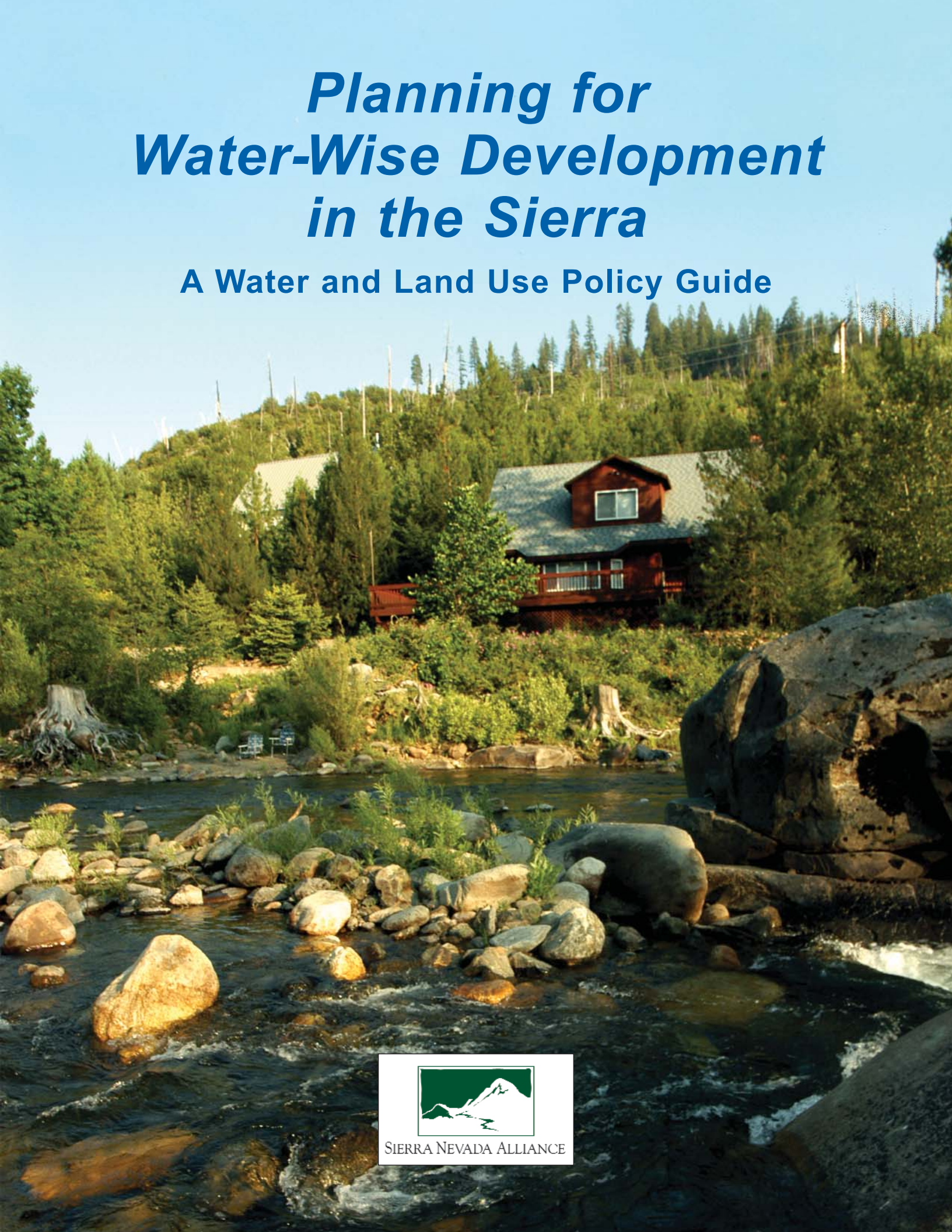
Planning for Water-Wise Development in the Sierra

A Water and Land Use Policy Guide



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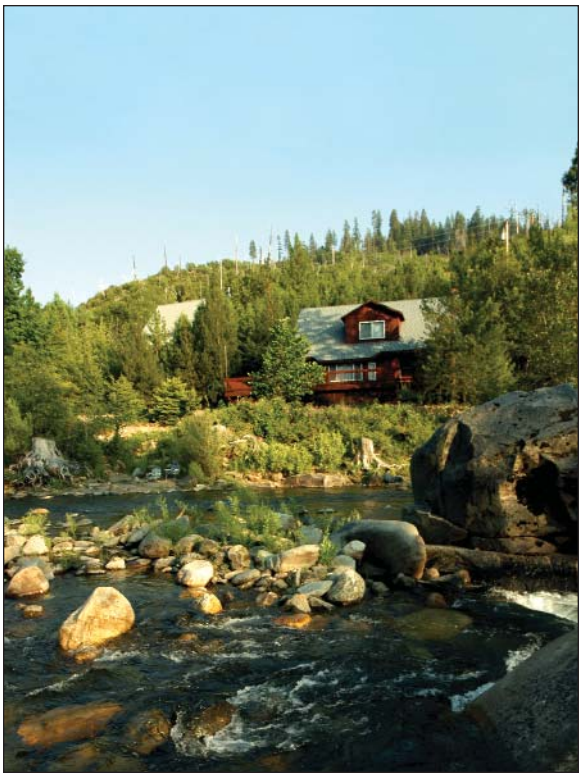

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A Water and Land Use Policy Guide

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August 2008

Sierra Nevada Alliance

www.sierranevadaalliance.org

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The authors bear responsibility for any factual errors. Recommendations and views expressed are those of the Sierra Nevada Alliance and do not necessarily represent those of funders, reviewers or others who offered assistance to this report. Additional photos in this guide book have been provided by the Local Government Commission.

The Local Government Commission and the Sierra Nevada Alliance

The Local Government Commission, a California-based, nonpartisan, membership organization established in 1983, works with local elected officials and other community leaders to create healthy, walkable and resource-efficient communities.

- www.lgc.org

The Sierra Nevada Alliance has been protecting and restoring Sierra land, water, wildlife and communities since 1993. The Alliance unites hundreds of individuals and conservation groups to protect Sierra resources. The Alliance is driven by a vision of a Sierra where natural and human communities coexist in harmony; a Sierra where residents and visitors alike understand and value the unique qualities of the range and protect the places they love.

SIERRA NEVADA ALLIANCE

For more information or to obtain copies of this guidebook, visit our website or contact our office:

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Introduction.

About this Guide

Planning for Water-Wise Development in the Sierra provides local conservation groups, local government and the public useful information about the connection between development and water – water quality, water supplies and the health of the Sierra's watersheds.

This guide presents planning strategies that promote development patterns and practices better aligned with water protection goals. It does not address every aspect of water management or land use planning, but instead focuses on land use decisions made by city and county governments and encourages involvement from water managers and integration with local water management efforts. Most of the suggested strategies can be implemented at the local level to help communities protect water resources as they grow.

This guidebook is organized into six chapters:

- ➢ Chapter 1 provides an overview of the current state of Sierra waters.
- ➢ Chapter 2 focuses on strategies to preserve and restore natural infrastructure, such as wetlands, rivers and riparian areas.
- ➢ Chapter 3 reviews how to protect water resources while accommodating growth through thoughtful community planning and design.
- ➢ Chapter 4 suggests design strategies to reduce runoff and encourage more efficient use of water supplies.
- ➢ Chapter 5 offers solutions to some of the principal challenges of water and wastewater management in the region and examines practical ideas for improving coordination between land use planning and water and wastewater agencies, water conservation and efficiency programs, and integrated wastewater management.
- ➢ Chapter 6 summarizes the key points and strategies for water-wise development shared in the guide.

More Tools for Better Land Use and Water Planning

To help communities with the challenging decisions related to growth, water management and watershed protection, the Sierra Nevada Alliance has two helpful reports. *The State of Sierra Waters: A Sierra Nevada Watersheds Index* highlights threats to the 24 major watersheds of the Sierra Nevada. *Planning for the Future: A Sierra Nevada Land Use Index* reveals the risks of unplanned development and details the threats of sprawl to the communities and landscapes of the region. These resources provide recommendations and data for local governments about the threats to water and land under current growth and development trends.

In 2005, the Local Government Commission created planning principles for aligning local land use decisions with efforts to protect and restore water resources. *The Ahwahnee Water Principles for Resource-Efficient Land Use* provide integrated policy guidelines that communities can use to address the disconnect between water and land use, and achieve broader planning and community design objectives such as safety, housing and economic vitality. The Ahwahnee Water Principles, fact sheets and guidebook are available at www.water.lgc.org.

Chapter 1.

The Importance of Sierra Water

The Sierra Nevada includes roughly 25 million acres and spans more than 400 miles from the Mojave Desert to the Cascade Range of northern California and Oregon.

Sierra Nevada water is essential to the existence of California's communities and ecosystems, and to the state's economic prosperity. In addition to being obviously vital for the towns and communities of the Sierra – providing high-quality drinking water, prime recreation opportunities and a diverse and vibrant ecosystem – water originating in the region provides more than 60% of California's and most of northwestern Nevada's developed water supply, and drives the majority of California's 386 hydroelectric power projects.

The many benefits provided by the region's watersheds and the ecological systems they support are often called "ecological services." Economists refer to the valuable goods created through ecosystem services, such as timber products, healthy fisheries or agricultural products, as "natural capital."

According to the Natural Capital Project of the 1996 Sierra Nevada Ecosystems Project, a project requested by Congress as part of a study of the entire Sierra Nevada ecosystem, the Sierra Nevada ecosystems produce approximately $2.2 billion worth of commodities and services annually, including water resources, agriculture, timber products, ranching, mining, tourism and recreation.

The direct value of water for irrigation, municipal and hydroelectric use is $1.3 billion a year, based solely on the value of the actual water rights. That's more than 60% of the total dollar value of all natural products or services produced by the entire region.[1]

The water from the Sierra Nevada is also a major component behind the enormous agricultural economies of the Central and San Joaquin Valleys.

The Sierra Nevada Range and California Cascade

From its border with the Cascade Range to the Tehachapi Mountains, from the Great Basin to the Central Valley, the Sierra Nevada runs 430 miles long and encompasses desert, high desert, blue oak woodland, alpine highland and many other kinds of terrain.

In 2005, the gross value of agriculture production in California counties using Sierra Nevada water was greater than $18 billion.[2]

Though not as easily quantifiable as the economic value of its water, equally important to California is the role the Sierra plays as a water storage center. Sierra snow pack is California's single largest water storage system. Much of the water consumed by people living in large metropolitan areas, including Los Angeles, Oakland, Reno and San Francisco, comes directly from the Sierra.

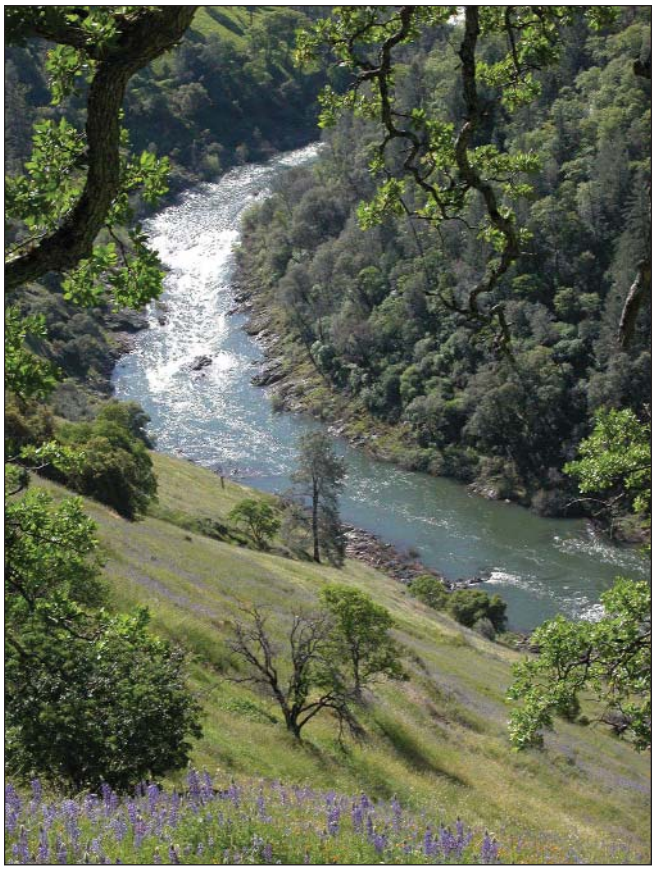


photo: Bill Center

With a growing population and changing climate, our current water delivery systems will be challenged to meet demand.

Current State of Sierra Waters

The value of Sierra watersheds cannot be overstated. As well as ensuring clean, reliable water, they are the basis for healthy landscapes and prosperous communities now and in the future. Yet it would be wrong to assume that the high mountain watersheds of the Sierra Nevada are pure and pristine. The early impacts from mining, logging and railroad construction – sometimes referred to as "legacy" impacts – as well as the effects of more recent human activity, remain a problem throughout the region.

The Sierra Nevada Ecosystem Project report points out that riparian areas are the most altered and impaired parts of the Sierra. Dams, ditches, flumes, roads and other structures have changed the shape, flow, temperature and quality of our rivers and streams.

Manipulation of our waterbodies for water supply, irrigation, transportation, hydropower, waste disposal, mining, flood control, timber harvest, recreation and other uses has degraded watersheds throughout the Sierra.

Other indicators of water quality impairment in the Sierra come from data gathered by the California State Water Resources Control Board. This state agency tracks water quality in selected areas of watersheds throughout the state. Of the 24 major watersheds in the Sierra region, 11 contain at least one river, stream or lake that has been impaired for some period of time by pollution (metals, nitrogen, phosphorous, mercury, sedimentation/siltation, salinity, chlorides, flow or habitat alternations, and pathogens).

And in the Sierra Nevada Ecosystem Project report's index of Biotic Integrity, which uses the presence of various important fish communities to measure relative watershed health, less than one-third of the Sierra's 24 major watersheds receive scores indicating "good" watershed quality.[3]

Existing Threats to Sierra Water

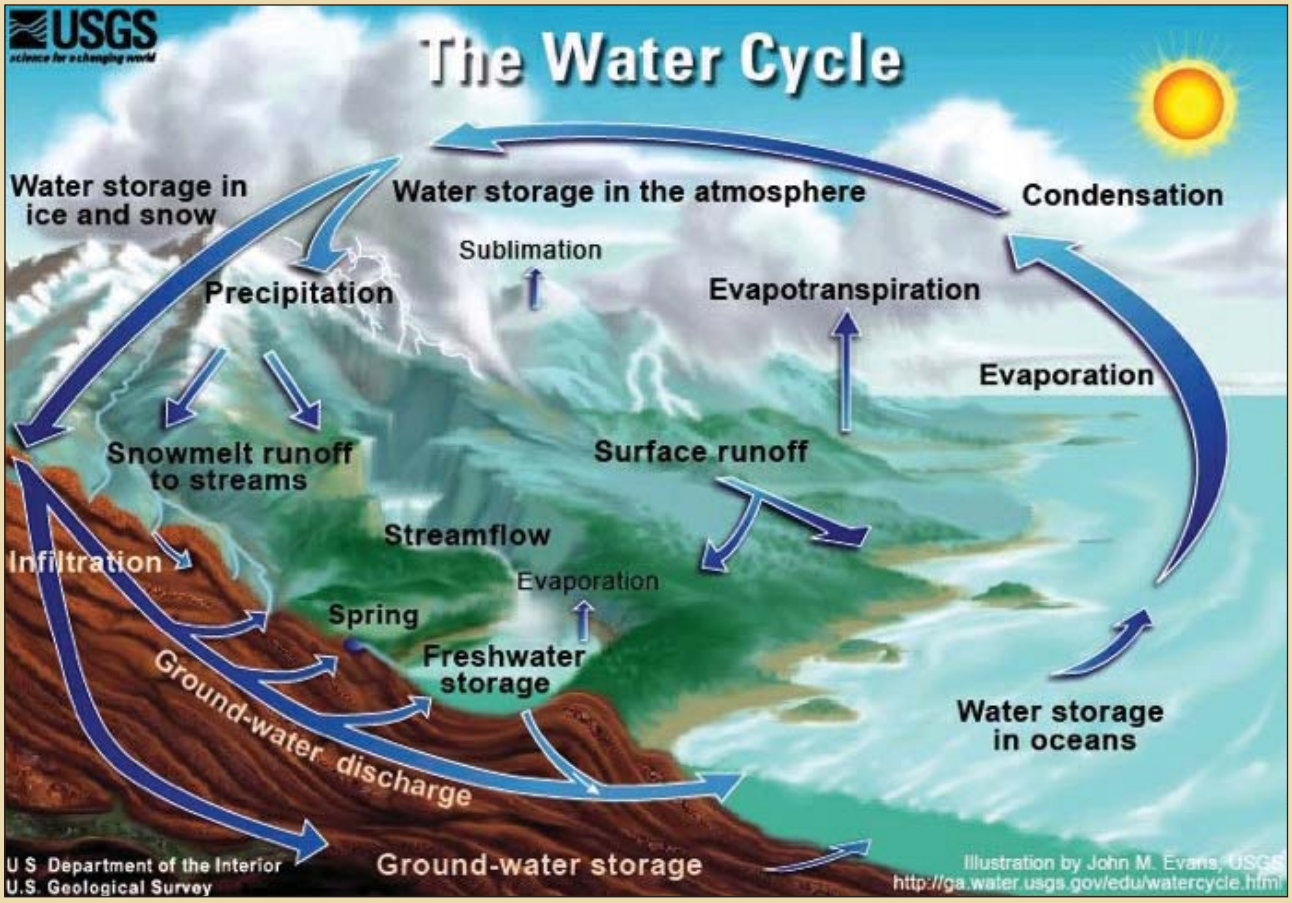
Many activities threaten the waters of the Sierra – and many such threats are caused or compounded by patterns of human settlement. Some of the most significant threats are summarized below.

- **Increasing Demand on a Finite Supply:** With a growing population and a changing climate, our current water delivery systems will be challenged to meet demand. One study indicates that at current levels of per capita water use, the water demand generated by California's future residents will require a 40% increase in supplies.[4]

Because so much of California depends on water from the Sierra, it is impossible for the region to ignore the many issues currently straining the state's water resource system. These include the 2007 court decision to reduce water pumped from the Bay Delta, and cutbacks on the amount of Colorado River water coming to California.

The demand for water from the Sierra creates controversial management issues between counties and the state over water rights, stream and river flows, reservoir management and flood control.

Exacerbating Sierra Nevada water supply issues are regional growth projections. The Sierra is the third-fastest growing region in California. According to the California Department of Finance, the current population of approximately 600,000 residents is expected to triple to somewhere between 1.5 and 2.4 million residents by 2040.



What Is the Water Cycle?

The hydrologic cycle is the continuous movement of water between land, waterways, the oceans and the atmosphere. It is an essential natural process that recycles and distributes the earth's water supplies.

In the hydrologic cycle, water evaporates from bodies of water (oceans, lakes and rivers), and is transported as water vapor to different locations where it falls back to the earth as precipitation in the form of rain, snow, hail or fog.

Once in liquid form back on earth, water either soaks into the soil or collects and moves across the surface as runoff, eventually flowing back into bodies of water such as streams, rivers and lakes. Water that soaks into the soil percolates down into groundwater reservoirs or aquifers. Some water that soaks into the soil is taken up by roots of plants in a process called transpiration.

What Is a Watershed?

A watershed is an area of land within which all water drains to a common point or outlet, like a river, lake or the ocean. A watershed creates a hydrologic network connecting water as it moves through the land. The Sierra's 24 major watersheds catch, cleanse, store and transport all the water that falls within the region. They have biological and physical components that make up important ecological systems such as wetlands, rivers, lakes, meadows, forests and floodplains.

photo: Kenneth & Gabrielle Adelman

Blue Oak Woodland Habitat in Placer County is cleared for development of Bickford Ranch, a planned residential community east of the City of Lincoln.

Between 1990 and 2004, the number of building permits issued in the Sierra increased by 22% annually.[5] More people and more development mean additional demand for water for drinking, irrigation and recreation.

Sierra residents, like residents throughout the state, have a growing demand for water but less of it to go around.

■ **Inefficient Development Patterns Consume Valued Lands:** In a natural state, most of the earth is covered by layers of soils and vegetation that can absorb, cleanse and drain water. These natural drainage processes are critical to overall watershed health: they sustain water quality, contribute to stable surface and groundwater supplies, and maintain terrestrial and aquatic ecosystems.

The spread of pavement, rooftops and other impervious surfaces, combined with compaction of soil and removal of trees and vegetation, prevents water from soaking into soils and destroys the natural infiltration and cleaning function provided by the infrastructure of the earth's surface. This increases the amount and speed of stormwater runoff, which erodes stream banks, reduces opportunities for groundwater recharge, and pollutes water with contaminants such as oil and grease washed from developed areas.

Research has demonstrated a strong inverse relationship between impervious cover and water quality. Multiple studies show that significant water quality impairment often occurs when as little as 10% of a watershed is covered with impervious surface.[6]

Much of the recent growth occurring in the Sierra today is accommodated by low-density residential development that sprawls outside of existing city and community centers. Not only does this growth often damage natural infrastructure valued for its water storage and filtration qualities, but this particular kind of development is one of the worst culprits for increasing impervious surface.

Much as population growth creates new water supply dilemmas, population growth intensifies impervious surface concerns, especially when accommodated by low-density development outside of city and town centers.

■ **Stressed Water and Wastewater Infrastructure:** The rural nature of the Sierra means that many communities in the region depend on small, isolated municipal water and sewer agencies for water and wastewater service. Individually, these smaller agencies often lack the technical or financial capacity toupgrade their treatment facilities and infrastructure. In other cases, the difficulty of expanding water or wastewater infrastructure to rural areas means that residents rely on individual septic systems and well water. Individual septic systems have a high failure rate and are a source of ground and surface water contamination.

