Ibid, p. 9.

22. United State Department of Transportation, Federal Highway Administration (FHWA), Design Guidance, Accommodation Bicycler and Pedestrian Travel: A Recommended Approach. A US DOT policy Statement on Integrating Bicycling and

Walking into Transportation Infrastructure.

23. FHWA, supra, p. 19.

24. Ewing, Reid, Residential Street Design – Do the British and Australians Know Something We Americans Don't, ITE Compendium of Technical Papers, 1993.

25. ITE, supra, and Burden, Dan, Street Design Guidelines for Healthy Neighborhoods, Local Government Commission, January, 1999.

26. ITE, supra, pp. 16.

27. "Urban Traffic Calming Treatments: Performance Measures & Design Conformance," ITE Journal, August, 1997.

28. United States Department of Transportation, Federal Highway Administration (FHWA), Traffic Calming Measures, www.fhwa.dot.gov/environment/calm/part2.htm

29. ITE, supra, p. 15, summarized from Table 1.

30. Traffic Calming, Selected Practices, Lessons Learned, Rutgers University, Center for Urban Policy Research, 2001. Also information provided for Pedestrian Safety in Facts and Figures, Pedestrian Safety Roadshow, www.ota.fhwa.dot.gov/walk/facts/index.html

31. ITE, supra, pp. 18-19.

32. ITE, supra, pp. 18-19. Supported by Child Pedestrian Injuries on Residential Streets: Implications for Traffic Engineering, by Peter Jacobsen, Craig L. Anderson, Diane G. Winn, John Moffat, Phyllis F. Agran and Sheila Sarkar, ITE Journal on the Web, February, 2000.

33. Utah Department of Health, Violence and Injury Prevention Program, Utah Pedestrian Fact Sheet, 3/2001.

34. Utah Department of Health, Violence and Injury Prevention Program, Utah Bicycle Fact Sheet, 3/2001.

35. FHWA, supra, p. 131.

36. Atkins, Crystal and Michael Coleman, The Influence of Traffic Calming on Emergency Response Times, ITE Journal, August 1997.

37. Ibid, p. 132.

38. Ibid, p. 132.

39. Uniform Fire Code, Fire Department Access and Water Supply, Part III, Article 9, 1997.

40. Fernandez, John M., Boulder Brings Back the Neighborhood Street, Planning, June 1994, p. 25.

41. Presentation to Fire Marshals Roundtable, Skinny Streets, September 20, 1995, Salem Oregon, p. 7.

42. New Urban News, supra, p. 9.

43. Ibid, p. 9.

44. FHWA, supra, p. 135.

45. Ibid. p. 135.

46. Ibid, p. 135.

47. Ibid, p. 135.

48. FHWA, supra, p. 3.

49. Ibid, p. 15.

50. ITE/FHWA, supra, p. 43.

51. Institute of Transportation Engineers Journal, Urban Traffic Calming Treatments: Performance Measures and Design Conformance, August 1997, pp. 34-40.

52. Improving Residential Street Environments, FHWA, 2000.

53. PDOT, supra.

54. ITE/FHWA, supra. pp. 189-192.

55. PDOT, supra.

56. California Safe Routes to School Initiative, Safe Routes to School March, 2000, and, Nationwide Personal Transportation Survey, Center for Disease Control and Prevention.

57. Ibid.

58. ITE, supra, p. 13.

59. Jacobs, Allan B., Great Streets, Cambridge MA., Massachusetts Institute of Technology, 1993, p. 272-273.

60. ITE, supra, p. 28.

61. Ibid, p. 6.

62. Ibid, p. 22. (Identified as a reasonable standard for residential streets and supported by research of FHWA and ITE and consistent with the recommendation of the State of Utah, Governor's Office of Planning and Budget.).

63. Ibid, p. 16.

64. Ibid, p. 16.

65. Ibid. p. 16-17.

66. Ibid, p. 28.

67. Ibid. p. 25.

68. Swift and Associates, Residential Street Typology and Injury Accident Frequency, June 2001.

69. ITE, supra, p. 26.

70. Ibid, p. 26.

71. State of Utah, Governor's Office of Planning and Budget, Residential Street

Design, www.governor.state.ut.us/planning/LandUse/StreetDesign.htm.

72. U.S. Department of Transportation Policy Statement, March, 2000

73. New Urban News, March 2001

What you can do to get involved

All of the concepts and ideas presented in these chapters are ones that affect our families and us. Envision Utah depends on input from a wide variety of sources, including citizens, business people, civic leaders, political leaders, planners and many more. This program depends both on broad citizen input and continued involvement in the community.

A good community doesn't just occur by happenstance. It requires a thoughtful approach to how a strong community can become even stronger. It also requires a continued commitment to fostering ideas, shaping those ideas into tangible results, and always being open to updating those ideas and results as time goes by.

For more information about Envision Utah, here are some additional resources and ways to become involved to help shape our communities:

ENVISION UTAH

A Partnership for Quality Growth

Envision Utah
www.envisionutah.com
(801) 303-1450
kthompson@cuf-envision.org
abeseris@cuf-envision.org
254 South 600 East, Suite 201
Salt Lake City, Utah 84102

Governor's Office of Planning and Budget
www.governor.state.ut.us
Utah Quality Growth Commission
(801) 538-1027
1-888-854-4260
116 State Capitol
Salt Lake City, Utah 84114

Quality Growth Efficiency Tools (QGET)
(801) 538-1855
Scott Frisby
sfrisby@gov.state.ut.us
116 State Capitol
Salt Lake City, Utah 84114