▼ *The Sierra snow pack acts as the state's largest freshwater reservoir, but its storage capacity is threatened by global warming. Higher temperatures could lead to more precipitation falling as rain rather than snow.*

There are 24 major watersheds in the Sierra Nevada and the Pit River in the California Cascade. A watershed has boundaries just like a city, county or state. The boundaries are defined by water flow and ridgelines. The major watersheds all have smaller watersheds within their boundaries – tributaries that flow into the larger rivers.

source: GreenInfo Network, Sierra Nevada Alliance

Where Are the Sierra Nevada Watersheds?

WESTERN SLOPE

Upper Sacramento
Feather
Yuba/Bear
American
Consumnes
Mokelumne
Calaveras
Stanislaus
Tuolumne
Merced
San Joaquin
Kings
Kaweah
Tule
Kern
Caliente

EASTERN SLOPE

Eagle Lake
Honey Lake
Truckee
Carson
Walker
Mono Basin
Owens
Mojave

CALIFORNIA CASCADE

Cow Head Lake
Lake View
Surprise Valley
Madeline Plains
Duck Flat
Pit River
Whitmore

Because groundwater quantity is an unmonitored water resource, there is also concern that the increasing number of individual wells is straining the region's groundwater supplies as a whole. Several studies indicate that groundwater supplies in the Sierra are being drained faster than they are being recharged. As population increases, greater demand will be placed on water and wastewater infrastructure, creating additional challenges to protecting water quality and ensuring water reliability.

■ **Global Warming and Reduced Snow Pack:** The Sierra snow pack acts as the state's largest freshwater reservoir, and its storage capacity is dramatically threatened by global warming. Leading climate scientists believe the Sierra could lose as much as 25% to 40% of its snow pack by 2050 and between 29% and 90% of its snow pack by the end of the century.[7]

The effects of global warming are already being seen in the Western United States in terms of earlier melting snow pack and earlier spring runoff. A smaller snow pack means less water runoff in the spring and early summer to refill reservoirs that supply water in the later summer and fall when California needs it most.

Healthy farming and rangelands are essential to the Sierra's rural character and its economies, but agricultural practices must be managed to minimize impacts to the watershed.

In addition to storage concerns, more precipitation falling as rain instead of snow will fundamentally alter the movement of water through the region. More runoff in mid-winter could lead to more flooding and erosion.

Consequently, restoring forest and meadow health in the Sierra to help slow water runoff is even more important if rain becomes a more common form of precipitation in higher elevations.

■ **Agricultural and Industrial Uses:** While this guide is focused on commercial and residential development, it is important to note that logging, mining, grazing and agricultural activities also create their own threats to Sierra water.

Logging, especially clear-cutting, can alter drainage and runoff patterns, and increase sedimentation and erosion.

The history of mining in the region has left Sierra watersheds with toxic residues, most notably mercury, which continue to seep into water supplies.

Grazing activities when operated poorly can compact soil, destroy vegetation and reduce the function of riparian areas. Poor grazing practices have also been known to increase sedimentation and contaminate waters with fecal coliform.

Healthy working landscapes are an essential part of the Sierra's character and rural economy. While farming and grazing practices can have significant impacts on water, the threat of converting those lands to development is also concerning. Sustainable management and stewardship practices on ranching and agricultural lands can alleviate impacts and enable such areas to provide watershed benefits.

Land Use Planning and Water Protection

Not all of the threats to Sierra water can be solved by better land use planning decisions. However, many threats can be reduced by local government developing water-wise approaches to deal with the region's expanding population. In particular, local government has the opportunity to decrease the impact of new development on water resources because in California, as in most states across the country, local government makes the decisions about where and what we develop.

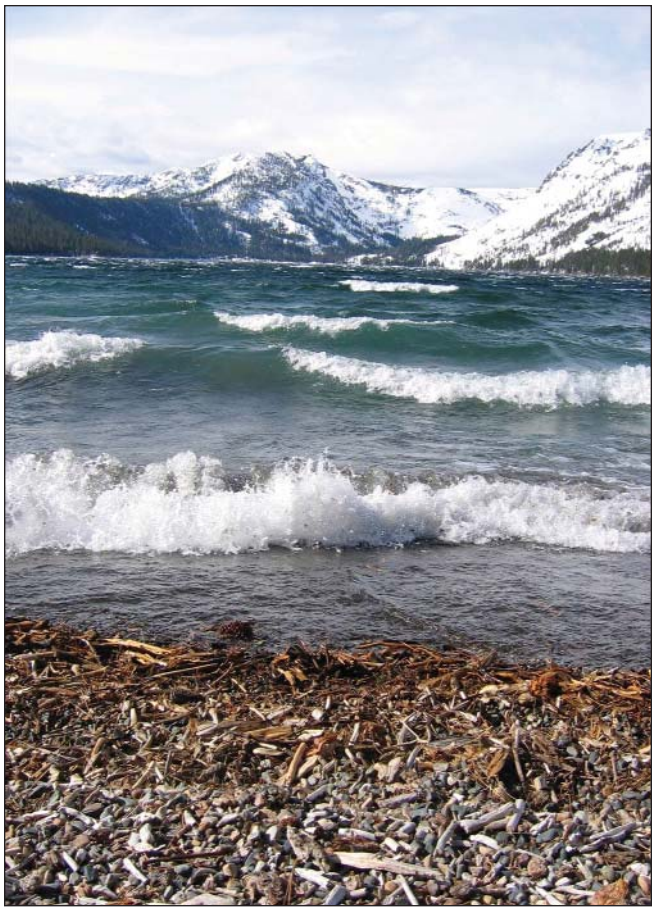
City and county governments are vested with the power to approve or disapprove proposals such as subdivisions, public work projects, development projects and zoning laws. Fortunately for the public, all of these actions are not completely haphazard – most of them are guided by a city or county general plan. Theoretically, a general plan represents a community's vision of its future and is created by a highly inclusive, collaborative community process. A general plan must also pass the rigors of the California Environmental Quality Act (CEQA), which requires cities and counties to evaluate the plan's environmental implications.

Unfortunately, despite good intentions, many of the county and city general plans in the Sierra are failing to adequately protect the region's watersheds.

In some areas, general plans are out of date by as much as 30 years. Even up-to-date general plans often do not protect our water because they encourage or simply permit development patterns antithetical to water protection goals.

For instance, many general plans incorporate zoning regulations that strictly separate residential and commercial uses. This practice of use separation was intended to separate housing from toxins associated with industrial uses and made more sense when industry was a dirtier business that it is today.

While some separation of uses is still important, the strict segregation of use zoning laws created decades ago are a principal cause of dispersed, auto-dependent development. Auto-dependent development amplifies water quality problems related to supply, impervious surface, and stressed water and wastewater infrastructure.



As communities begin to plan more with watershed health in mind, many of our planning tools may need to be changed, refined or augmented to achieve the water protection that is vital to the future of our environment, our economy and our lives.

In many cases, these changes simply require looking back 100 years to the way our communities were originally constructed. Some of the fundamental characteristics that make small towns throughout the Sierra vital and coveted places to live and visit are the same characteristics that reduce the impact of development on water resources. Narrows streets, compact city centers and a mix of residential and commercial neighborhoods are examples of such qualities.

What Are City and County General Plans?

California law requires each city and county to adopt a general plan "for the physical development of the county or city, and any land outside its boundaries which bears relation to its planning" (Government Code Section 65300). A county general plan serves to outline growth and development in the unincorporated areas (i.e., those areas not within the jurisdiction of a city) of the county. A city general plan serves the same purpose, only for those areas within the city's jurisdiction. A good general plan represents the community's vision of its future and is created by a highly inclusive, collaborative community process.

A general plan document is made up of principles, goals and policies, which the county board of supervisors (in the case of a county general plan) or the city council (in the case of a city general plan) along with the planning commission follows when making their land use decisions. Once a general plan is adopted, all subdivision, public works projects and zoning decisions must be consistent with the general plan.[8]

All general plans must contain at least the seven following elements: land use, circulation, housing, conservation, open space, noise and safety (Government Code Sections 65300 et seq.). Many cities and counties choose to augment this list with additional elements related to water, preserving scenic aesthetics, wildfire and fuels, community design, public facilities, the local economy and air quality.

A general plan also provides a foundation for more detailed plans and implementation programs, such as area or community plans, zoning ordinances and specific plans.

Aside from general plans, local regulations, codes and ordinances work at a finer level of detail to specify the type, location and form of development and a litany of design requirements from lighting and landscaping to street widths, signage, parking requirements, placement of utilities and other components of the built environment.

Chapter 2.

Preserving and Restoring Natural Infrastructure

Though it is growing quickly, much of the Sierra Nevada remains undeveloped, with relatively large areas of high-quality and contiguous open space, intact habitat, valuable natural resources and ecologically sensitive areas. As a consequence, the watersheds of the Sierra still encompass a lot of critically valuable land worth protecting.

However, the region is changing and many Sierra communities are expanding to their edges and beyond into surrounding open space and working lands. In many cases, land that serves valuable ecological functions and is vital to watershed health is being converted to development. Development on floodplains, wetlands, riparian areas, meadows and other natural infrastructure threatens the quality and reliability of the region's water.

This chapter outlines steps that communities can take to protect those areas of valuable natural infrastructure and protect our water resources.

Where to Develop, Where to Protect

Few things are more important to water and the health of watersheds than how and where we accommodate future growth. With the Sierra Nevada projected to add 850,000 to 1.75 million new residents by 2040,[1] conservation and growth management efforts must be equally attentive to where growth should not go as they are to where it should. Just as certain locations are best to protect, other areas are more suitable for growth. Identifying those areas – and the strategies

to direct the right type of development into them – should occur concurrently with conservation efforts.

This chapter focuses on where not to grow, while the following chapters discuss planning and design strategies for where to grow. Merging these two decisions is essential to managing growth and achieving more efficient land use patterns. Combined, they help preserve areas critical to watershed health while fostering high-quality growth in the right locations, which include:

- ➢ Existing communities, which are already developed and thus disturbed.
- ➢ Areas currently served by water and sewer infrastructure.
- ➢ Areas with sufficient water supplies.

Efficient land use patterns also require compact community form, which reduces the amount of land needed to accommodate growth and leaves more areas undeveloped.

Identifying Areas to Protect

A variety of conservation tools are available to help communities protect and restore valuable lands as they grow. Selecting the right tools for a successful conservation program requires a larger strategy.

The following six steps should be taken as part of a community-based effort to initiate and implement a comprehensive land conservation strategy.

Step 1. Involve the Community Early and Often: The process of determining ways to preserve priority areas can be contentious and requires a continuation of community dialogue. The more information a community has to guide the discussion the better. The front-end work of identifying and assessing existing natural resources and community geography is a start.

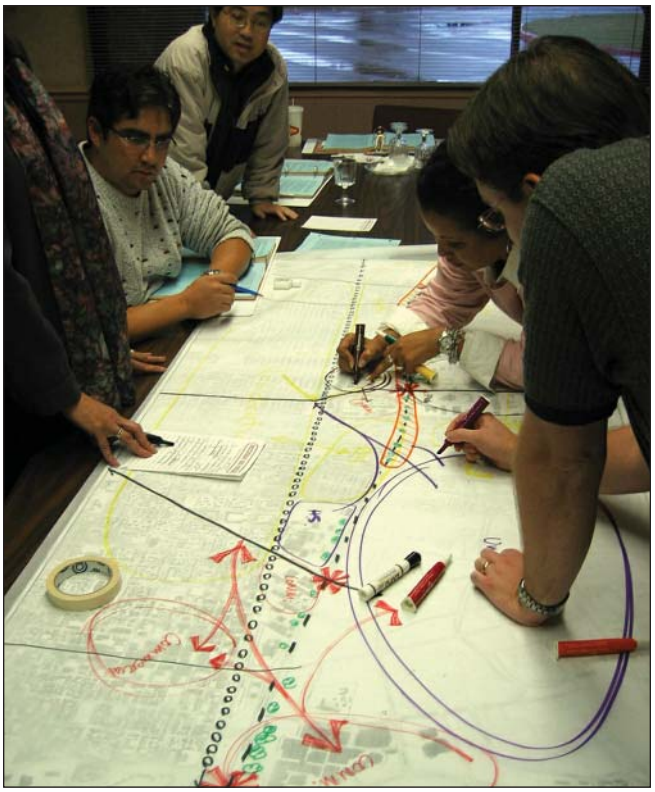
A growing suite of tools is available to help the process. These tools range from computer-assisted, decision-support programs that help people and policy-makers visualize and assess the implications of future growth, to simpler community visioning workshops using markers to draw on maps and share ideas about local assets. Whatever the method, the community should prioritize areas for preservation, restoration or special management.

Property rights, financial resources, allowable uses and the extent of protection are key considerations for any conservation strategy. It is best to be up front about them from the start. If the community dialogue has been open and inclusive, then there is less chance of opposition from land owners, conservation advocates, neighborhood groups or other people with a stake in how the area grows over time. Open community dialogue also allows all involved to learn about community concerns and become familiar with potential solutions for addressing them.

Step 2. Set Goals: Determine the values and specific goals that are being sought by preserving land. Without clear and specific goals, it will be harder to gain community support, find funding, or determine what areas are most important to protect or restore.

The following list of core objectives should be included for preserving land for watershed protection:

- ➢ Protect large, continuous natural areas as open space and maintain distinct buffers between communities.



- ➢ Preserve important and sensitive ecological areas such as wetlands, floodplains and riparian corridors.
- ➢ Preserve and enhance the value of these areas as natural infrastructure.
- ➢ Create multi-benefit parks and open space within and around the community to serve as both recreational amenities and natural infrastructure and natural water storage.
- ➢ Create and connect meaningful open space within the community to support compact form.

Step 3. Identify Undeveloped Areas: Determine the undeveloped areas both within and outside of the community. One way to identify these areas is by using a Geographic Information System (GIS). A GIS program integrates software, hardware and data and can be used to map areas according to various characteristics such as developed or vacant land, water features, vegetation or soil types, or special habitats.

Different land maps can be used as stand-alone maps or overlaid to identify areas of environmental richness and help community members prioritize conservation efforts.

GIS studies can also help analyze land types based on weighted values that reflect community priorities and

goals. Publicly available data sets can often be found online and are relatively accessible.

Step 4. Assess Conservation Values: Assess the values of potential conservation areas (i.e., recreational, resource protection, habitat, aesthetic) and the potential threats to those areas. Not all lands are of equal ecological value or face immediate threats. Assessing the value of identified areas according to the community's established conservation goals (e.g., floodplain management) will help determine conservation priorities.

Understanding what areas are important – and why – helps establish community buy-in and may point to certain conservation strategies. For example, if protecting a particular stream is a goal, then strategies such as riparian buffers or setback ordinances will be important.

Assessing threats is also important so that areas that are under pressure can be targeted for more immediate action, while areas out of immediate harm's way can be a part of longer-term efforts. Assessing threats often requires attention to local land use designations (e.g., low-density residential zoning in floodplain areas). For example, if habitat protection is a goal, assess the value of remaining areas for achieving that protection and the potential for development of those areas under current zoning.

Step 5. Prioritize Areas for Protection: Rank areas according to their natural resource value, suitability for development and relationship to community values and goals. GIS mapping, resource assessments and development build-out analysis are tools to help community members understand options and make sound decisions, but those tools do not make the decisions.

Prioritizing conservation areas is easier if the community is able to rank the values and goals they have set for protecting open space. If the primary goal is water protection, then those lands that achieve that benefit would be ranked as the most important to protect. If the goal is to create a regional network of open space, then contiguous lands would be ranked as most important.

This is a challenging but important step that demands real and inclusive dialogue between all parts of the community. The Trust for Public Land (www.tpl.org) has created several resources to help communities through the process.

Step 6. Implement Protection Strategies: Develop and implement plans and strategies to protect targeted areas. Once areas are identified and prioritized, the community(s) involved must determine how to protect and restore those areas that are the most important through the use of local and regional planning strategies.

There is no silver-bullet method for land protection; the best approach involves a combination of incentives, acquisition programs and land use regulations. These strategies include:

- ➢ Zoning tools.
- ➢ Conservation easements.
- ➢ Transfer of development rights.
- ➢ Greenways and greenbelts.
- ➢ Buffer zones and setbacks for resources protection.
- ➢ Urban growth boundaries.
- ➢ Open space districts.
- ➢ Habitat conservation plans.
- ➢ Restoration strategies.

■ Finding Funds to Preserve Land

The need for funding should be considered throughout the land-conservation effort. Local funding sources are the foundation of any long-term strategy. A growing number of communities have passed initiatives in support of public funding, usually through a sales tax increase, to support acquisition of open space.

External funding from federal, state and private sources can be leveraged, but is generally not as reliable as locally generated funds. While the availability of federal funding has declined precipitously since 2002, California state bond monies such as those provided through Proposition 50, and more recently through Proposition 84, have provided significant, if short-term, funding.

Future state and federal funding opportunities are unclear, but having an action plan, with conservation goals, priority areas and potential strategies will be a huge asset when those opportunities arrive.

Maintaining partnerships with various stakeholders is also important since California is prioritizing, and often requiring, collaborative efforts in its funding programs.

Current Trends – Growth in Valuable Natural Areas

Much of the development in the Sierra today threatens watershed infrastructure. This trend is easy to spot as dispersed development becomes scattered throughout the region's landscapes. The evidence plays out in regional growth and development trends, where we can see a rise in the conversion of working landscapes and increasing amounts of development out in the urban-wildland interface, including areas of high fire danger.

photo: Nevada Division of Water Resources, Naomi Duerr

A new subdivision encroaches on agricultural land on the east side of the Sierra Nevada.

Conversion of Rangeland, Forests and Farms

Large open areas and agricultural lands provide valuable services and assets to the community. These spaces also support vital watershed functions, such as cleansing water as it percolates through layers of vegetation and soil, providing space for groundwater recharge, protecting riparian habitat and allowing space for the natural fluctuations in water levels of rivers and streams. Healthy working landscapes, such as agricultural land, in turn depend on healthy watersheds. When watersheds are degraded, the health and productivity of farm and grazing lands can be impacted.

Despite the importance of these areas, rangeland, forests and farms are being subdivided and replaced with exurban development, particularly low-density "ranchettes."

photo: Darin Dinsmore

Ranchettes dot the landscape in the foothills of Calaveras County. Such development patterns are a primary cause of disappearing agricultural lands and open space in the foothills of California.

Ranchettes are homes built on large parcels of land, usually no smaller than 1.5 acres, and located in a rural or agricultural setting separate from urban areas. In the Sierra, ranchette development is outstripping all other forms of development by as much as 10 to 1.

Between 2002 and 2004, for example, 3,100 acres of agricultural land in Amador County were converted to ranchettes.[2] In fast-growing Placer County, 27,600 acres of agricultural land were lost between 1992 and 2002, a 14% decline in just 10 years.[3]

Increasing Development in High and Extreme Wildfire Hazard Areas

Recent data show that dispersed development patterns are also pushing development into high fire risk areas in the wildland-urban interface (WUI).

Between 1990 and 2000, 97% of the Sierra's population growth occurred in areas classified as extreme or very high fire threat by the California Department of Forestry and Fire Protection (CalFire). Future growth is poised to continue this trend: 94% of the land slated for residential development in the Sierra is in extreme or very high fire threat areas.[4]

This development trend presents a problem to water resources because evidence suggests residential and commercial structures in the WUI exacerbate the likelihood of fire. When fire becomes catastrophic, as it easily can in areas of high fire threat, it can damage the ecological function of a watershed and the quality and quantity of its water.

Homes built in high fire hazard areas increase the risk of catastrophic fire.

photo: Solomon Henson

94% of the land slated for residential development in the Sierra is in extreme or very high fire threat areas.

An area that has been severely burned becomes hydrophobic and acts like a giant impervious surface causing extremely rapid runoff of sediment and other pollutants, which enter lakes and streams and cause water quality problems.

One factor that points to the relationship of wildfire risk and the presence of homes and their residents in high fire hazards areas is the increase in ignition sources when more homes are built in the WUI. CalFire data shows that, between 2000 and 2005, the majority of fires within CalFire's jurisdiction were caused by humans. Equipment, vehicles and debris burning were among the largest ignition-source culprits.[5]

Another factor increasing wildfire risk is the limitation that development in the WUI places on fuel reduction and fire prevention efforts. Once homes are introduced into a high fire threat area, fire managers no longer have the same range of options to manage fire and reduce fuels. The result: a large portion of the WUI in the Sierra lacks consistent fuel-reduction treatments.

Combined, these risks increase the threat of catastrophic wildfire and the threat of damage to both property and watersheds.

Recognizing the connections between development patterns, catastrophic wildfire and water quality impacts highlights the need for coordinated planning in the Sierra. With these connections in mind, aligning land use planning with both fire management and water management goals is a sound watershed protection strategy.

Protecting Ecologically Valuable Areas as Natural Infrastructure

Once areas are identified for protection, the community(s) involved must pursue planning strategies to actively protect those areas identified. The following planning strategies are some common options for diverting development away from those areas important to protect and into those areas most suitable for accommodating growth.

■ Use Zoning Tools to Maintain Rural Development Patterns

Zoning codes, established within a city or county's land development regulations, are the primary policy instrument for determining what gets built and where. The quality of development in recent decades highlights the inadequacies of local zoning. Though not the sole culprit, conventional zoning is a chief driver of sprawl development patterns. Despite these shortcomings, local zoning is a powerful tool for shaping and maintaining rural development patterns by directing growth to certain areas and away from others.

For land conservation purposes, zoning codes are commonly used to establish land use designations and development densities that support open space and farmland protection goals.

Under California law, the zoning code must specify "allowable uses," which are typically broken into agricultural, residential, commercial, industrial and more recent mixed-use categories, with sub-categorizations within each of those (e.g., rural residential, single-family residential and multi-family residential). While the separation of uses under this form of "Euclidian zoning" is often criticized for creating communities in which residents are forced to drive significant distances between home and work, even traditional Euclidian zoning, when applied strategically, can create opportunities for the protection of open space and agricultural land. One important way zoning regulations can make a difference is by setting standards for density.

Zoning can reduce densities ("down-zoning") or increase densities ("up-zoning"). Communities often down-zone to lessen development intensity in certain areas, but at a watershed scale this can have unintended consequences if it is not balanced with adequate up-zoning to encourage appropriate development in other areas. Down-zoning alone does not get rid of growth; it simply pushes it to other parts of the watershed, often into areas that are more ecologically valuable than the area being down-zoned.

A better approach is to use up-zoning and down-zoning to intensify development in some areas and reduce it in others. For example, raising densities within the community and establishing maximum densities for residential development outside the community (e.g., maximum densities of at least 60-80 acres per unit) encourages infill and prevents future growth from spilling into open space and forcing communities to re-zone agricultural and open space districts to accommodate the increasing population.

What Are Zoning Codes?

In California, general plans provide overarching vision and guiding policies for future development. Local zoning codes are what actually implement the policies in the general plan. Zoning codes regulate what gets built and where, making them largely responsible for shaping patterns of development as well as the function and character of the community.

Zoning codes regulate development through the zoning map, which divides the city or county into separate zoning "districts;" a list of "allowable uses," which specifies the land use types that are allowed in each district; and "development standards," which are applied generally or to specific areas or land uses.

A zoning code also includes administrative requirements, which include guide interpretation and enforcement of the code, and permitting and development review procedures, which include provisions for preparing, filling and approving permit applications.

■ Initiate Conservation Easements

A conservation easement is a legal agreement that permanently limits uses of a piece of land to protect its conservation value. Local land trusts work with landowners to create conservation easements as an alternative to subdividing or selling the land for development. The easement spells out the rights that the landowner retains and the restrictions on use of the property.

In return for putting their land under easement, landowners typically receive monetary compensation, can stay on their land and can receive significant tax benefits. To be eligible for federal tax deductions, conservation easements must be dedicated in perpetuity so that the easement remains in force forever and "runs with the land," meaning that all subsequent landowners are bound by the easement as well.

Easements on private lands have become an effective means of protecting large expanses of natural and working landscapes without having to purchase the land outright or needing to manage it over the long term. Cities and counties can partner with local land trusts as funding partners and integrate easements into local planning efforts.

■ Develop a Transfer of Development Rights Program

In a Transfer of Development Rights (TDR) program, landowners living on valuable land worthy of protection are able to sell their right to develop that land. Depending on the program, landowners have the option of selling the development right or rights associated with their property either directly to another developer or to a local government that

Mariposa County General Plan Protects Open Space and Agricultural Lands

In 2006, Mariposa County adopted a new general plan with some of the strongest language for open space and agricultural land protection in the Sierra. The plan designates 61% of the county (426,000 acres) as agricultural land, while just 13% (86,700 acres) is designated for residential development. Perhaps most importantly, future residential growth will be located around existing towns. Areas zoned for agriculture have a maximum density of one house per 160 acres. Changing that zoning to residential requires administrative steps and arriving at sets of findings that are some of the most protective of any county in the Sierra.

The Mariposa County General Plan also calls for the creation of area plans for each community within the county to ensure new development is consistent with local values and needs. To develop the area plans, each community must establish a planning advisory committee composed of local residents, property owners and business owners.

The new general plan also contains policies to avoid sprawl and ensure that growth happens in and around existing communities and infrastructure.

Fact sheet on model language from Mariposa County's General Plan: www.sierranevadaalliance.org/programs/db/pics/1172008463_26714.f_pdf.pdf

Mariposa County General Plan: mariposacounty.org/planning/General_Plan/General%20Plan%20Home%20Page.htm

Nevada County's General Plan Preserves Open Space

In its General Plan, Nevada County recognizes the importance of preserving open space not only as means to protect the watershed and natural habitat, but also to protect the rural character and economy of the area.

Policy Language from Nevada County's General Plan:

"Conserve the natural and scenic resources, and open space lands to protect and enhance the County's quality of life and character ensuring a viable economy."

manages a TDR bank. Developers interested in buying development rights are typically other landowners who wish to increase the density of development on their land to a level greater than that for which it is zoned. For instance, a landowner who owns five acres of land zoned at one residential unit per acre could buy five development rights and increase her development rights to two units per acre.

A variation on the program would be a landowner who owns two pieces of land – one on which he wishes to develop and one on which he doesn't. The landowner would be able to trade the development rights from the parcel he doesn't want to develop to the parcel that he does.

For a TDR program to work, a government entity must designate land within a jurisdiction as either a "sending" or "receiving" area for development rights. A sending area would be land from which development rights are to be taken and a receiving area is land for which development rights are to be applied. For example, a county might designate property within a riparian corridor as land important for preservation – therefore that land would be a sending area. The same county might designate property within city limits as appropriate for development – therefore that land, with the agreement of the city, would be a receiving area.

A TDR program enables a community to shift development away from land it wants to protect but cannot

Transfer of Development Rights Program in Tahoe Region

One Transfer of Development Rights Program with a track record of success in protecting watersheds is implemented by the Tahoe Regional Planning Agency (TRPA) for the Tahoe Basin. TRPA is a regulatory agency charged with protecting and improving the water quality and clarity of Lake Tahoe.

TRPA's Transfer of Development Rights Program allows for transfer of land coverage, residential development rights and residential development allocations. The program is successful in channeling growth towards areas of high land capability while encouraging restoration of sensitive watershed areas in part because of a land capability ranking system established by TRPA in the 1970s.

The ranking system, referred to as the Bailey Land Scoring System, determines which parcels and parts of parcels could accommodate the proposed development with the least environmental damage. Factors such as topography, stream channels, slope and soil type factor into each parcel's score. The Bailey System has allowed TRPA to set up an incentive program in which land owners who transfer development rights from parcels ranked and scored as "sensitive" can receive bonuses such as extra allocations or development rights.

For more information: www.trpa.org Code of Ordinance, Chapter 34

Truckee to Establish Transfer of Development Credits

In an effort to preserve existing open space and increase the amount of desired types of open space under permanent protection, the City of Truckee will establish a transfer of development credit (TDC) program. TDR and TDC programs help communities to retain farmland, preserve endangered natural environments and protect historic areas, while directing development to more desired areas.

Policy Language from the City of Truckee's General Plan:

"Establish a transfer of development credit (TDC) program and other effective mechanisms for ensuring permanent open space protection. In addition to a TDC program, these mechanisms may include outright purchase, establishment of easements, development incentives, or other means, as appropriate. Long-term management strategies must also be developed."

photo: Jon Green

The Yolo Bypass provides many benefits, variously serving habitat, flood management and agricultural needs. It also creates a greenbelt between West Sacramento, Woodland and Davis.

afford to purchase. At the same time, development is focused in designated growth areas. The result is win-win: the landowner receives just compensation, while the community can protect important natural areas, agricultural lands or open space.

■ Use Greenways and Greenbelts to Shape the Community

Greenbelts are common tools used to define an edge to a community as well as ensure the separation of communities within a region. They are often comprised of agricultural easements and are usually developed through coordination between neighboring jurisdictions. Dedicating land to be included in a greenbelt system protects valuable open space, agricultural lands and/or sensitive habitats. Greenbelts ensure the close proximity

Open space can serve both environmental and recreational benefits.

of nature to local residents and can even provide opportunities for recreation.

Greenways are similar to greenbelts but are usually defined as linear corridors of protected land either used for transportation, recreation, wildlife movement or habitat conservation.

Greenbelts and greenways can be effective in serving the recreational and aesthetic needs of residents as well as providing space for water infiltration, retention and management. Creating greenway corridors along waterways provides a vegetative buffer between land uses while also receiving runoff to serve as a regional water management strategy.

■ Create Multi-Purpose Parks and Open Space

With growing pressure on finite amounts of land within our communities, it is important to make the best use of space. Increasingly, this means thinking about open space as an amenity that can serve multiple community benefits. Different types of open spaces – agricultural and rangelands, community parks and trails, riparian areas, or greenbelts and buffers – provide various benefits and will be valued by people for different reasons. This comes with an understanding that open space is not only needed for aesthetic or environmental reasons, but for other functions, including storm drainage and flood control, wastewater treatment and groundwater recharge.

Increasingly, open space can play double or even triple duty. Playing fields, parks, community ponds and other amenities that already exist, or are planned for

Land Trust and Habitat Protection Programs

In Placer County, one of California's fastest growing counties, the Placer Land Trust is using collaboration and conservation easements to balance rapid growth and land conservation. The trust works with willing landowners to preserve and conserve their lands. Participating landowners receive significant tax reductions. Land is protected through the acquisition of conservation and agricultural easements, or fee title ownership by the Placer Land Trust or qualified nonprofit organizations and public agencies.

The trust also crafted the West Placer Habitat Protection Program with developers, conservation groups and government agencies to protect 3,500 acres of critical habitat in western Placer County over 25 years. Real estate transaction fees in the West Roseville Specific Plan area fund the program. To date, 2,000 acres of valuable land have been protected.

For more information: (530) 887-9222, info@placerlandtrust.org www.placerlandtrust.org/current.htm

Davis Greenbelt Used as a Community Park

The City of Davis created a community-wide greenbelt system to provide meaningful open space throughout the city. The Davis Greenbelt is more than recreational space – it provides regional flood attenuation and groundwater recharge, provides a buffer between residential areas, and creates a vital component of the cities renowned transportation system.

An interconnected system of trails and paths create a safe and sustainable system for walking and biking around the community, helping to make Davis the most bike-friendly city in the country. There are more than 60 miles of greenbelt in a town of merely 10 square miles.

For more information: www.daviswiki.org/The_Greenbelt

future development, can be used as valuable infiltration and storage areas if properly designed. For example, many communities have restored or created wetland areas that serve flood control and stormwater needs by detaining runoff, while also providing "nearby nature" that can be enjoyed by residents and provide wildlife habitat.

■ Create Buffer Zones and Setbacks for Resource Protection

Buffer zones create a transition or barrier of open space between potentially conflicting land uses. Placing buffers between development and sensitive natural resource areas is a key water protection strategy. These water-specific buffers are commonly used along rivers and streams, around wetlands or lakes, or to protect known groundwater recharge zones. They provide flood protection, reduce erosion, protect water quality and create/protect habitat. Studies have shown that forested buffers are highly effective in removing particulate pollutants from runoff.[6]

Communities can establish setback requirements that create buffers by specifying how far a development must be built from a stream, wetland or other water body. The U.S. EPA recommends a minimum of 100 feet for water quality protection and at least 300 feet if a habitat corridor is also needed.[7] However, local conditions will drive the ultimate size and shape of a buffer.

Some localities have developed buffers of varying sizes, depending on what they are protecting. In effect, these "roving" buffers are sized to meet intended needs, and so may be small in certain areas but far wider in others.

■ Define Community Edges with Urban Growth Boundaries

Urban Growth Boundaries (UGBs) confine growth to a designated zone by creating a boundary around a municipality or developed area outside of which urban development is prohibited. UGBs are not meant to stop or restrict the amount of growth, but to contain outward urban expansion. Typically, the area inside the boundary – the growth zone – provides enough land, infill and redevelopment potential to accommodate projected growth over a 20-year period. Zoning ordinances usually need to be changed to allow and encourage higher densities inside the boundary.

Yolo County Collaborations for Regional Conservation Plan

In 2004, Yolo County and the cities of Woodland, West Sacramento, Davis and Winters initiated a collaborative planning process to develop a countywide conservation plan. The jurisdictions established the Yolo County Habitat Joint Powers Authority (JPA) to lead the effort. In 2007, the JPA launched the Yolo Natural Heritage Program, a county-wide Natural Communities Conservation Plan/Habitat Conservation Plan (NCCP/HCP) covering a 653,629 acre planning area. The Yolo Natural Heritage Program will conserve a wealth of habitat within natural open space and agricultural landscapes in the county.

The NCCP/HCP outlines what local agencies must do to obtain permits for urban development and public infrastructure projects while protecting biological resources and maintaining the county's agricultural heritage.

For more information: www.yoloconservationplan.org

Open space in Tulare County.

Truckee Protects Water Resources through Setback Areas

The City of Truckee prohibits development within established setback areas from the Truckee River and also requires that development outside its downtown be setback 100 feet from the boundary of the Truckee River's 100-year floodplain.

Policy Language from the City of Truckee's General Plan:

"Prohibit development within established setback areas from the Truckee River, except as otherwise allowed in the Development Code. Outside of the Down-town Specific Plan Area, development shall be set back a minimum of 100 feet from the edge of the Truckee River 100-year floodplain. Within the Downtown Specific Plan Area, development shall be set back a minimum distance from the edge of the 100-year floodplain that is equivalent to one foot above the base flood elevation. Grading, landscaping and drainage uses within the established setback area shall also be subject to strict controls. Improvements for public access and use may be allowed within the established setbacks."

Preserving Butte Sink Wetlands as Natural Infrastructure

At 18,000 acres, the Butte Sink Wildlife Management Area is a valuable asset to California's Central Valley and the nation. Composed predominantly of wetlands, the area is surrounded by productive agricultural areas west of Yuba City. It comprises a substantial portion of the Pacific Flyway and supports the largest concentration of waterfowl per acre in the world. The majority of acres in the area were purchased through conservation easements by the U.S. Fish and Wildlife Service from willing landowners. In exchange for payment, landowners agree to maintain wetlands and other habitats on their property in perpetuity, protecting wildlife habitat and the state's rapidly disappearing wetlands.

For more information: www.fws.gov/sacramentovalleyrefuges/butte.htm

A similar approach is to create policy that limits the extension of infrastructure, thereby forcing development to occur in areas that are already served by existing public services and facilities. These controls are meant to limit "leap frog" development patterns.

More and more localities are employing urban growth boundaries to protect open space and encourage development in already developed areas. UGBs can be effective in managing growth and preserving open space surrounding a community, but they should be coordinated with efforts to ensure that job and housing options are provided for a range of income levels and are fairly distributed in the community. Efforts to control growth outside the UGB must be balanced with efforts to encourage affordable, quality development within it or development demand will be pushed to other areas outside of the community.

The most effective approaches require regional cooperation, such as revenue sharing agreements, between multiple jurisdictions.

- **Establish Open Space Districts**

Open space districts are independent special districts within local governments with the role of protecting and acquiring open space in and around the community. They are often established by local ballot measures through which local residents decide to tax themselves to protect open space. In 2005, 80% of such measures passed as voters approved $1.7 billion for open space protection.[8]

Analysis by the Trust for Public Land found that since 1988, voters have approved almost $46 billion to fund the protection of open space, parks, wildlife habitats, watersheds, farms and ranchlands. In the U.S., the total amount allocated through local measures in 2008 is likely to eclipse $50 billion.[8]

- **Initiate Natural Community Conservation Plans and Habitat Conservation Plans**

Habitat Conservation Plans (HCP) and Natural Community Conservation Plans (NCCP) are locally

Ventura County's Guidelines for Orderly Development Establish Urban Growth Boundaries to Support Efficient Growth

The Guidelines for Orderly Development established a formal policy between Ventura County and the cities therein, stating that urban development should occur, whenever and wherever practical, within incorporated cities. Adopted in 1969, the Guidelines allow "for urbanization in a manner that will accommodate the development goals of the individual communities while conserving the resources of the County… and promote efficient and effective delivery of community services…"

They have helped maintain distinct boundaries between communities and distinguish urban and rural areas. Several communities also established greenbelt agreements designed to create contiguous corridors of agricultural land as buffers between adjacent communities.

Save Open Space and Agricultural Resources

More recently, several Ventura County communities have also have passed "Save Open Space and Agricultural Resources (SOAR)" ballot initiatives. The initiatives created urban growth boundaries called City Urban Restriction Boundaries (CURBs). Voter approval is required to extend city services outside the CURB and for changes to zoned land uses (farmland or open space) outside the line. The boundaries cannot be changed without a majority vote of the people.

For more information: www.ventura.lafco.ca.gov/html/faq.htm

developed plans that are completed to satisfy federal and state species protection laws. The plans are developed under California's Natural Community Conservation Planning Program Act and the federal Endangered Species Act for the protection of species and habitat.

The California Department of Fish and Game administers the Natural Community Conservation Plan (NCCP) program that aims to conserve natural communities at the ecosystem scale while accommodating compatible land use to reduce conflict between conservation efforts and reasonable uses of natural resources. The U.S. Fish and Wildlife Service administers the Habitat Conservation Plan (HCP) program that works hand-in-hand with the state program resulting in joint NCCP/HCPs.

The state program is generally more expansive than the federal equivalent because it focuses on protecting whole ecosystems rather than single species. All NCCPs are completed in concert with HCPs, which are funded under the Endangered Species Act. An adequate NCCP/HCP will likely receive implementation funding from state and federal sources.

NCCP/HCP plans allow local governments to coordinate their natural resource planning at a regional level and to determine how and where growth should occur over a longer timeframe. Developers benefit through streamlined permitting processes that clarify allowable types and locations of development in the plan area.

The plans reduce risk and conflict because all parties know what to expect and what is required. The plans must specify a strategy for achieving the required objectives of natural community conservation and compatible land use and economic activity. The strategy might include such techniques as land acquisition, developing wildlife reserves or watershed management.

For more information, visit the Department of Fish and Game website (www.dfg.ca.gov/nccp) and *A Local Official's Guide to Habitat Conservation Laws* (www.ilsg.org/habitat).

■ Support Watershed Restoration

While not a strategy to preserve land or target growth, restoration practices can re-establish particular working parts of a watershed's ecology, enabling it to function again the way it was intended. Restored wetlands,

Sonoma County Open Space District Preserves Local Legacy

In 1990, Sonoma County residents voted to create the Agricultural Preservation and Open Space District to acquire and preserve agricultural and open space lands. The district, which is funded through a voter-approved quarter-cent sales tax, has been able to permanently preserve almost 75,000 acres of open space and agricultural land. The district's boundaries are the same as the boundaries of Sonoma County. The county board of supervisors serves as the district's board of directors. An independent Open Space Authority monitors all sales tax expenditures and a citizen's advisory committee advises the board and staff on policy matters and proposed land protection efforts.

In July 2006, the district completed a planning strategy called "Connecting Communities and the Land: A Long-Range Acquisition Plan." The plan calls for strategically conserving areas near existing already protected lands "to create a connected network of great open spaces: agricultural lands, greenbelts, natural areas, multi-use trails, streams, parks and preserves where people can enjoy scenic rural areas and local agricultural products."

For more information: www.sonomaopenspace.org, (707) 565-7360, openspace@sonoma-county.org

Placer Legacy Open Space and Agricultural Conservation Program

The Placer Legacy Open Space and Agricultural Conservation Program protects and conserves open space and agricultural lands in Placer County. This voluntary, non-regulatory program, developed to implement the goals, policies and programs of the 1994 Placer County General Plan, allows for willing buyers and sellers to acquire land for conservation and open space uses. Since its inception, about 5,500 acres in the Sierra have been acquired, including 1,300 acres that have been turned into county parks and bike and pedestrian trails.

For more information: Ed Sullivan, esullivan@placer.ca.gov, (530) 745-3030
www.placer.ca.gov/Departments/CommunityDevelopment/Planning/PlacerLegacy.aspx

floodplains, streams, rivers and riparian areas can provide water storage, purification and infiltration, which will reduce flood risks, improve water quality and enhance supplies.

Restoration goals may include activities that increase community value or use of a body of water, practices designed for reducing or eliminating erosion, channel reconfiguration, floodplain reconnection, in-stream habitat protection, dam removal and stormwater management.

Local watershed councils, local conservation groups and Resource Conservation Districts (RCDs) are often engaged in restoration work and can be valuable partners for local government. RCDs also provide important links to local landowners, which is especially

Restoration practices can restore watershed infiltration and purification potential and reduce flood risk.

Restoration Projects

Deer Creek

Education was an important component of a restoration effort headed by the Friends of Deer Creek. The Friends of Deer Creek determined that erosion into the creek at an abandoned road crossing was leading to unacceptable amounts of sediment entering the watershed.

The group received funding from the Sierra Nevada Alliance to initiate a restoration project focused on reducing erosion through streambank stabilization by removing invasive plant species and then re-vegetating the area with native plants. The re-vegetated area also increased shade cover for the creek to improve stream habitat and decrease algal growth.

The group developed educational materials and a presentation to educate the public and property owners along the creek about the importance of native species and the harmful effects of sedimentation.

Truckee River

Partnerships are also an essential part of effective restoration efforts. For example, the Truckee River Watershed Council is collaborating with the U.S. Forest Service to restore two important tributaries to the Middle Truckee River watershed. Davies and Merrill Creeks run though mountain meadows and provide wetland and aquatic habitat important to the watershed's health.

The restoration project addresses impacts on floodplain processes, drying out of wetland and meadow areas and increased erosion and channel incision that have resulted from historic railroad grades constructed in the early 20th century.

For more information: www.truckeeriverwc.org

valuable since agricultural and pasture lands often contain sites that can be restored and maintained to serve double-duty as working lands and water protection areas.

Successful restoration efforts depend on several factors, but few are as important as collaboration. Partnerships with various stakeholders are often the most important aspect of a project for two reasons. First, if interested parties are not included in project conceptualization and planning from the beginning, they are more likely to push back later in the process and may ultimately stop the project altogether. Second, any project will benefit from greater levels of participation.

Often, a project cannot even get off the ground without initial partnerships to provide funding, access to property, technical assistance or other project needs. Ideally, the lead organization provides a venue for bringing stakeholders to the table well before a project is initiated so needs can be assessed and potential projects identified, prioritized and planned in a coordinated manner.

From Where We Grow to How We Grow

Unfortunately, much of the development occurring in the Sierra today threatens watersheds and the natural infrastructure they provide. Dispersed development patterns are pushing suburban development into the rural and wild parts of the Sierra. As a region, the Sierra will continue to grow. But it is not growth itself that is the problem. Rather, it is the quality of that growth – how and where it is occurring – that we must change.

Where development occurs is central to the health of watersheds and the water resources they provide. For the sake of water resources, planners must identify and protect ecologically valuable lands and direct development into areas most suitable for future growth. This chapter outlined the concepts and steps behind the first part of this strategy – identifying and conserving open space and working lands in and around the community.

The following chapter deals with the second part of the strategy – planning where and how to develop with an eye for water resource protection.

Chapter 3.

Water-Wise Community Planning and Design

What gets built where is critical to the future of Sierra watersheds. Thus, community planning plays a central but often overlooked role in watershed protection and sustainable water management. Planning for water-smart growth is one of the biggest challenges for the region, and the focus of this chapter.

Poorly planned growth has become a chief threat to the region's waters. But what is good growth, from a watershed perspective? The key factors are the location and form of development. These determine the shape of a community and the development patterns for a region.

Getting the form of new development right means developing more compactly, disturbing less land to accommodate a set number of additional people or businesses. Combined with the choice of a strategic location, a development that has a compact form serves to protect critical areas, make the best use of existing infrastructure, reduce water demand and the impacts of stormwater and wastewater, and strengthen existing communities.

This chapter outlines planning strategies that prevent dispersed rural sprawl and encourage town-centered development that is compact, encompasses a mix of uses, is pedestrian-oriented, and ensures a range of housing types. The overarching goal is to locate development in strategic areas and enable a compact community form.

The result is environmentally sustainable development patterns that strengthen existing communities while preserving rural heritage and landscapes. To achieve this result, Sierra communities should design future development to fulfill several planning objectives:

- **Compact Design:** Support compact community form in the design of buildings, neighborhoods and the community as a whole.
- **Infill and Revitalization:** Direct new growth to existing communities and developed areas, and support the "recycling" of land through redevelopment.
- **Mixed-Use Development:** Enable a mix of land use and development types to support compact community form, economic development, affordable housing, jobs-housing balance and pedestrian-oriented design.
- **Complete Streets:** Support connected, multi-modal street designs that enable improved access, safety, walkability and a compact community form.

Together, these practices lead to sustainable rural development patterns, protecting watershed health and preserving the regions rural character as it grows.

The potential benefits to water management and watershed protection goals include:

- ➢ Preventing dispersed growth in critical water resource areas.
- ➢ Leaving more parts of the watershed as open space and natural infrastructure.
- ➢ Reducing reliance on wells and septic systems.
- ➢ Reducing the amount of impervious cover within the watershed.
- ➢ Reducing per-capita stormwater runoff.
- ➢ Reducing residential water demand.
- ➢ Making better use of existing infrastructure systems.

In addition to protecting water resources, good community planning brings investment and vitality into downtowns, creates safe and connected neighborhoods, and supports the rural economy.

But before we look at ways to grow better, it is important to understand how we are growing now and the ways various development patterns affect water resources.

How We Are Growing

By 2040, the Sierra region will need to accommodate between 850,000 and 1.75 million new residents as the population swells from 650,000 to as many as 2.4 million. How and where that growth occurs is essential to the long-term sustainability of the region's water. In recent decades, the predominant form of growth in the Sierra has been inefficient – covering valuable land, increasing water pollution, stressing water and wastewater infrastructure, and creating higher demands on needed water supplies.

The hallmarks of these development patterns are visible throughout the region: homogeneous sub-divisions and isolated, large-lot "McMansions" served by big-box commercial centers and linked by miles of highway-strip development. This type of growth is out of sync with the region's character and historic communities. It lacks discernable edges or town centers and scatters large, isolated houses across the rural landscape, carving up valuable watershed lands with pavement. The following development patterns are indicators of inefficient land use.

photo: Kenneth & Gabrielle Adelman

Low-density residential construction outside city centers strains infrastructure and increases impervious surfaces.

■ "Not-So-Rural" Housing in Rural Areas

Isolated, large-lot residential developments, often called "ranchettes" or "McMansions," have become increasingly common in the Sierra. Usually occurring on 1- to 20-acre parcels, this type of housing consumes a large amount of land per unit of development, and typically occurs outside – often well beyond – existing community boundaries. Since it is geographically dispersed, this type of housing tends to not be served by infrastructure, relying instead on wells and septic systems, which creates further concerns for water quality and supplies. It also requires more and longer roads, creating more impervious cover and stormwater runoff.

In the proper context, low-density zoning can support rural development patterns and help maintain agricultural lands and open space. However, there is a difference between truly rural housing types in rural areas and what amounts to suburban housing types in rural areas.

In rural areas, zoned densities should be low enough to support housing needs for key elements of the rural economy, farming and ranching, and preservation of open lands. Densities in those areas must be low enough to actually support viable farms, ranches and open space. By and large, areas zoned for 1- to 30-acre lots are not low enough to serve truly rural development types and pose a threat to water and healthy ecosystems.

Large-lot homes and homogeneous subdivisions are features of the growth pattern predominant in the Sierra today.

Development patterns which separate land uses – the places where we live, work, go to school and play – require more people to drive more often.

Fewer People in Bigger Houses

According to the U.S. Census, the national average size of new single-family homes increased from 1,500 square feet in 1970 to 2,266 square feet in 2000. Over the same period, the average household size declined – from 3.1 to 2.6 people per household.[1] Per capita square footage per household has increased from 483 to 872 square feet, nearly double what it was in 1970. This trend is consistent with the trend of low-density residential development. For the watershed, the result is more impervious surface per capita.

Extending Infrastructure – More Growth Outside Existing Service Areas

Throughout the Sierra, communities face numerous challenges related to water and sewer infrastructure, including the preponderance of new development that occurs beyond the reach of existing infrastructure. This forces water agencies to extend already worn-out infrastructure systems rather than reinvest in upgrading them, or accept the risks to local water supplies of adding more unmonitored wells and septic systems.

There are also implications for future growth patterns. Many developed areas do have infrastructure, but it is often over capacity and in need of upgrade. To avoid rural sprawl, those areas should be revitalized to accommodate some future growth. Unfortunately, growth outside those areas draws needed investment away, preventing needed infrastructure upgrades and possibly contributing to "leap frog" development patterns.

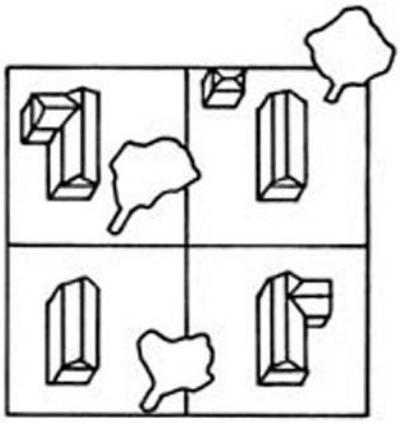
More Driving – Increasing Vehicle Miles Traveled (VMT)

Transportation trends are another important indicator of the way a region is growing. Vehicle Miles Traveled (VMT) measures automobile use in terms of the number and the length of vehicle trips. For example, 10,000 vehicles each traveling an average of 12 miles per day would result in 120,000 vehicle miles traveled per day. Higher VMT indicates dispersed patterns of growth that reinforce reliance on driving to meet daily needs. This correlates with the region's exurbanization, resulting in "extreme commuting."

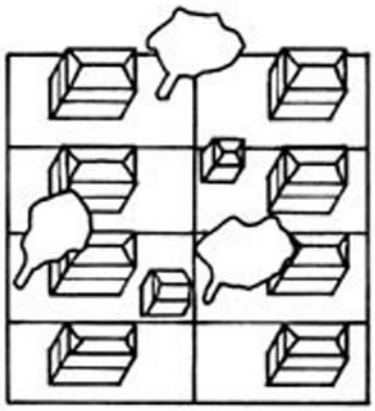
Between 1990 and 2000, VMT increased by 30% in the Sierra region.[2] This VMT increase is nearly double the growth in population, indicating that current development patterns are leading to longer commutes and more driving. This translates to an increased transportation infrastructure – more and larger roads and parking lots – making walking around even harder and thus reinforcing automobile-dependency.

The added pavement also means more impervious cover, preventing groundwater recharge and leading to more impacts from stormwater runoff.

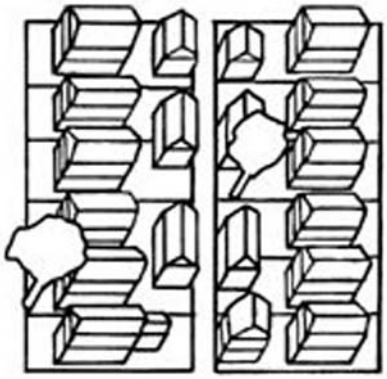
Examples of Various Density Scenarios



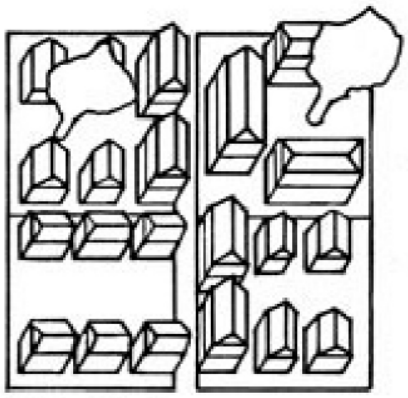
Suburban Ranch House
4-6 units per acre
7,260-10,890 sq. ft. lot



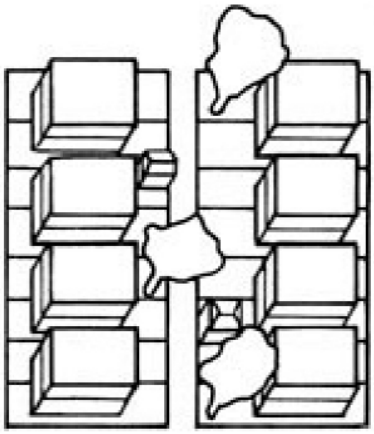
Single-Family Detached
8-12 units per acre
3,630-5,445 sq. ft. lot



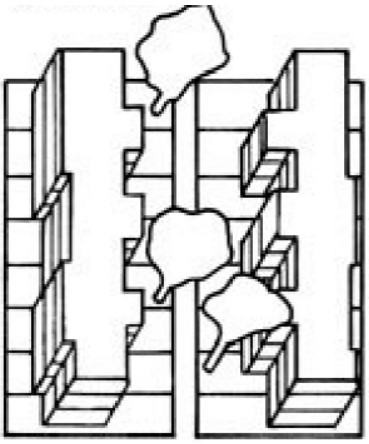
Small-Lot Single-Family
with Second Unit
16-24 units per acre
1,815-2,722 sq. ft. lot



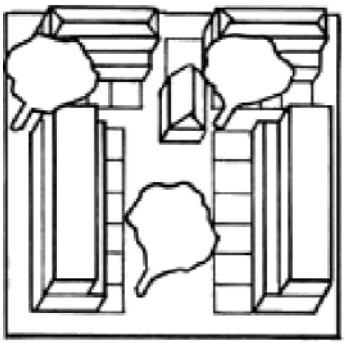
Cottage Courts
16-24 units per acre



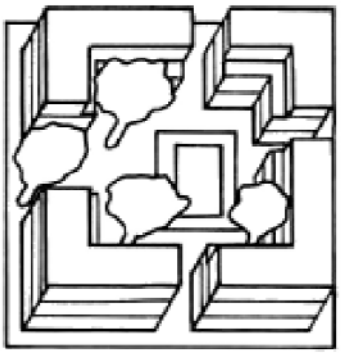
Duplexes / Fourplexes
16-32 units per acre



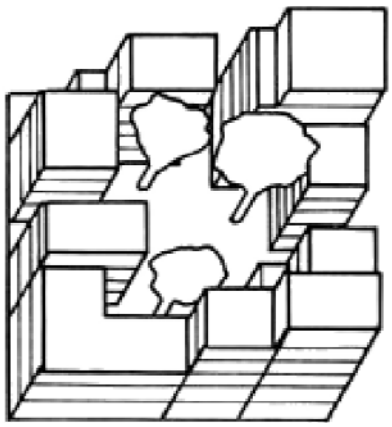
Townhouses
16-48 units per acre



Cohousing Block
20-50 units per acre



Garden Apartments
20-60 units per acre



Mid-rise Apartment Block
40-200 units per acre

Drawings: Stephen M. Wheeler, Greenbelt Alliance, *Smart Infill*

Development Patterns and Water – What's the Connection?

Recent growth in the Sierra, characterized by dispersed, low-density, auto-dependent development, threatens the region's water resources and rural character. These development patterns significantly affect how and where we live, how we get around, where we shop, and even what we do. They also influence how much land is consumed for a given amount of growth, the extent and location of impervious cover, how much growth occurs on existing infrastructure, and even how much water is used for landscaping. Development patterns have direct impacts on water quality, water demands, the costs of providing water and sewer service, and the overall health of watersheds and their tributary systems.

Impervious Cover and Stormwater

Different development patterns and densities have correlated amounts of impervious cover and thus stormwater runoff. On a per capita basis, increasing density shrinks the development footprint, minimizing land disturbance and impervious cover in the watershed. As a result, more land is left undeveloped. Conversely, lower-density patterns of development result in a greater loss of sensitive environmental lands, including wetlands, flood plains, critical habitat, aquifer recharge areas, stream corridors, and steep slopes due to a higher instance of land disturbance and impervious surfaces.

The drawings to the left provide examples of some of the various density scenarios possible per acre of land.

In 2002, the U.S. Environmental Protection Agency modeled the stormwater impacts of new development at densities of one, four and eight residential units per acre. The study found that 10,000 homes at one unit per acre resulted in 20% impervious cover within the watershed. In contrast, the same number of homes built at eight units per acre resulted in 8.1% impervious coverage within the watershed.

As impervious coverage within the watershed increased, so did stormwater runoff. The average runoff generated per unit in the one unit per acre scenario was 18,700 square feet annually. The average runoff per unit at eight units per acre was 4,950 square feet annually. The charts on the next page highlight the EPA's findings.

Sprawl has direct negative impacts on water quality, water demands, the costs of providing water and sewer service, and the overall health of watersheds and their tributary systems.

Stormwater Impacts of New Development at Densities of One, Four and Eight Residential Units Per Acre

Scenario A	Scenario B	Scenario C
		
10,000 houses built on 10,000 acres produce: 10,000 acres x 1 house x 18,700 ft³/yr of runoff = **187 million ft³/yr of stormwater runoff** **Site: 20% impervious cover** **Watershed: 20% impervious cover**	10,000 houses built on 2,500 acres produce: 2,500 acres x 4 houses x 6,200 ft³/yr of runoff = **62 million ft³/yr of stormwater runoff** **Site: 38% impervious cover** **Watershed: 9.5% impervious cover**	10,000 houses built on 1,250 acres produce: 1,250 acres x 8 houses x 4,950 ft³/yr of runoff = **49.5 million ft³/yr of stormwater runoff** **Site: 65% impervious cover** **Watershed: 8.1% impervious cover**

Scenario A	Scenario B	Scenario C
		
Impervious cover = 20% Runoff/acre = 18,700 ft³/yr Runoff/unit = 18,700 ft³/yr	Impervious cover = 38% Runoff/acre = 24,800 ft³/yr Runoff/unit = 6,200 ft³/yr	Impervious cover = 65% Runoff/acre = 39,600 ft³/yr Runoff/unit = 4,950 ft³/yr

Scale of Analysis	Scenario A	Scenario B	Scenario C
One Acre	1 house	4 houses	8 houses

source: U.S. EPA

The Arbors Brings Mixed-Use Infill to Main Street in Murphys

The Arbors is a 1.5-acre mixed-use, infill project built on Main Street in downtown Murphys, a historic Gold Rush town in Calaveras County. The project incorporates retail, affordable housing, tourist accommodations and off-street parking. It includes eight buildings comprised of 17,000 square feet of retail, with restaurants and shops, and seven residences – five of which are living lofts above ground-floor retail.

The project has been unexpectedly lucrative. Before the project was built, retail rents in Murphys were less than $1 per square foot, and it was projected that the Arbors would help boost rents to $1.25 a square foot. In 2002, rents increased to between $1.60 and $2.00.

The Arbors' success is in part due to the open public process during its design, the historic design, the collaborative approach with the County to meet local regulations, and important up-front investments, including essential roadwork, and a survey of the downtown's trees to ensure that the Arbors had a net beneficial impact on the area's natural tree canopy.

For more information: Rudy Ortega, Architect, (209) 728-2025

The EPA study corroborates other research on the effects of density on water, land conversion and patterns of growth. Purdue University researchers examined two potential project sites in the Chicago area – one within an already developed area of the city and the other on the urban fringe. The study revealed that placing a commercial development on the urban fringe would produce 10 times more runoff than a commercial development in the already developed area.[3] The drastic difference of stormwater runoff between these two sites is based on the amount of permeable soil replaced by impervious surfaces post-construction.

The developed urban site already had existing infrastructure and impervious surfaces while the agricultural lands or open space at the urban fringe had relatively permeable soils pre-development. The effects of commercial development within the urban core increased the average annual runoff by 58% while the conversion of agriculture or open space to commercial use increased runoff by 670%.

Impacts on Water Supply and Demand

Development that is spread out across a wider area requires more infrastructure to serve a given number of homes and businesses. This means higher costs for water service and more water lost through leakage.[4] For this reason, connecting dispersed, outlying development to water and sewer systems is often cost-prohibitive. One way around this is to develop residential parcels with private wells and on-site septic systems.

But this alternative has its own water problems – namely, the water supply and reliability impacts of inefficient and unmonitored groundwater usage, and the water quality impacts associated with leaking septic systems.

When private wells and on-site septic systems are not feasible, the higher costs of serving dispersed development and extending new infrastructure, rather than repairing and maintaining existing systems, must be borne by ratepayers and taxpayers. More financially efficient development patterns are created when new growth is located where infrastructure already exists.

■ Large Lot Sizes Increase Water Demand and Infrastructure Costs

Bigger lot sizes are characteristic of conventional low-density development outside of town centers and require more land and water than the more compact design characteristic of historic neighborhoods. Residential landscaping accounts for around 50% of household water demand[5] and larger lots almost always have more lawns and landscaping than smaller lots.

Utah studies found that water use was cut in half, from 220 to 110 gallons per day, when density increased from two to five units per acre.[6] A study in Seattle

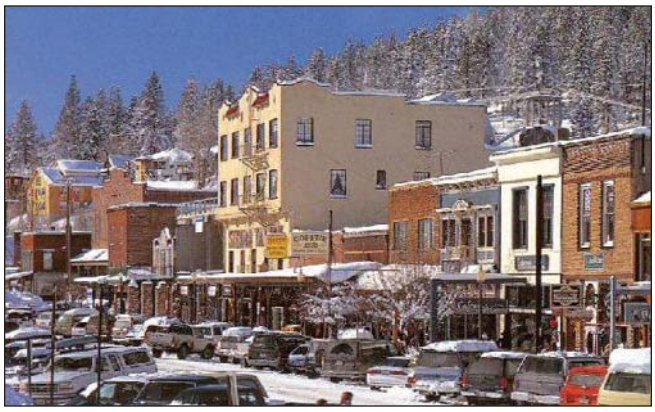
found that a reduction in density from 12 to four units per acre increased outdoor water demand for landscaping by 158%.[7]

Bigger lots also require longer pipes, raising the cost of service. Transmission mains are the pipes that deliver water to a neighborhood, usually running under the street. Distribution mains are the pipes that deliver water from the transmission main to each house.

Smaller lots bring houses closer to the street, which shortens distribution mains. Smaller lot sizes, common in traditional neighborhoods, allow more homes to fit on a given block, so more houses are served per block of transmission main, which reduces the amount of transmission main needed per household.

Dispersed Development Increases Water Loss Due to Leakage

All water systems leak. A system can lose from 6% to 25% of its water to leaks and breaks.[8] How much water is lost depends on the condition of the system, how far it has to carry water, and how much pressure is needed to deliver the water. More pressure means more leakage; and the farther a system has to carry water, the more pressure it will need. In more dispersed development patterns, more water is lost from the system due to leakage.



Downtown Truckee, constructed before the turn of the 20th century, is a mixed-use, compact and pedestrian-friendly community.

Development Patterns that Support Water-Smart Location and Compact Community Form

Getting the location and form aspects of development right is not easy. It is achieved through a combination of factors such as density, a mix of land uses, street design, location and arrangement of parking and landscaping, and transportation options. In general, planning for a compact downtown and pedestrian mobility are mutually supportive. Qualities that make a community walkable also make it more compact.

Strategies to support compact, walkable development patterns include:

- ➢ Providing a mix of uses.
- ➢ Encouraging infill and redevelopment.
- ➢ Designing complete streets for all types of users.

Mixed-Use Development Creates Vibrant Towns and Protects Important Watershed Areas

Land use mix refers to the diversity and configuration of land uses and development types within a community or development district. Conventional "Euclidian" zoning practices segregate different development types into different areas. This creates a separation of land uses that is prevalent in almost all post-World War II developments.

While the separation of incompatible uses is helpful (e.g., an industrial plant and a housing complex), it has also forced apart the places where people live, work, and access services.

From a watershed perspective, separated land uses are problematic because they disperse development. Dispersed development means more units spread out over more acres, and more impacts to open space and natural infrastructure. Dispersed development also increases driving, and therefore roads and parking lots, adding to increased impervious surface and runoff concerns.

In historic neighborhoods, built before today's zoning practices, development was mixed – residences were sited near or even above retail and commercial spaces, for example. This brought various daily needs closer

Mariposa County's General Plan Supports Mix Use

Mariposa County allows for a mix of land uses in the core areas within its Village Center. It specifies that "secondary residential and office uses should be allowed and encouraged only above the ground floor to maximize the pedestrian scale and function of the core. Within the balance of the Village Center, there should be a mix of residential (predominantly multi-family), secondary commercial, business park and public or institutional uses." This mix of uses will help promote a more lively core that can help attract business and promote safety through having "eyes on the street."

Policy Language from the Mariposa County General Plan:

"Designate a diversified compatible mix of land uses in close proximity to residential uses."

Truckee Encourages Diverse Neighborhoods and Mix Use

The City of Truckee aims to create vibrant neighborhoods and reduce vehicular traffic by allowing a variety of uses to abut each other such as commercial, residential and recreational areas.

Policy Language from Truckee's General Plan:

"Support development of neighborhood centers through establishment of uses and facilities that provide a direct benefit to the neighborhood, such as educational and recreation facilities, day care services, places of worship, community meeting centers, fire stations, small parks, libraries and other public facilities, telecenters, and neighborhood commercial uses."

"Allow transitional uses such as office/professional in areas where existing commercial uses directly abut single-family residential uses and adequate buffers are not available, and permit neighborhood serving commercial uses in residential land use designations."

"Strongly encourage mixed-use development in appropriate locations, including the Downtown, Gateway area and Donner Lake."

together, making more vibrant town-centers and enabling people to easily access goods, services and make social contact.

While separating uses pushes development out, mixing uses has the opposite effect. It brings complementary land uses and development types closer together in an integrated fashion to reduce vehicle trips per capita and support a balance between housing and jobs, housing diversity, mobility options and compact form.

Many planners and local officials seek to mix uses to improve the local tax base and, ultimately, to create more vibrant downtowns and commercial areas.

Increasingly, mixed-use development is gaining recognition for its role in protecting open space and preventing automobile-dependent development patterns.

photo: Sierra Business Council

Residential and commercial uses meet in these lofts – residential above, commercial below – in Murphys, CA.

Tahoe Community Enhancement Program

The Community Enhancement Program (CEP) is a collaboration between local government jurisdictions and the Tahoe Regional Planning Agency (TRPA), a regulatory agency charged with overseeing development permitting. The program seeks to implement mixed use projects within Community Plan and/or Master Plan areas that demonstrate net gain results from community reinvestment and redevelopment activities.

The program's primary goals are: (1) create and enhance mixed use community centers, (2) create multi-modal transit options, gathering places and economic centers, and (3) promote transfer of development that results in substantial environmental benefits.

Some of these objectives relate to achieving the environmental thresholds that TRPA has set for the Tahoe Basin, while others are goals established after receiving input from citizens at community visioning workshops.

Developers participating in the program receive a package of development incentives such as unit, height and density bonuses. The program has not yet entered the construction phase. Applications submitted by developers interested in applying to the program are being reviewed by TRPA staff, and several public meetings have been held to keep the public informated about the proposed projects.

For more information: Darin Dinsmore, Dinsmore Consulting, (530) 277-0196

What Is Greenfield Development?

Greenfield development refers to projects that occur on lands where development has not previously taken place. Greenfield projects are often located outside of existing communities, demanding extension of infrastructure and services to support them.

Infill and Redevelopment: Invest in the Community, Protect the Watershed

Infill and redevelopment are town-centered approaches to development that support economic development and reduce rural sprawl by capturing new growth within already developed areas. Both strategies make more efficient use of existing infrastructure by locating growth in areas that are already served by road, water and sewer systems.

By virtue of their location, infill and redevelopment focus investment into the community rather than outside of it and therefore help to concentrate the impacts of development into areas that are less valuable from a watershed protection or ecological view.

Infill is a "prevention" strategy – it keeps development off valuable natural infrastructure such as meadows, wetlands and forests in the watershed by accommodating new growth in areas that are already disturbed. A study in Florida found that an infill housing development consumed 73% less open space per housing unit than a greenfield site.[9]

Infill development provides other benefits as well. A study providing comparative analysis of the transportation and environmental impacts of infill versus greenfield development in several areas found that public infrastructure needs were lower in the infill sites; household travel costs were lower in the infill sites; and environmental impacts were reduced with the infill sites.

A comparison conducted in Montgomery County, MD, found that the cost of providing infrastructure to an infill housing unit was 92% less than providing the same infrastructure to a greenfield housing unit.[10] This difference is primarily because existing infrastructure can be used to absorb demands created by new development.

Redevelopment is one of the best ways to protect natural areas and prevent the spread of impervious cover. Encouraging development in areas that are already paved (often called greyfield or brownfield sites) allows a community to accommodate growth that otherwise would end up in an undeveloped area. For example, if an old shopping center is replaced by mixed-use development, growth is accommodated with no net increase in impervious surface cover.

Overcoming Barriers to Infill Development

Despite the fiscal and environmental benefits of infill development, a number of potential hurdles often make infill more difficult, uncertain and expensive than conventional greenfield projects.

- **Physical Barriers:** Site constraints and, in some cases, the need for environmental cleanup can reduce the amount of buildable land and drive up costs.

- **Social Barriers:** New development changes the feel of the place. Infill can bring benefits, but residents may not be comfortable with the changes it brings. Resistance can stem from negative perceptions based on past projects that were incompatible with the feel and scale of the community.

Understanding tradeoffs between various development alternatives is important to planning how a community will grow. Discussions about growth should address design concerns for new development within the community.

- **Regulatory Barriers:** Local land use regulations pose some of the most challenging barriers to infill development, including:

  ➢ Zoning regulations often reduce the types of projects that can be built in an area.

  ➢ Inflexible bulk regulations (setbacks, frontages, loading, heights, densities) can prevent projects from fitting into a given site without numerous variances.

  ➢ Antiquated development regulations can inadvertently result in designs that are incompatible with the existing character of older communities and generate resistance from community members.

  ➢ Parking, setbacks and other requirements can take up a disproportionate amount of an infill site, rendering a project financially infeasible.

  ➢ Burdensome entitlement processes for infill projects can slow approval processes and create greater challenges to otherwise good projects.

  ➢ Conflicting requirements or approvals can limit the ability of developers to achieve permitted densities.

Truckee Encourages Infill

As population increases in the Sierra, towns will have to balance preserving open space with accommodating new residents. The City of Truckee balances these two goals by promoting infill projects. Infill projects take advantage of existing infrastructure, thus avoiding greenfield development.

Policy Language from Truckee's General Plan:

"To provide for projected population growth in an efficient manner, accommodate development at the highest densities in infill areas, consistent with goals for environmental protection and land use compatibility."

Truckee Railyard Goes Green

The Truckee Railyard project exemplifies community design that serves to shrink the "footprint" of development while integrating "green infrastructure" into site design. The Railyard project features a mix of housing, retail and commercial uses with pedestrian, bicycle and vehicle access that will be built on a brownfield site in downtown Truckee.

The pedestrian-friendly orientation and increased use mix create compact community form, while brownfield redevelopment clean ups already impacted land. The project also includes on-site drainage features and creek restoration.

If approved, the Truckee Railyard project will be built in three phases over about 10 years. The first phase will include a 60-room hotel, a 1,000-seat theater with up to six screens, a 25,000-square-foot civic center, a 20,000-square-foot grocery store and several live-work buildings with living quarters over the retail shops.

When fully built out, plans call for the project to have 570 residential units, 70,000 square feet of retail shops, 15,000 square feet of office space, a parking structure, a civic center, a grocery store, a theater, a hotel and open spaces for uses such as a farmers' market.

For more information: Darin Dinsmore, Dinsmore Consulting, (530) 277-0196

This neighborhood of short block and sidewalks in downtown Quincy, CA, retains its rural charm.

Lively wall murals, landscaping and pedestrian walkways transform alleys in Exeter, CA, into friendly spaces for gathering and commerce.

■ **Economic Barriers:** Funding infill projects, particularly if part of the goal is to complement affordable housing efforts, can be a challenge. The combination of physical, social and regulatory barriers to infill projects make them less appealing to developers – they are less certain and increase risk.

In some cases, the site needs significant preparation to be infill-ready. The relatively small size of most infill development projects also makes it more difficult to realize economies of scale for labor and materials, and approval and entitlement processes are more burdensome and therefore costly.

Ultimately, it is often easier to build "cookie cutter" projects in open space outside of town than it is to wrestle with community members, local policies, and other constraints. Sadly, the result is to push more development into more valued lands in the watershed and surrounding our communities – and put greater strain on local budgets and infrastructure systems.

Complete Streets – Pedestrian Friendly, Safe, Appealing, Efficient and Water-wise

Planning communities to facilitate the movement of cars rather than as a system of connected places for people, businesses and other activities, is a driver of, and reinforces, sprawl-type land development.

An efficient transportation system creates mobility options, ensures access, and makes efficient use of streets, parking and other transportation infrastructure.

An inefficient transportation system focuses on the movement of cars alone, creating barriers to walking and bicycling, and dividing various parts of the community so the only way to get around, even a short distance, is to drive. Indicators of an inefficient transportation system are oversized roadways, dead-end streets, lack of sidewalks and pedestrian access, and insufficient access to local and regional transit.

Amazingly, the types of streets that our grandparents lived on reflect many of the best street designs today. In contrast to the wide streets of conventional subdivisions, traditional neighborhoods have narrow streets, short blocks, many connections, sidewalks, and roadside landscaping. They provide a multi-purpose transportation network of roadways, streetscapes and trails that connect various parts of the community. They are designed to meet the needs of pedestrians, ensure safety, create visual appeal, and allow efficient access to multiple modes of transport. In short, they are "complete streets."

Complete streets are also central to water-wise land use. As a result of layout, connectivity, route choices and innovative streetscape designs, complete streets support more compact community form, reduce dependence on the auto, reduce impervious surfaces, and increase transportation options.

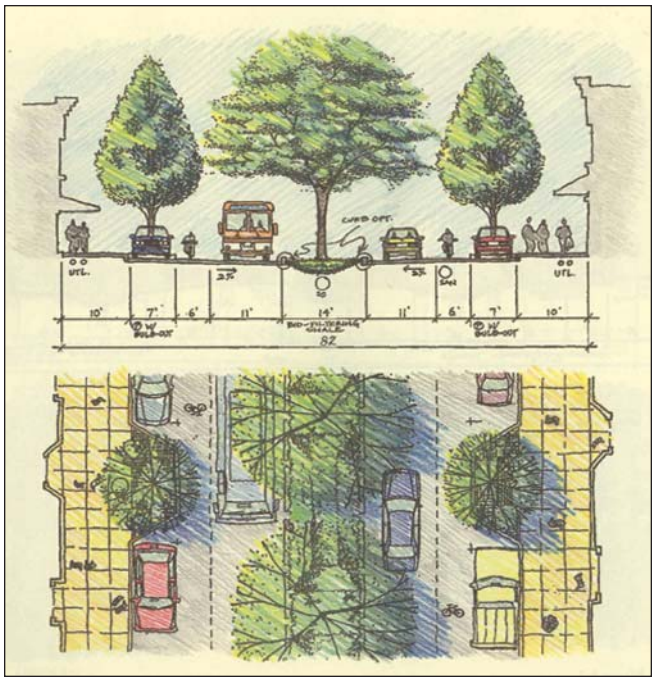


photo: Portland Metro's Green Streets Guidelines

This sketch outlines a complete and connected streetscape with sidewalks, on-street parking, bike lanes and natural drainage.

A complete street incorporates some or all of the following components:

- ➢ A connected system of streets and small blocks.
- ➢ Access to and support for multiple modes of transportation – including walking biking and public transit if available.
- ➢ Narrow streets that balance mobility, environmental protection, emergency response, and reduce traffic speed.
- ➢ Multi-use right-of-ways that accommodate auto travel, bike paths, sidewalks, medians, landscaping, drainage, aesthetics and access.
- ➢ Green infrastructure such as street trees and swales to handle stormwater.

■ Changing Policies to Create Complete Streets

At the local level, the circulation element of a county's or city's general plan (one of the seven required elements in a general plan per state law), provides overarching policy direction for street designs and mobility planning. More specific requirements as to the geometric and design parameters of local streets are usually part of local development codes and public work standards.

While a growing number of general plans for cities and counties across California are altering street

Grass Valley Strives to Integrate Land Use and Transportation

Creating greater options for mobility, so that the car is not the only means of transport, is a key goal for linking water, land use and transportation because it can reduce impervious cover and support compact community form. The following goals and objectives are examples from the circulation element of the City of Grass Valley's General Plan.

Policy Language from Grass Valley's General Plan:

"Circulation Goals:

- ➢ Ensure that street and roadway improvements complement and support land use goals, objectives, policies and plans;
- ➢ Provide a circulation system that utilizes a variety of transportation modes, including alternative means of transportation;
- ➢ Provide for the safe and efficient movement of people and goods in a manner that respects existing neighborhoods and the natural environment."

"Circulation Objectives:

- ➢ Development of a viable pedestrian and bicycle transportation network (sidewalks, paths, lanes and trails) providing alternatives to motorized vehicular transportation.
- ➢ Placement of public transportation access at convenient locations;
- ➢ Convenient, safe and functional facilities for pedestrians, bicyclists and equestrians;
- ➢ Flexible standards that respect existing neighborhoods;
- ➢ Use of City standards throughout the Planning Area;
- ➢ Provide for the safe and efficient movement of people and goods in a manner that respects existing neighborhoods and the natural environment."

What Is Shared Parking?

Shared parking is the concept of sharing parking spaces between businesses based on the premise that not all businesses operate during the same hours and that not every employee or customer has their own vehicle.

For instance, restaurants, especially during dinner hours, have different hours of operation than do office buildings. When placed near one another (such as in a mixed-use area), the same parking lot could serve both office employees as well as restaurant customers. Similarly, even a parking lot built only for a single-use office building most likely doesn't need to provide parking for every single employee since not all of them will drive to work at the same time.

Conventional planning often doesn't provide for the opportunity of implementing shared parking concepts because many zoning codes require minimum parking requirements based on studies of peak-period demand. This method of determining how much parking is needed often results in more parking spaces than are ever used.

Complete and connected streets provide space for vehicular traffic but also make other community interests a priority in their design.

requirements to allow for narrower widths, shorter block lengths, greater connectivity and improved access, many local codes and street standards do not support such design. This is because most local codes are based on standardized formulas and traffic models from state highway department manuals.

These formulas and models suggest street designs that allow for faster car travel, but their narrow scope of analysis doesn't take into account other interests of the community, such as safety, health, open space, water protection and community character. The result is local codes that emphasize the importance of streamlined vehicular travel at the expense of other community goals.

Street design resources: A number of resources available to provide guidelines for street design that accommodate community objectives in addition to vehicles. **Resources include:** the American Association of State Highway Transportation Officials (AASHTO) Policy on Geometric Design of Highways and Streets ("The Green Book"); the Institute of Transportation Engineers (ITE) Traditional Neighborhood Development Street Design Guidelines; and ITE's Traffic Engineering Handbook; *Residential Streets: Objectives, Principles and Design Considerations*, published by the American Society of Civil Engineers.

■ Common Obstacles to the Creation of Complete Streets

Two common obstacles to implementing better "complete streets" designs are fire codes and parking codes.

Fire and emergency response are and continue to be important considerations to improved street design. Firefighters in particular are concerned with narrower street widths as a potential barrier to emergency access. Dialogue between fire officials and local planners is often the most effective way to ensure that street design changes accommodate emergency response needs.

In examining parking obstacles, the automobile-oriented design of many communities is reflected in the fact that parking has become a predominant feature of the developed landscape. So much parking makes it challenging to walk from one place to another, contributes significantly to the total impervious surface in a watershed, and disperses development, creating inefficient land use.

One of the reasons parking lots are dominating features of the landscape is that many parking requirements are set to meet parking demands on the busiest days of the

Narrow street widths in this smart-growth development (Doe Mills, in Chico, CA) increase the pedestrian-friendly environment of the new community.

year. Another reason is that they are borrowed from suburban development contexts that don't fit the needs and conditions of smaller Sierra communities.

More efficient parking policies, such as shared parking, diagonal stalls, on-street rather than off-street parking, and underground or structured lots, are excellent ways to keep a town walkable, use land efficiently, and lessen the amount of pavement and impacts associated with development.

To determine whether the local codes in your community support complete and connected street design, the following basic questions may be helpful:

- ➢ What required street dimensions are included in codes? Do they support narrower widths?
- ➢ How do codes treat the "right-of-way" – as multi-purpose or for cars only? Or as a streetscape that enables walking and biking, landscaping and safety?
- ➢ Does the street network provide connectivity between the places people live, work and shop?
- ➢ To what extent are biking and pedestrian travel considered within transportation-related aspects of codes and standards?
- ➢ Do zoning codes or community ordinances require minimum parking standards? Is there language that prohibits shared parking?

Regulatory Barriers to Compact Community Form

Before World War II and the advent of modern zoning regulations, compact form was the norm for neighborhood design. Until recently, this was also the case in the Sierra. There is a vast difference in the scale of the historic homes in the Sierra, compared to the massive size and opulence of houses and gated subdivisions being built today. Bulk regulations, which are established within local zoning requirements, are important policy levers affecting the scale of development.

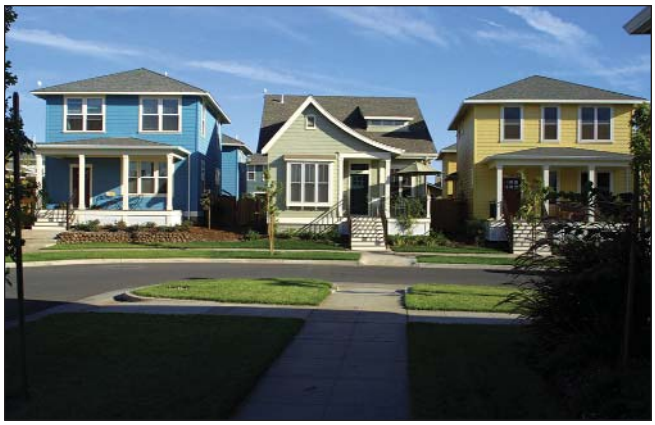
Bulk regulations refer to the building's size and how it is sited or arranged on a property. The following are typical attributes of bulk regulations that inflate the development footprint and create barriers to compact design.

- **Inflexible Setbacks:** "Setbacks" are established as an amount of space between a building and the street. In development regulations, the front lawn is an example of a setback. Setbacks are intended to allow air and light circulation, and manage separation between buildings and public rights of way. Most codes have a landscaped setback, while others allow parking, landscaping and other activities within mandatory setbacks. Codes typically prescribe a minimum distance for setbacks, say 20 feet. Such minimums, when combined with other bulk regulations, underlie the uniformly sized yards characteristic of modern subdivisions.

Two problems arise from modern setback requirements. First, they are often oversized, which pushes homes away from the street and make less appealing streetscapes and neighborhoods. Inflexible setbacks lead to "cookie-cutter" projects as developers will maximize the building footprint based on uniform setbacks.

Inflexible setbacks also undercut a developer's ability to arrange a building away from an ecologically sensitive portion of a site, or to protect and use on-site natural drainage features. Furthermore, the larger the setback requirement, the larger the parcel needed per unit of development.

To increase flexibility, encourage compact design, and create more variety in a neighborhood, planners are beginning to use more flexible setback requirements including maximum setbacks, build-to lines and zero lot-line provisions. These can serve to shrink the amount of land needed, but work best when coordinated with other design elements.



Doe Mill, a new urban subdivision, permits units to be built in close proximity to the street, a method allowing for more efficient use of each buildable parcel.

Mandated setbacks diminish the flexibility of architects and developers to design according to the natural topography of a site.

Doe Mill Neighborhood

Doe Mill, located in Southeast Chico, is an example of how to provide a range of housing choices in a traditional, compact, walkable neighborhood design. This 180-unit Traditional Neighborhood Development features small-lot single-family homes, bungalow houses arranged around common courtyards, several four-plexes, 70 carriage units over detached garages and 38 planned row houses around a central green space area. Homes range in size from 900 to 1,450 square feet.

The neighborhood is arranged on a traditional grid of narrow streets and alleys. Most of the streets are 26 feet wide with bulbouts at each intersection to slow traffic and ease pedestrian crossings. Sidewalks are five feet wide with seven-foot planting strips between the curb and sidewalks. Trees located at 35-foot intervals in the planting strips will shade the streets and sidewalks.

The neighborhood includes two major greens and was built near two City parks. A diversion channel that runs along Doe Mill's eastern border will also eventually contain bicycle and pedestrian paths that will connect with other destinations.

For more information: www.doemill.org
www.tndwest.com/doemillneighborhood.html

■ **Height Limitations:** Height is one of the most sensitive topics when discussing neighborhood design. From the watershed's perspective, development that cannot be accommodated by "going up," tends to "go out." Thus, height limitations are also correlated with loss of open space.

Many codes set height at one or two stories because people feel that taller buildings will be out of character with the community. Interestingly, many traditional downtowns have three- and four-story buildings, which are highly compatible with local character. Computer visualization programs can help community members envision what greater height allowances would look like in their community.

■ **Minimum Lot Sizes:** Minimum lot-size requirements are common in many development codes, to the detriment of water resources. Large-lot requirements increase distances between parcels, putting pressure on infrastructure and leading to inefficient land use. Also, inflexible lot requirements undermine efforts to design development around sensitive features, which makes environmental site design difficult.

At the extreme end, these requirements lead to "McMansion" residential projects that are out of character with the region, and put stress on infrastructure and resources.

Lot widths, or "frontage," can also be specified in the code and likewise serve to push development "out," while making more efficient land use more difficult.

Combined, these seemingly innocuous zoning parameters have a great impact on community form and thus

on the amount of land that is covered in a watershed by development. Importantly, it is the combined effects of these requirements along with other parameters such as street and landscaping requirements that produce the built environment. In most conventional codes, they combine to create less efficient and more homogenous development.

From the watershed's perspective, assessing and updating local codes and ordinances to address use separation, dimensional standards for lots and buildings, and to increase densities in appropriate locations, is a critical water protection strategy.

Planning Strategies for Compact Community Form

The following planning strategies are some common options for discouraging low-density sprawl development and for encouraging development patterns that support compact community form.

■ Long Range Planning: Aligning the General Plan and Compact Development

The General Plan is a starting point for supporting infill development. Language in various elements of the plan, including the land use, conservation, circulation, open space and housing elements, can support infill since infill can provide benefits in each of those policy areas. Other non-required elements such as a water element, public facilities or infrastructure element are also be good places to include goals, objectives and policies that are supportive of infill.

■ Propose A Zoning Overlay

As discussed in Chapter 2, zoning implements the policies of general plans and contains the primary development and density standards for communities. Conventional zoning codes emphasize the separation of land use types, allowable property uses and the control of density through numerical parameters (e.g., floor area ratios and dwelling units per acre). Improving development to be more watershed-friendly must therefore address the codes that determine how and where development occurs.

One way zoning can impact whether a community achieves or maintains a compact form is how and whether zoning codes relate to infrastructure. Jurisdictions can enact policies that require development to occur in areas that are already served by adequate public services and utilities.

This tactic decreases the opportunity for development to consume open space outside of city or community boundaries because such areas are often not serviced and/or are difficult to service via existing public services and utilities. Zoning can be coordinated with water, sewer and transportation infrastructure to ensure growth occurs in areas with those services.

Truckee Coordinates Development with Infrastructure

The City of Truckee promotes efficient development patterns by coordinating development with existing infrastructure.

Policy Language from Truckee's General Plan:

"Approve rezoning and development permits only when adequate services are available, or when a program to provide services has been approved by the applicable District and the Town of Truckee."

"Cooperate with special districts to plan for and identify suitable future sites for needed facilities, including schools, fire stations, solid and liquid waste disposal sites, and utilities infrastructure, so that the local population can be safely and efficiently served, while minimizing potential environmental impacts."

"Work with all special districts to ensure that development within the Town is coordinated with provision of services."

Grass Valley's New Form-Based Development Codes

Grass Valley used a form-based approach when revising the City's Development Code. The new form-based Grass Valley Development Code was adopted in 2007 to protect Grass Valley's unique Gold Rush Era character. The code replaced conventional zoning in key areas with historic neighborhood form-based standards to ensure new development respects and enhances the compact, walkable and mixed-use character of the town's historic core.

The code also includes "Traditional Neighborhood Subdivision Requirements" to create new neighborhoods that blend with and are connected to adjacent development, are built in a visually appealing manner that fits surrounding development context, are designed in accord with natural features (e.g., creeks and riparian areas) and public spaces, are human-scaled, and have a pedestrian-oriented street layout.

For more information: Opticos Design, Inc., www.opticosdesign.com/cd.html

What Are Form-Based Codes?

The Form-Based Code Institute defines a form-based code as "a method of regulating development to achieve a specific urban form." Form-based codes "create a predictable public realm primarily by controlling physical form, with a lesser focus on land use, through city or county regulations."

Form-based codes often include the following elements:

- ➢ Regulating Plan: A plan or map of the regulated area designating the locations where different building form standards are applied, based on clear community intentions regarding the physical character of the area being coded.
- ➢ Public Space Standards: Specifications for the elements within the public realm (e.g., sidewalks, travel lanes, on-street parking, street trees, street furniture, etc.).
- ➢ Building Form Standards: Regulations controlling the configuration, features and functions of buildings that define and shape the public realm.
- ➢ Administration: A clearly defined application and project review process.

Source: Form-Based Codes Institute, *Definition of a Form-Based Code.*

For more information: www.formbasedcodes.org

Overlay zoning is a tool that can be used to apply special standards and support certain types of development in particular areas without completely revising existing zoning. An overlay generally supersedes requirements in the underlying zoning. An overlay to support mixed-use development might be called a "mixed-use overlay." This overlay could be used to override zoning codes that discourage the construction of commercial and residential units near each other, and thereby create the possibility for a greater use mix in areas currently zoned for single use.

■ Consider Developing Form-based Codes

Form-based codes are among the best tools for coordinating aesthetic elements of design. Form-based codes differ from traditional "Euclidean" zoning because they place an emphasis on form rather than function.

While conventional codes can be highly prescriptive in terms of allowable uses, use separation, densities and lot-building configurations, form-based codes focus on the relationship between building fronts and the public realm (streets, parks and other outdoor spaces), the shape and size of buildings in relation to one another, and the scale and types of streets and blocks.

For instance, communities are now using form-based codes to make multiple design elements, such as building facades, landscaping and streetscapes, mutually supportive and designed according to an overall theme. Form-based codes also often specify setbacks, height allowances and building appearance.

Unlike design review guidelines or other aesthetic principles, form-based codes are regulatory. Form-based codes use graphic visuals to communicate concepts and regulations. Because of this they can make communication between planners and the public more streamlined.

For instance, rather than trying to figure out how and if his or her proposed project conforms to zoning codes and ordinances by flipping through hundreds of written pages, a developer can use form-based code visuals to determine whether he or she is on the right track. It's one example where the phrase "a picture is worth 1,000 words" is especially applicable.

By concentrating on the visual appearance of the built environment, form-based codes can add to the cohesive feel of a community, and make the center of a community a more pleasing place to spend time. These details can go a long way in supporting the kind of vibrant, diverse and pedestrian-friendly environment important to achieve successful compact community form.

■ Inventory and Map Vacant Land and Potential Infill Sites

A practical step for making a community infill-ready is to assess the potential for future infill development. Identifying vacant parcels and their property owners can help a community plan future development. In general, GIS mapping is the best way to assess infill potential, but even a "windshield survey" and a local parcel map can help identify under-utilized areas.

■ Develop Specific Plans to Encourage Compact Design, Mixed Use, Infill and Redevelopment

A specific plan is not a component of a general plan. It is a separately adopted plan to help implement general plan policies. Not to be confused with community plans or area plans, specific plans are described by statute. The purpose of a specific plan is "systematic implementation" of the general plan. Unlike community and area plans, under California public resources code, specific plans are required to identify proposed major components of infrastructure needed to support planned land uses.

Specific plans can be used to designate the type of development desired in various locations and to overcome existing zoning barriers without wholesale revisions to zoning codes. They can address specific planning and design issues at a finer scale than a general plan and can help to coordinate development in various parts of the community.

For all these reasons, specific plans provide a level of flexibility that can make it easier for developers to design projects around site constraints and overcome barriers in conventional codes. Specific plans can, for instance, establish unique development codes for infill or mixed-use development, or establish more flexible parking requirements.

Angels Camp Encourages Infill on Vacant Parcels…

The City of Angels Camp is in the process of monitoring the supply of land available in the city and maintaining a list of vacant and underutilized parcels for future development. Monitoring and mapping underutilized parcels within the city can provide a useful tool to identify where infill development could occur.

Policy Language from the Angels Camp General Plan: "Prepare a map of vacant parcels throughout the city and make the map available for developers at the Angels Camp Community Development Department public counter and/or on the city's website."

…and Supports Multimodal Transportation and Compact Development

Angels Camp encourages compact development patterns in order to allow for sidewalk or trail systems that encourage access between residential, commercial, recreational and public facilities using low-impact modes of transportation, thus having multiple benefits for the watershed.

Policy Language from the Angels Camp General Plan: "Encourage compact development patterns suitable for public transportation, pedestrian movement, use of low-speed vehicles (LSVs), and bicycles between high and medium density residential developments."

Truckee Uses Incentives to Encourage Mix Uses…

The City of Truckee recognizes the need for incentives to encourage mix use to influence how and where new development is located. Incentive programs for mixed-use encourages walkable neighborhoods, compact form, and less vehicle trips.

Policy Language from Truckee's General Plan:

"Develop a program to provide effective incentives for inclusion of a residential component in mixed-use projects."

…and Eases Requirements to Reduce Parking

A good first step in easing parking requirements is to take an inventory of parking facilities and assess where excess parking exists and how parking can be shared among a variety of uses. The City of Truckee plans to take this first step through conducting an evaluation of its parking requirements in its development code. Excessive parking requirements drive impervious cover in the watershed and prevent compact community form.

Policy Language from Truckee's General Plan:

"Conduct an evaluation of parking requirements in the Development Code to ensure that excessive parking is not required, and to address options for shared parking and other parking lot alternatives, particularly in the Downtown and Gateway areas."

■ Create Incentives for Good Development

There are many strategies and techniques cities can use as incentives to encourage infill and mixed-use development:

Density Bonuses: A developer can be rewarded for preserving valuable resources or other public benefits by being granted the permission to build more units than would normally be allowed in a zoning district. Density bonuses often work well in conjunction with a Transferable Development Rights program.

Streamlined Approval Processes: Pushing infill, mixed-use or dense developments through the review process will save the developer time and money thus making it more appealing to build these types of projects.

Reduced Exactions: Exactions help offset infrastructure costs or financial burdens caused by new development. Exactions can be either an "impact fee" or land dedicated to a specific use, which a developer is required to pay or provide to receive project approval.

■ Initiate a Capital Improvement Program

A Capital Improvement Program (CIP) establishes a plan for matching the costs of agreed upon community improvements – from fixing roads, to water and wastewater infrastructure, to parks and recreation projects – with anticipated revenues, such as taxes and bonds. Usually a CIP links to long range plans – such as general plans or specific plans.

Developing a CIP is an opportunity to make sure money is allocated to support responsible planning projects such as infill development and water and wastewater infrastructure improvements, and is an opportunity to get various government entities, including school districts, park and recreation departments and other municipalities on board with responsible planning choices.

In addition to prioritizing funding for infill and redevelopment, a CIP may also encourage "developer improvements" – any improvement to be constructed by a developer necessary to support their project. Such an improvement, while necessary to the function of the proposed project, usually provides an area-wide benefit not specific to the project.

For developers interested in projects long distances from water and wastewater infrastructure, such an improvement can often make the proposed project too costly. This is one way of using market forces to reduce incentives for developing outside of serviced areas, and therefore limit sprawl.

■ "Fix-It-First" Infrastructure Policies

Communities can ensure efficient use of fiscal resources and support infill with "fix-it-first" infrastructure policies. A "fix-it-first" policy prioritizes spending on repair, upgrade and maintenance of

Mariposa County General Plan Encourages Compact Growth

Mariposa County uses strong language in its general plan to focus growth in areas where services are already provided or are at least in close proximity. The policies encourage development near urban cores and discourage sprawl in open spaces that are not served by current infrastructure.

Policy Language from the Mariposa County General Plan:

"Goal: 'Create land use density and development patterns to manage growth in patterns avoiding sprawl.'

"Implementation Measures:

- Development shall grow outward from Planning Areas and Residential Areas with available services.
- Establish land development regulations defining permitted uses and establishing standards for close-to-services development.
- The County shall make findings that the development will not result in premature urbanization of the Planning Study Areas.
- No urban expansion shall occur within the Mariposa Town Planning Study Area unless water and sewage disposal are available from a centrally coordinated and managed system."

existing infrastructure, before allocating those monies to increased expansion.

"Fix it first" is a concept that has received increasing attention since the tragic failure of the levees during Hurricane Katrina in 2005 and the 2007 collapse of the Interstate 35W bridge in Minnesota.

Fix-it-first policies can be coordinated with CIPs to channel resources to projects in areas where infill is desired instead of extending services to outside areas.

■ Develop a Transferable Development Rights Program

As discussed in Chapter 2, a transferable development rights (TDR) program is a market-based tool for directing growth into designated areas and away from areas with greater conservation value. In addition to its usefulness as a land preservation tool, because a TDR can channel development into targeted areas, it can also be coordinated with infill and redevelopment efforts.

The most effective TDR program for enabling compact development would be one in which land within a city or downtown area was prioritized as a receiving area for development rights. This way development rights transferred from other locations would support city centered dense development.

■ Ease Parking Requirements: Encourage "Maximum" Rather than "Minimum" Parking Spaces

Parking requirements have significant impact on the shape and function of communities. Most communities have high parking requirements based on antiquated transportation models and formulas. From the watershed's perspective, more parking not only enlarges the footprint of development, it means more pavement. Individuals can view planning regulations as limitations to personal freedom, rather than as a tool to take charge of how their communities and landscapes are changed.

Reducing parking requirements, allowing shared parking, capping parking spaces and using efficient parking designs (diagonal stalls) are ways to reduce the parking footprint and to enable infill projects.

Collaboration and Education

Developing and implementing strategies to encourage compact form requires both community buy-in and support from the private and public sectors. Especially in the Sierra, many individuals view planning regulations as limitations to personal freedom, rather than as a tool to take charge of how their communities and landscapes are changed.

The success of any strategy should begin with engaging the community in a meaningful dialogue about the tradeoffs between various types and locations of development. Such a dialogue can take place as a formal part of a planning process, or as an informal part of a grassroots effort. It is likely that both types of gatherings are important and necessary to begin to build a broad inclusive vision for the form of a community.

The most successful community dialogues are ones in which participants have the opportunity not just to critique proposed plans but also to learn about likely consequences.

To foster community support, it is also crucial to make sure that stakeholders with various interests are represented at the table. A broad spectrum of participation creates an environment where strategies can coalesce around common values rather than getting hung up on ideological differences. Finally, most people believe in the importance of protecting water quality and reliability.

Highlighting the relationship between development and water resources can go a long way towards influencing the opinion of the general public about components of compact form such as density and lot size. This type of dialogue can help community members make more informed decisions.

It is equally important to create an environment where local leaders from the public, private and non-profit sectors work together and leverage resources. Infill projects, mixed-use development, revitalization, street retrofits and other sustainable development projects can be complex, involve multiple property owners, and require clean-up of a site.

In the short term, these projects are often more expensive than doing nothing or relying on conventional development to build a tax base. In the long term, however, such projects add value and vitality to the community, boost the local economy, and help maintain local character.

Conclusion

Working to ensure a city or communities within a county have compact form reduces the pressure to accommodate additional population by expanding outward into valuable natural infrastructure. Compact form also reduces impervious surfaces, protecting water quality by reducing stormwater runoff and protecting natural infiltration, and, by virtue of its location and form, compact development requires less infrastructure to serve a given number of homes and businesses. This reduces costs for water service as well as leakage repairs and the water pollution problems associated with poorly designed or maintained individual septic systems.

There are many strategies to encourage compact community form that will accomplish vital community objectives:

- ➢ The encouragement of development into existing communities.
- ➢ The integration of a diversity of land uses, development types, transportation options and housing choices.
- ➢ The creation or redevelopment of communities that are walkable and pedestrian-oriented.

It is not always about implementing new tools, however, but also about removing barriers to compact form. From the watershed's perspective, assessing and updating local codes and ordinances to address barriers to compact form include:

- ➢ Reforming the local zoning code to allow a greater mix of uses.
- ➢ Changing dimensional standards for lots and buildings.
- ➢ Increasing densities in appropriate locations.
- ➢ Reducing street width and parking requirements.

Whatever tools or strategies a city or county is considering to address community form, gaining community understanding and participation in the process is a key to success. Without adequate outreach, education and participation, many of these tools can be misperceived as limiting personal freedoms. Significant community participation is critical to successfully implementing tools that work for each specific county or city.

Even in an ideal world – one in which planners have worked to encourage compact development in those areas of a watershed where it will have the least impact – new development may still pose a risk to water resources if the site-level design details of structures or landscapes are overlooked.

The next chapter explores the architectural and civil engineering elements of development, and examines how to reduce water demand and minimize water quality impacts at the site.

Chapter 4.

Strategies for Sustainable Site Planning and Design

The previous chapters focused on how and where to grow, and ways to preserve those areas that should not be developed. Along with how and where we develop, what we develop – the design of the built environment – is critical to water resources. As we encourage development in good locations and enable compact community form, we can rethink the design of lots, buildings, landscaping, infrastructure, streets and public spaces to minimize their impacts on water quality, supplies and reliability.

This chapter discusses four central strategies that serve to minimize the impact of development on water resources. In combination, they reduce water demand, protect water quality, and limit the overall disturbance of new development on watershed health. These strategies include:

- ➢ Protect natural assets with better site planning and design.
- ➢ Utilize green infrastructure to manage stormwater runoff.
- ➢ Use water-wise landscaping practices.
- ➢ Install water-efficient technology.

photo: Nevada Tahoe Conservation District

Rocklined swales are a natural way to convey runoff.

Background: Stormwater Runoff and Natural Drainage

Development replaces natural land cover with hard impervious surfaces, which alters natural drainage processes. Prior to development, much of the landscape can absorb water, allowing it to infiltrate into soils, recharge groundwater systems, and provide base-flow to rivers and streams, while the rest drains slowly over the surface. Vegetation, soils and organic matter cleanse the water and manage its pace as it flows over and through the ground. The water takes many paths, some fast and some slow, as it runs into and through rivers, streams and other water systems in the watershed.

When land is developed, impervious surfaces, like pavement and buildings, replace absorbent land, which prevents water from infiltrating into the ground. The reduced infiltration causes corresponding reductions in groundwater recharge and base flow to rivers and streams. Reduced infiltration also increases the volume and velocity of surface runoff, and thus increases the threat of flooding. More and faster runoff impacts stream health and water quality, causing erosion and sedimentation, channel incision, stream bank instability and habitat degradation.

The runoff also collects a variety of pollutants from roads, parking lots, buildings, lawns and other areas that are carried and discharged directly into local

What Is the NPDES Program?

Passed in 1972, the Clean Water Act is the principal law governing water quality in the United States. The Clean Water Act gives the U.S. EPA authority to set water quality standards and made it unlawful to discharge pollutants from point sources (such as pipe discharging waste from a sewage plant or a factory) into navigable waters, unless a permit was obtained under its provisions.

In California, the Porter-Cologne Water Quality Control Act gives the State Water Resources Control Board and nine Regional Water Quality Control Boards authority over water quality regulation at the local, regional and state level.

In 1987, the Clean Water Act was amended to address the problem of non-point source pollution in stormwater runoff by expanding the national pollutant discharge elimination system (NPDES) program to discharges from stormwater systems. This change brought cities and counties, as operators of municipal separate storm sewer systems (MS4s), under the regulatory provisions of the NPDES Municipal Stormwater Program.

Stormwater runoff often discharges to local waterbodies and can carry a variety of pollutants from roads, parking lots and other areas.

rivers and streams. The range of pollutants in developed areas that can be picked up in runoff include heavy metals, oils and grease, pet waste, fertilizers and pesticides, and even noxious air pollution that settles on the ground. These pollutants create a toxic stew that is destructive to the quality of receiving waters and, subsequently, to aquatic vegetation and wildlife.

In combination, the impacts of stormwater runoff have become recognized by the U.S. Environmental Protection Agency as the number one threat to water quality in the nation.[1] However, until recently, stormwater was not a significant issue for most of the rural communities of the Sierra Nevada. Recently, this has been changing as more communities come under provisions of the National Pollutant Discharge Elimination System (NPDES), a program under the Clean Water Act designed to regulate the impacts of stormwater runoff from developed areas.

The program was implemented in two phases. Phase I requirements came out first and covered larger areas with populations of 100,000 or more people. In 1999, Phase II regulations were issued, bringing smaller communities under NPDES rules. For example, Calaveras County was designated a Phase II community in 2006 and is now required to comply with California's General Stormwater Permit. To comply with this permit, Phase II communities are required to:

- ➢ Develop a stormwater management program meeting six minimum control measures.
- ➢ Implement the program.
- ➢ Require management controls and Best Management Practices.
- ➢ Create measurable goals for the program.
- ➢ Evaluate on the program's effectiveness.

The six minimum control measures required by the U.S. EPA are:

1. Public education and outreach.
2. Public participation and involvement.
3. Illicit discharge connection and elimination.
4. Construction site runoff control.
5. Post-construction runoff control.
6. Pollution prevention and good housekeeping.

Background: Using Water Efficiency to Reduce Water Demand and Boost Supplies

The Pacific Institute's 2005 report entitled *Waste Not Want Not* highlights the potential for increasing water supplies by decreasing demand. Conservation, the report found, was the cheapest and most readily available means for increasing the reliability of water supplies in California. Of all water uses, reductions in residential water demands provide the greatest opportunity for cost-effective water savings through conservation.

The report estimated that urban water conservation can contribute 2.0 to 2.3 million-acre feet a year to our water supplies – enough to supply the current household demands of more than two million new residents. (One acre-foot is roughly the amount needed by a single family for one year).

Mandatory Conservation Practices

The state of California is slowly taking steps at a legislative level to enhance planning and management of water supply at a local level. In particular, the state's "show me the water laws" (SB 610 and SB 221) require water agencies to verify supplies are adequate to meet the long term needs of proposed development projects (above a certain size) before the project can be approved by the local land use agency. Those laws are discussed in further detail in Chapter 5.

Recent state legislation is also pushing for improved water conservation practices, particularly in landscaping. Assembly Bill (AB) 325, the Water Conservation in Landscaping Act of 1990 and AB 1881, the Water Conservation in Landscaping Act of 2006 show an evolution in state support for water-efficient landscaping practices.

At the forefront is the California Urban Water Conservation Council, an organization that was created to "increase efficient water use statewide through partnerships among urban water agencies, public interest organizations, and private entities" and "integrate urban water conservation Best Management Practices into the planning and management of California's water resources."

California Urban Water Conservation Council's Memorandum of Understanding

The California Urban Water Conservation Council (CUWCC) was at the center of a historic Memorandum of Understanding (MOU) in which almost 100 urban water agencies pledged to implement 14 Best Management Practices.

The MOU was first adopted in 1991 and most recently amended in 2007. It establishes a suite of urban water conservation practices referred to as Best Management Practices (BMPs) intended to reduce long-term urban water demands from what they would have been without implementation of these practices. The MOU also sets forth programs which may be instituted during occasional water supply shortages.

Signatories to the MOU include water suppliers, non-profits engaged in water resource conservation and other interested groups. The MOU contains 14 BMPs, which signatories pledge to develop and implement.

Water Conservation in Landscaping Act of 1990

Passed on the heals of the state's last drought, AB 325, the Water Conservation in Landscaping Act of 1990, required that the Department of Water Resources (DWR) develop a Model Water Efficient Landscape Ordinance. This model ordinance was adopted and went into effect January 1, 1993.

Water Conservation in Landscaping Act of 2006

AB 1881, the Water Conservation in Landscaping Act of 2006, requires DWR to update the Model Efficient Landscape Ordinance established under AB 325 no later than January 1, 2009, according to many of the recommendations of the CUWCC Landscape Task Force. The CUWCC Landscape Task Force was created under separate legislation, AB 2717, to review landscape water issues and make recommendations for improvements. Subsequent to this action by DWR, AB 1881 requires local agencies to adopt the updated model ordinance by January 10, 2010.

The bill also requires the California Energy Commission to adopt performance standards and labeling requirements for landscape irrigation equipment to reduce the unnecessary consumption of excess energy or water.[2]

What Is the California Urban Water Conservation Council's MOU?

The California Urban Water Conservation Council was created to increase efficient water use statewide through partnerships among urban water agencies, public interest organizations, and private entities. The Council's goal is to integrate urban water conservation Best Management Practices into the planning and management of California's water resources.

The Council's Memorandum of Understanding was signed by nearly 100 urban water agencies and environmental groups in December 1991. Since then, the Council has grown to include more than 380 groups. The participating organizations pledged to develop and implement 14 comprehensive conservation Best Management Practices:

1. Residential Surveys
2. Residential Retrofits
3. System Water Audits
4. Metering
5. Landscape
6. Clothes Washers
7. Public Information
8. School Education
9. Conservation Programs for Commercial, Industrial and Institutional (CII) Accounts
10. Wholesaler Incentives
11. Rates
12. Conservation Coordinator
13. Waste Prohibitions
14. Ultra-low-flush Toilets

For more information:
www.cuwcc.org/aboutus.html

Encouraging Water Efficiency in New and Existing Development

Greener development is gaining market appeal as more people pay attention to the environmental impact of their homes and look to save money over the long term. This is demonstrated by the number of growing consumers and developers looking to build and buy "green" homes.

Corporate membership in the U.S. Green Building Council increased from 600 in 2000 to more than 5,500 members by the end of August 2005.

In response to growing demand, over 21,000 building industry professionals have become accredited to certify Leadership in Energy and Environmental Design (LEED) standards since 2000.[3]

Strategy 1: Protect Natural Assets with Better Site Design

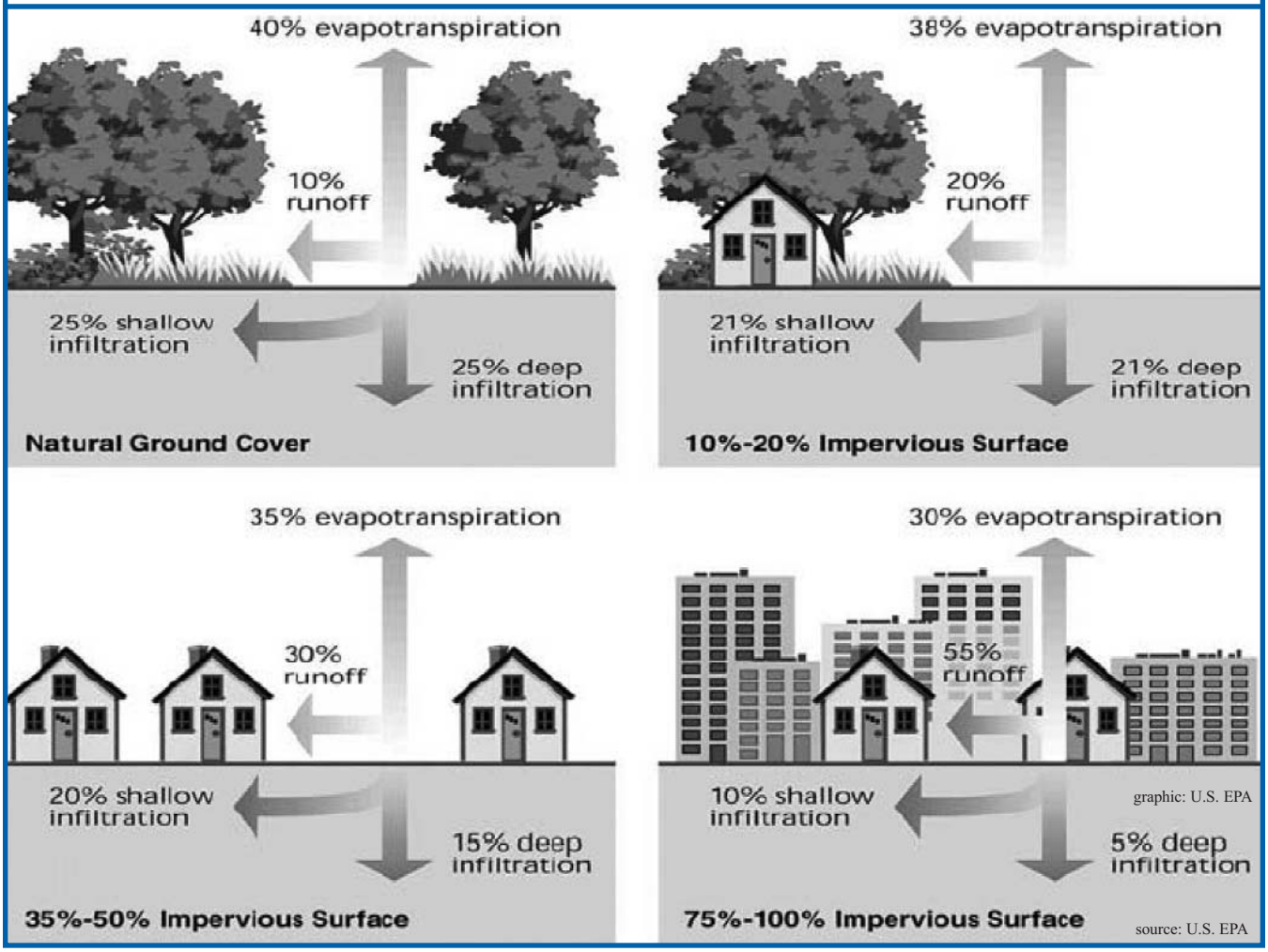
Location is key when it comes to preventing watershed impacts of development. Regardless of scale, certain areas are more suitable for development than others. At a larger scale, those areas that are already developed are best. The same principle applies at a site-level scale, where existing conditions make certain areas more suitable for development than others. A site plan can layout buildings, streets, driveways, and parking in areas of the least ecological value on a parcel to avoid more sensitive areas and take advantage of natural features.

Some disturbance is inevitable when developing open land, but it is possible to minimize that disturbance by avoiding sensitive areas, protecting natural assets found on-site and integrating "green infrastructure" into the project.

Unfortunately, most development projects in the past have failed to work with a site's natural conditions and assets. Instead, they began with wholesale conversion of the existing landscape through clearing, grading, cut-and-fill and other preparation activities that can have enormous negative impacts to watershed health.

Often a parcel was subdivided without regard for existing soils, topography, vegetation or water resources

As land cover changes, so does the amount of precipitation that absorbs into the ground, evaporates into the air, or runs off.



and then prepared for construction by adjusting the topography and organic features, and by pumping-out or filling-in natural drainages to make the site fit the development plans as conceived on paper.

An alternative to this approach is to make protecting the site's environmental assets one of the project's design goals. The first step towards this goal is to identify areas on the site that should be conserved, and identify those most suitable for development. The second step is to decide on a construction approach that causes the least damage to those areas slated for conservation.

The following are some common planning and construction objectives that can lead to more environmentally friendly site planning and design.

Assess Site Characteristics to Establish the Development Envelope

The site planning and design phase offers developers the greatest opportunity to minimize the impacts of a proposed project by incorporating a site's specific characteristics into the project's design. Similar to planning for development on a regional scale, minimizing impacts requires an assessment during which areas to prioritize for preservation and areas most suited for development are identified.

The "development envelope" describes the part of a site where development will be located. It is the buildable area of a parcel once portions deemed not suitable for development – based on site characteristics or local regulations – have been established.

Areas to avoid from a water protection standpoint include:

Steep Slopes, Erosive Soils and Sensitive Areas: To the highest degree possible, buildings, roads and other structures should be located on stable soils and flat to moderate slopes to avoid soil erosion. Developers should seek ways to protect ecologically sensitive features on site as natural amenities.

Water Features: Set development back from streams, wetlands and riparian habitats. Design to protect existing drainage features as much as possible. This not only protects watershed infrastructure and associated ecosystems, but may reduce the risk of future on and off-site flooding.

Existing Vegetation and Soils: Preserve existing trees that do not present a fire hazard, and maintain as much of the site's natural vegetation and soil structure as possible. Healthy plants and soils facilitate natural drainage and other ecosystem processes that sustain healthy watersheds. The loss of vegetation and compaction of soils leads to urban runoff problems and reduced groundwater infiltration. Maintaining healthy vegetation and root systems serves to sustain the infiltration and filtration capacity of the ground, reduces erosion, stabilizes slopes, and protects nearby streams and rivers.

■ Cluster Buildings and Infrastructure

Once the development envelope is determined, focus development onto a smaller portion of a site to reduce land disturbance and overall impervious surface coverage. Clustered development allows for conservation of on-site features and creative use of open space, such as small-scale agriculture.

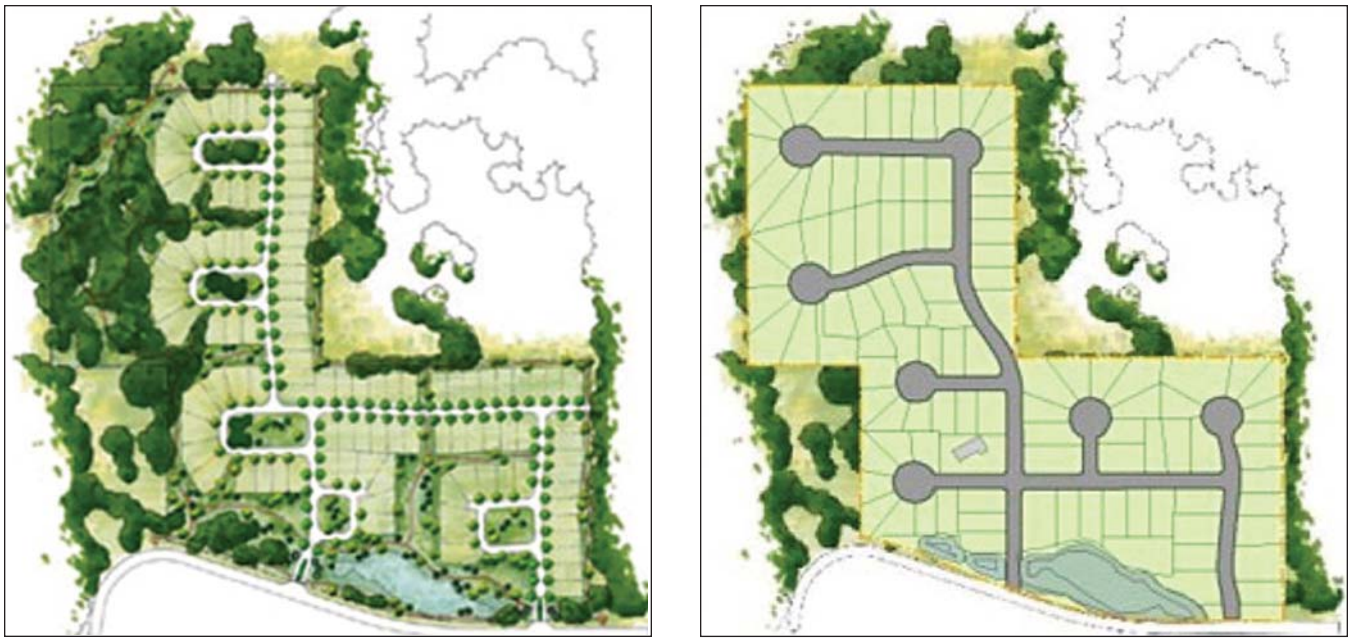
Strategically clustering development also allows coordination and shared use of various amenities and infrastructure needs such as wastewater and transportation systems. For example, large, low-density projects need a vast street system to serve homes distributed throughout the site and long driveways are needed to serve homes set-back from the street. This entire transportation infrastructure adds up to more land disturbance,

What is the LEED Green Building Rating System?

The LEED Green Building Rating System is among the most popular rating systems to determine the environmental friendliness of a home. The LEED for Homes rating system measures the overall performance of a home in eight categories:

1. **Innovation and Design Process (ID).** Special design methods, unique regional credits, measures not currently addressed in the Rating System, and exemplary performance levels.
2. **Location and Linkages (LL).** The placement of homes in socially and environmentally responsible ways in relation to the larger community.
3. **Sustainable Sites (SS).** The use of the entire property so as to minimize the project's impact on the site.
4. **Water Efficiency (WE).** Water-efficient practices, both indoor and outdoor.
5. **Energy and Atmosphere (EA).** Energy efficiency, particularly in the building envelope and heating and cooling.
6. **Materials and Resources (MR).** Efficient utilization of materials, selection of environmentally preferable materials, and minimization of waste during construction.
7. **Indoor Environmental Quality (EG).** Improvement of indoor air quality by reducing the creation of and exposure to pollutants.
8. **Awareness and Education (AE).** The education of homeowner, tenant and/or building manager about the operation and maintenance of the green features of a LEED home.

For more information: U.S. Green Building Council, www.usgbc.org



The drawing on the left illustrates the relationship between a planned community and its impervious footprint when laid out according to conservation site design principles. Notice how much less impervious surface is created compared to the example of a conventionally planned community (right).

Truckee Avoids Development on Slopes

Building on slopes not only leads to soil erosion that negatively impacts water quality, but also detracts from scenic and natural views. The City of Truckee protects steep slopes from development, with the most stringent standards applying to steeper areas. The City also requires projects to incorporate planning and design measures to minimize disturbance, and to use Best Management Practices for erosion control.

Policy Language from Truckee's General Plan:

"Preserve slopes of 30% or greater as open space and avoid slopes of 20% to 30% if there are other, more suitable areas for development with slopes less than 20%."

"Require projects that require earthwork and grading, including cuts and fills for roads, to incorporate measures to minimize erosion and sedimentation. Typical measures include project design that conforms with natural contours and site topography, maximizing retention of natural vegetation, and implementing erosion control Best Management Practices."

Angels Camp Protects Waterways

The City of Angels Camp holds water quality as a top priority in its community and requires development setbacks along waterways to prevent stream bank erosion and channel sedimentation.

Policy Language from Angels Camp General Plan:

"Designate Resource Management & Open Space Setbacks Along Creeks. Establish an open space setback encompassing designated flood hazard areas along Angels Creek and Six Mile Creek. Designate these areas as Resource Management (RM) on the city's general plan maps and as Open Space (OS) on the city's zoning maps. Establish similar setbacks along other drainages within the city (e.g., China Gulch) or along drainages in areas that may be annexed into the city in the future."

Alpine County Addresses Erosion Control during Construction

Alpine County makes erosion control a priority by establishing guidelines for erosion and sediment control during construction as well as requiring a long-term plan outlining an erosion control strategy for the development.

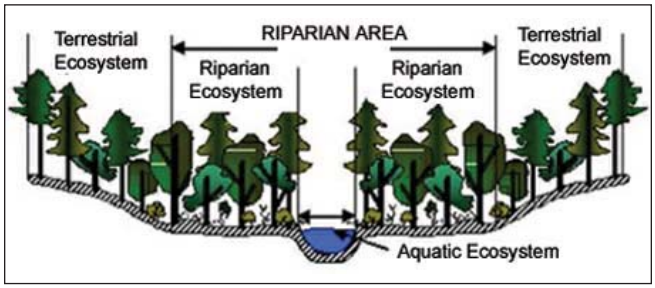
Policy Language from Alpine County Building Department, Grading Permit:

"Erosion and sediment control plans shall be designed to prevent increased discharge of sediment at all stages of grading and development from initial disturbance of the ground to project completion and shall be consistent with all local, state and federal rules and regulations."

"Runoff shall not be discharged from the site in quantities or at velocities substantially above those which occurred before grading except into drainage facilities found by the Building Official to be adequate to convey the estimated increase in runoff."

Set development back from streams, wetlands and riparian habitats.

Clustering development can be used to protect valuable habitats.



A riparian area is typically a narrow strip of land, centered around a river, stream or other watercourse, that extends to the ordinary high-water line and surrounding streamside vegetation.

more impacts during grading and construction and greater amounts of impervious cover. The amount of water and wastewater infrastructure is also reduced in clustered development.

In a clustered layout, one road can serve several homes and sometimes even driveways and parking areas can be shared. Clustering eliminates the need for a widely dispersed road network. Thus, less land is disturbed for road building, reducing erosion and other impacts from cut-and-fill practices, and reducing on-site impervious cover.

Truckee Promotes Clustered Development

The City of Truckee encourages clustered development as a means to preserve open space as well as to minimize disturbance of natural features and sensitive areas. Clustered development allows for flexible site design, which responds to site features which may be a significant asset to the community, such as natural drainage areas, wetlands, wildlife habitat, or floodplain.

Policy Language from Truckee's General Plan:

"For all residential developments, require clustering where appropriate. Clustered development as defined in this General Plan includes the following considerations:

- Clustering of residential development will allow flexibility of site design in responding to the natural features and resources of an individual site.
- Clustering means that structures will be located on a site so that larger areas are left as undeveloped open space.
- Undeveloped areas may either be preserved in private or public open space, or may be a portion of an individual lot, with deed restrictions prohibiting construction in that portion."

"Residential development shall be clustered to avoid areas of significant natural resources, including wildlife habitat and migration corridors and visual resources."

"Clustered development shall incorporate preservation of open space areas as an integral and primary consideration in the overall development plan for a site. Considerations in preserving open space through clustering shall include the following:

- Maximizing preservation of open space types that reflect the Town's priorities as stated in the Conservation and Open Space Element.
- Maintaining an appropriate relationship of the site to the character and context of adjacent neighborhood areas and nearby and adjoining open space areas.
- Respecting individual site features and characteristics, including topography, natural features, natural hazards and constraints and the presence of sensitive biological resources."

Minimize Grading and Erosion during Construction

Ensure that those features (including topographical features, vegetation and water resources) that have been conserved on the site are not degraded during construction. Implement temporary and permanent Best Management Practices to limit damage to vegetation and soils and to prevent discharges to surface and groundwater that could occur during and after construction.

In California, the State Water Resources Control Board regulates water quality impacts of construction activities. Projects that disturb more than one acre of soil are required to develop and implement a Storm Water Pollution Prevention Plan (SWPPP).

Temporary Best Management Practices can help limit damage to vegetation and soils during construction.

Natural vegetation helps catch and filter runoff in this example of green infrastructure at work.

A SWPPP must include a site map showing existing and proposed building structures, roadways, storm water collection and discharge points, general topography and drainage patterns.

A SWPPP must also list BMPs that will be used to address stormwater runoff from the site and provide various monitoring programs. This process offers an opportunity to incorporate water protection strategies into the earliest phases planning and site design.

Clustering development can minimize project impacts, particularly at a site level. Ideally, each project looks at opportunities to protect or enhance natural assets on or adjacent to the site. However, even well-designed projects have impacts if they are not well-placed on a regional scale (bad location) or encourage rural sprawl (bad form). It is important to balance good site planning with broader community planning goals to prevent inefficient land use, auto dependence and leapfrog development.

Strategy 2: Utilize Green Infrastructure to Treat, Reduce and Reuse Stormwater

Grey vs. Green Infrastructure

Drainage is a normal process that is altered when permeable lands are covered with impervious surfaces like buildings and pavement. Once developed, the ability of the landscape to absorb rainwater or snow melt is reduced and runoff increases, which can lead to flooding.

Conventional storm drainage and flood control systems were based on "conveyance." They were designed to convey large amounts of water out of an area as fast as possible. The result was a highly efficient system for discharging huge amounts of runoff and pollutants into local rivers and streams at high velocity. The unintended consequences on receiving waters, including scoured channels, bank erosion and loss of habitat were not foreseen. Unfortunately, these impacts have been grave.

Conventional conveyance-based stormwater systems rely on "grey infrastructure," a network of curbs, gutters, concrete channels and underground pipes, designed to collect and convey water from developed areas as fast as possible. But stormwater management has evolved rapidly in the last decade. Needing to comply with federally mandated NPDES rules, communities are rethinking their approach to stormwater management.

In recent years, there has been an increasing emphasis on "green infrastructure" as an alternative to conventional "grey" approaches. Conventional "grey" tactics are centralized, single-focused, hard and structural, while newer "green" solutions are dispersed, integrated, non-structural and rely heavily on natural processes and systems. Low Impact Development is one of the more common names for the suite of site planning, design and engineering practices that have emerged from this shift.

LID Techniques

Low Impact Development is a stormwater management approach that is modeled after nature: manage rainfall at the source using a system of small, natural features that are designed into a site to collect, treat and convey

runoff. Techniques are based on the premise that stormwater is a resource not a nuisance or a hazard.

Instead of managing stormwater using large, costly end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small landscape features distributed strategically throughout a site. These landscape features, known as Integrated Management Practices (IMPs), are the building blocks of LID.

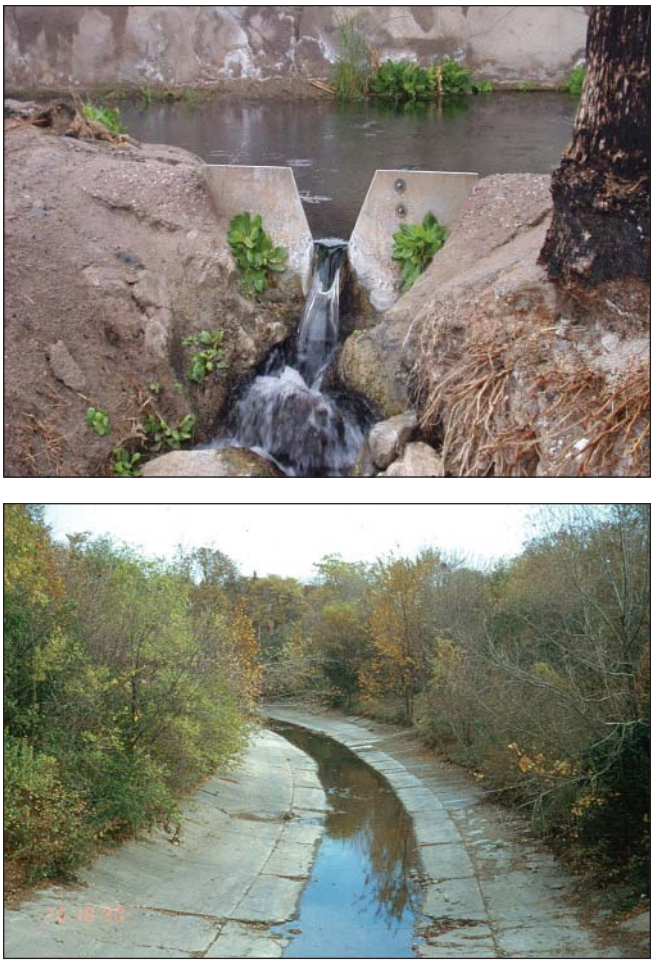
Almost all components of the urban environment have the potential to serve as an IMP. This includes not only open space, but also rooftops, streetscapes, parking lots, sidewalks and medians. LID is easiest when integrating the techniques into a site design before a project is built, but can be applied retroactively as well. Many communities are retrofitting streets, parking lots and buildings with green infrastructure strategies to capture, treat and reduce runoff from those areas.

LID techniques have been used in a variety of soil types, climatic conditions, topographies and scales of development. The goal is to restore the drainage functionality of a developed site by incorporating infrastructure features that mimic the drainage services provided by an undisturbed landscape. LID should be coordinated with planning for compact form and good location by ensuring that LID measures support rather than block compact design, infill and redevelopment objectives.

Linking multiple LID features throughout a site not only may improve the environmental performance of development but may also reduce costs relative to traditional stormwater approaches.[4]

Since LID incorporates small-scale controls to manage runoff at the source, it often works best when multiple techniques are combined. For example, in lieu of a treatment pond serving a new subdivision, a project might be designed as a "treatment chain" of LID practices that are integrated throughout a project, neighborhood or community. Thus, runoff from a commercial building might first be directed to a broad landscaped area called a "filter strip" that would then drain into a linear drainage swale, which then leads into a neighborhood wetland.

The menu of LID techniques continues to grow as engineers, landscape architects and planners develop new solutions to fit various development situations. The strategies below are not an exhaustive list of LID strategies, but they provide some examples that have been applied in the Sierra Nevada region.



Conventional grey infrastructure is efficient at carrying large volumes of stormwater away from our built landscapes, but not without contributing to water pollution and streambank erosion problems.

How Are Drainage and Soil Types Classified?

Soil type is a key concern for the use of on-site natural drainage practices. Different soils have differing levels of permeability and runoff potential. The USDA Natural Resource Conservation Service classifies soil types according to drainage potential on a continuum from A to D. Group A, which includes well-drained sands and gravels, is the most permeable and thus has the least runoff potential. Group D is the least permeable, consists chiefly of clay soils and has a higher runoff potential. In general, less permeable soils (Group D) are less conducive to infiltration-based stormwater strategies. However, "amended soils" can be used to increase infiltration in certain areas.

Village Homes Uses Natural Drainage

Village Homes, a development built in the 1970s in Davis, CA, is a model for incorporating green infrastructure into a site design to manage stormwater runoff. The 240-unit mixed-use residential development does not have a conventional curb-and-gutter storm sewer system to manage runoff from the development. Instead, a network of vegetated swales wind thorough the community, providing common open space while functioning as a "green" stormwater drainage system.

When it rains, the system captures runoff from the development. The swales slow runoff, allowing some of it to infiltrate into the ground while the rest is conveyed from the site at a more natural rate. Vegetation, soils and catchments within the swale also serve to filter pollutants, cleansing runoff as it moves through the system. The system was designed to carry remaining water slowly to the City's municipal facility; however, it works so well that the water rarely actually makes it there. Village Homes also features narrow streets, large areas of common open space, locally appropriate trees and other native vegetation.

For more information or to set up a tour: www.lgc.org

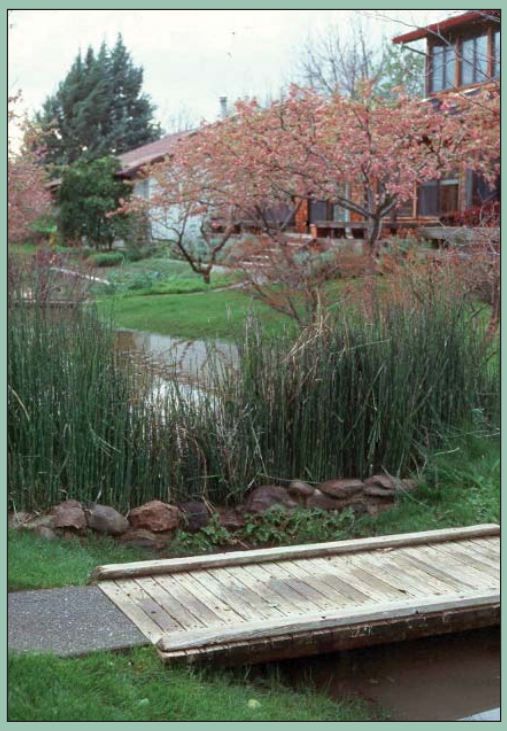


photo: Nevada Tahoe Resource Conservation District

This rocklined "infiltration trench" slows runoff and allows percolation into soils.

Swales: Swales are one of the more common types of "green infrastructure." Swales are drainage channels that can be designed to meet various needs and conditions with the end goal of conveying runoff more slowly than conventional stormwater drainage systems.

Some swales are lined with turf grass or native vegetation, which can serve to filter pollutants from runoff, while others are lined with coarser materials such as gravels, cobble or other "structure" that serve to slow runoff and allow it to percolate as it moves through the swale.

Bioretention Systems: Bioretention systems, more commonly known as raingardens, are designed to capture, retain and treat runoff from impervious surfaces. They reduce the volume of runoff, and filter it through soils, plants and organic matter. Bioretention systems can be designed into a variety of development settings, including residential lots, tree wells, street rights-of-way and parking lots.

Bioretention systems have been shown to function even in harsh winter conditions. Proper siting depends on a number of factors, including available space, depth to an impermeable layer (such as a hardpan or bedrock), depth to water table and soil type. On clay

Homeowners and Local Governments Combine Efforts to Keep Tahoe Blue

In 2005, the Tahoe Resource Conservation District (TRCD), the California Tahoe Conservancy and Placer County piloted the integration of private parcel BMPs with a public erosion control project in the North Tahoe Brockway community. The Brockway erosion control project is a part of Tahoe's Environmental Improvement Program, which encompasses hundreds of capital improvement, research and operation and maintenance projects to help restore Lake Tahoe's clarity and environment.

As part of the Environmental Improvement Program, Best Management Practices (BMPs) are required on all properties in the Tahoe Basin to reduce stormwater runoff and associated sediment and nutrient accumulation in Lake Tahoe. These include stabilizing bare soil with vegetation and mulch and capturing and infiltrating runoff from impervious surfaces, such as driveways and rooftops.

The Brockway community was selected as a pilot project area because to its close proximity to Lake Tahoe. The area contains steep slopes subject to water and wind erosion with large volumes of stormwater runoff from nearby casino parking lots that drain into the neighborhood and eventually the lake. After evaluating the private parcels within the project area, TRCD staff determined how to best combine public and private BMP installations while minimizing construction costs for homeowners. This maximized stormwater infiltration and treatment opportunities within the confined land area of the community, which will eventually reduce the amount of nonpoint source pollutants flowing into Lake Tahoe.

By increasing the amount of stormwater infiltrated on private properties, this will also increase the effectiveness of County stormwater treatment systems, which are often overloaded by private-property runoff.

Common BMP treatments recommended for Brockway homeowners included driveway conveyance and infiltration systems to keep stormwater runoff on-site and rock armoring and vegetation to control soil erosion. Infiltration systems recommended typically were below-ground rock systems or above ground vegetated basins to remove nutrients, fine sediments and other pollutants from runoff before entering the lake.

The Brockway private and public parcel integration project provided outreach to 121 homes. 41% of homeowners agreed to participate by having a BMP evaluation to determine which BMPs were needed to meet Basin requirements, control soil erosion and infiltrate runoff. This high response rate from homeowners, combined with the project's overall success, has resulted in increased coordination between TRCD and local jurisdictions and continued outreach to homeowners.

Educating homeowners about the importance of infiltrating stormwater runoff before it enters public treatment systems and also the jurisdictions' efforts to treat stormwater runoff has created more of an incentive to install private parcel BMPs.

For more information: http://pastoreryan.com/projects or www.tahoercd.org

soils, bioretention systems may need to be combined with underdrains to intercept water that does not infiltrate into the soil and direct flow to a conventional stormwater conveyance or to a grass swale to achieve infiltration. Underdrains are perforated pipes usually covered with at least two inches of soil or gravel. In higher Sierra areas, underdrains should be placed below the frostline.

Filter Strips: Filter strips are flat sections of land covered with vegetation and designed to slow runoff that flows onto the strip from adjacent areas of impervious cover. Filter strips are meant to handle "sheet flow" – runoff that arrives in a wide sheet rather than a concentrated stream – and are often used in conjunction with other practices. For example, a filter strip may lead into a swale system or infiltration basin. A com-

This swale can capture runoff from the adjacent road. Some swales, like this one, are lined with rocks, while others are lined with vegetation and other media like mulches.

mon setback might serve as a filter strip to treat runoff from a parking area.

Local codes may present the biggest obstacle for implementing filter strips because setbacks are often not allowed to be used for drainage, and raised curbs are often required on the perimeter of parking areas.

Permeable Paving Surfaces: Permeable paving reduces runoff and allows on-site infiltration while providing stable, load-bearing surfaces. Permeable paving surfaces aren't appropriate at all sites. However, the variety of permeable paving materials available have proven to be successful in many locations. Especially appropriate for pervious surfaces are low-traffic areas such as driveways, parking stalls, walkways, emergency vehicle access ways, alleys and highway shoulders.

With proper installation and maintenance, pervious pavements can infiltrate up to 80% of annual runoff volume and remove more than 90% of sediment.

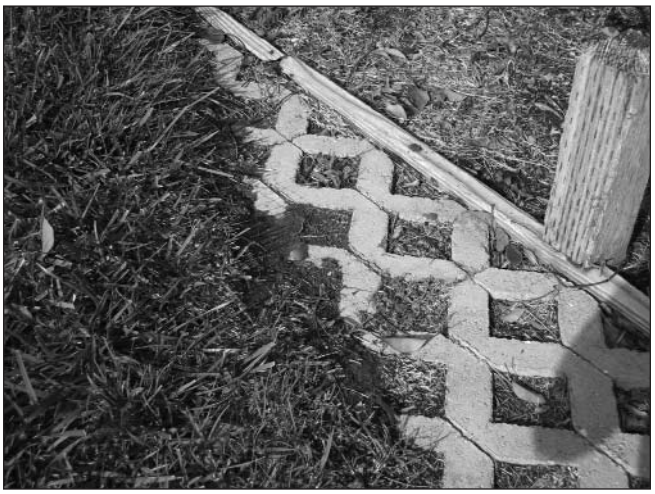
The winter climate of the high Sierra does not prevent use of pervious paving materials, but additional considerations are required to ensure long-term efficacy. Slope is another factor when evaluating whether pervious paving materials would suit a site. In general, pervious surfaces are not effective when the surface grade exceeds 5%.

Some of the most common permeable surface alternatives, generally applicable to Sierra conditions, are described below.

Turf Block: Turf block consists of a patchwork of turf interlaid within a precast latticework that provides structural integrity to support pedestrian and vehicular traffic. Open cells between a plastic lattice-structure are filled with a soil medium and seeded with grass. Water is able to pass through the resulting surface, which is quite literally a "green" hardscape. Maintenance requirements include mowing, fertilization, and irrigation. Porous turf is especially effective for overflow parking and emergency vehicle access.

Gravel Pavers: Gravel pavers are similar to turf block pavers in that they use a geometric support structure to keep the gravel in place and provide additional structural support. Most plastic geocell material is flexible so it can adapt well to shrink/swell soils and during freeze and thaw periods.

Stone or Block Pavers: Stone or block pavers are solid units of concrete, brick or stone laid side by side. They can bear traffic loads and are shaped to produce openings that are filled with porous aggregate or turf that allows for infiltration of stormwater.



Turf block can be an alternative to concrete or asphalt.

They have a long useable life, are relatively easy to install, and provide good infiltration. Stone and block pavers are sensitive to deformation and do require a thick base to prevent "heaving." In cold climates where areas need to be plowed for snow removal, blocks may catch on the shovel/snow plow and cause damage to the blocks and/or the plow.

Pervious Asphalt and Concrete: Pervious asphalt and concrete are similar materials that are evolving to meet a growing number of uses. Though they cannot bear the same loads, these materials look and act almost like normal pavement, except that they have tiny voids allowing infiltration. They can be used for parking stalls, walkways and along highway shoulders.

The surface areas do need to be cleaned two to four times a year to avoid clogging. However, research has found that even when clogged, pervious asphalt and concrete will infiltrate at rates near to or faster than most sands and soils.[5]

Using LID to Create "Green Streets:" As discussed in Chapter 3, complete and connected streets support more compact community form, reduce vehicle dependence, reduce impervious surfaces, and increase transportation options. Increasingly, complete and connected streets can also be designed to handle the very stormwater problems they create.

"Green street" approaches are gaining in popularity, and are being designed to manage runoff using landscaped systems that are also intended to improve the aesthetics of the streetscape.

Green streets incorporate a combination of several design attributes, including:

- ➢ Opportunities to minimize impervious cover, such as shared driveways, narrowed streets and clustered houses.

photo: Marsha Prillwitz

Parking spots with permeable pavement.

- ➢ Use of alternative paving materials.
- ➢ On-site natural assets such as roadside vegetation used as green infrastructure.
- ➢ On-street parking wherever feasible to reduce the need for large off-street surface lots.

City codes and ordinances are often obstacles to implementing complete and connected streets; they can also be barriers to incorporating green street design elements.

Two questions to ask when reviewing your city or county codes and ordinances for compatibility with elements of green street design include:

- ➢ What types of materials can be used for the full range of transportation infrastructure?
- ➢ How is erosion and stormwater addressed in the code? Is a specific erosion control ordinance referenced? Does it address street design?

How Overlay Zoning Can Be Used to Implement LID Techniques

Overlay zoning is a practice that establishes certain conditions for a specified area, as a means of protecting sensitive or valuable areas. In general, an overlay supersedes requirements in the underlying zoning, and sets conditions meant to achieve the overlay's objectives. Thus, a community wishing to prevent erosion impacts from development in a sensitive area could use a watershed overlay to require new development to implement LID site design techniques. This strategy is currently being vetted as part of a watershed overlay in Amador County.

Green Streets in the Pacific Northwest

Washington State Provides Guidelines for Water-Wise Roadways

The Washington State Department of Transportation's Highway Runoff Manual provides guidelines that the department, engineering consultants and many local agencies use to design stormwater systems for transportation projects. The manual includes guidelines for retrofitting and design guidance for several types of Best Management Practices, including LID techniques. It recently received an honorable mention in the Federal Highway Administration's 2007 Environmental Excellence Awards in the wetlands, watersheds and water quality category.

Download the manual: www.wsdot.wa.gov/Environment/WaterQuality/Runoff/HighwayRunoffManual.htm

Seattle Gets Edgy with Its Streets

Seattle is redesigning residential streets with natural drainage systems by replacing paved street edges with tree-planted vegetated swales, cascades and small wetland ponds. This allows stormwater to be absorbed into the ground instead of being channeled at high velocities with pollutants into local waterways.

One project in Seattle replaced a 660-foot block of conventional curbs and gutters with bioswales in the rights-of-way on both sides of the street and reduced the street width from 25 feet to 14 feet. These LID techniques resulted in cost savings of 29% for managing stormwater. By reducing the amount of street and sidewalk pavement, the techniques reduced paving costs by 49% and overall imperviousness by 18%.

Source: *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices,* U.S. EPA, December 2007.

Portland's Green Streets

Portland is a leader in using strategies that manage stormwater runoff while enhancing community livability. The City has developed and adopted a comprehensive "green street" approach for vegetated facilities to manage stormwater runoff at its source. Swales in curb extensions, in planters, along road edges, and in parking lots have been installed in numerous locations to reduce impervious surface, divert water from the sewer system and reduce polluted water entering the region's rivers and streams.

The designs also help reduce traffic, add urban green space, and improve pedestrian and bicycle safety. These and other design details are included in Portland's Stormwater Management Manual.

For more information: www.portlandonline.com/BES/index.cfm?c=44407

More Resources on Green Streets

Green Streets: Innovative Solutions for Stormwater and Stream Crossings (published by Metropolitan Council, 2003) is an illustrated handbook of stormwater management strategies and designs for most roadway types with trees, landscaped swales and special paving materials that allow infiltration and limit stormwater runoff. *Order a copy: www.planning.org/APAStore/Search/Default.aspx?p=2776*

Start at the Source – Design Guidance Manual for Stormwater Quality Protection (published by Stormwater Management Agencies Association, 1999) includes site design and landscape details for rural and urban streets, parking lots, driveways, buildings, landscapes and outdoor work areas. *Download: http://scvurppp-w2k.com/ basmaa_satsm.htm*

Green Streets in California

Sacramento Street Design Guidelines

Green streets in Davis, CA.

The City of Sacramento adopted street design standards for new streets of all types, from local residential to six-lane arterials. Following these standards, new streets will be narrower to calm traffic and create more walkable neighborhoods and commercial areas. The standards specify 30-foot local residential street widths and reduced travel lane widths on collectors and arterials.

All streets are required to have six-foot planter strips between the curb and sidewalk, creating a buffer between cars and pedestrians. The parkway strips also provide space for trees, upholding Sacramento's tradition of tree-lined streets.

For more information: Healthy Transportation Network. Safer Streets, Sidewalks and Trails. www.healthytransportation.net

City of Sacramento's Development Services, Resolutions and Ordinances: www.cityofsacramento.org/dsd/reference/resolutions%2Dand%2Dordinances

Chico Redesigns Roads to Reduce Erosion

Big Chico Creek Watershed Alliance partnered with the Big Chico Creek Ecological Reserve and the Butte County Resource Conservation District to redesign an existing gravel road to reduce the erosion of sediment into Big Chico Creek. The alliance also incorporated an outreach program to landowners in an attempt to educate the public on the importance of erosion control. It is also invested in a long-term project for developing a countywide program for dirt roads, including inventory, assessment and rehabilitation.

For more information: www.bigchicocreek.org

Green Streets for the City of Truckee

The City of Truckee plans to use Best Management Practices and LID strategies for its streets to minimize excessive paving and incorporate other techniques to help protect the water quality and quantity in creeks, lakes, natural drainages and groundwater basins.

Policy Language from Truckee's General Plan: "Utilize Low Impact Development and Best Management Practices established in the Regional Water Quality Control Board's Truckee River Hydrologic Unit Project Guidelines for Erosion Control, and the State of California Stormwater Best Management Practices Handbooks, and other resources such as the Practice of Low Impact Development (U.S. Department of Housing and Urban Development) and Water Quality Model Code and Guidebook (State of Oregon, Department of Land Conservation and Development) as guidelines for water quality and erosion control measures required by the Town."

Using these existing resources, Truckee plans to establish its own coverage limitations for paved areas to minimize excessive paving to avoid negative impacts to surface water runoff and groundwater recharge rates.

Policy Language from Truckee's General Plan: "Establish coverage limitations for impervious paved areas in new development, and encourage the use of permeable paving materials and other water quality management practices to minimize stormwater runoff and the loss of groundwater recharge from paving."

A rain barrel catches rooftop runoff.

Capture and Store Rainwater for Reuse: Rainwater is a precious resource, but once it hits the ground and becomes stormwater, we think of it as a nuisance. Capturing and storing rainwater runoff in cisterns or rain barrels is a simple means for reducing runoff while creating a new water supply for use in outdoor landscaping.

This is especially useful in the harsher weather conditions of the Sierra, where infrequent summer rains can provide much needed water for thirsty lawns and heavier fall storms can be captured and stored for later use.

Rain barrels are relatively low-cost devices that are placed below roof downspouts to capture roof-top runoff when it rains. Rain barrels serve two purposes: they retain runoff and capture water for reuse. Rain barrels range in cost from $60 to $135, which can be offset through water use savings for homeowners.

Cisterns are similar to rain barrels in that they provide dual stormwater and water conservation purposes, but they are larger. Cisterns have been used as water-capture and holding devices for centuries, particularly in areas where water is scarce.

A typical cistern will include a secure cover, a leaf and mosquito screen, a coarse inlet filter with clean-out valve, an overflow pipe, a manhole or access hatch, a drain for cleaning and an extraction system (tap or pump). Additional features might include a water-level indicator, a sediment trap or an additional tank for extra storage volume.

The biggest barriers to the use of cisterns to capture and reuse stormwater are initial costs for installation and the need for periodic maintenance and cleaning. Also, like greywater systems, cisterns require special design and maintenance considerations for the cold Sierra winter. Insulating or disconnecting the system, or locating it well below the frost line, are precautions that must be considered on a site-by-site basis.

Sierra Watershed Education Partnerships Team Up with Kids, Reduce Runoff at School

The Sierra Watershed Education Partnerships collaborated with engineers, scientists and children from the Tahoe Lake Elementary School in Tahoe City to create a “natural garden” to serve as an example for the students to learn about protecting water quality.

Pavement under the school’s roofline was ripped out and replaced with a planter bed containing native vegetation. Water running off the roof was directed to the native garden reducing the amount of runoff from the property.

The students were involved in all aspects of the project, including planting, maintenance and even mapping the school’s drainage patterns.

For more information, contact SWEP: (530) 525-9457, http://4swep.org

Strategy 3: Use Water-Wise Landscaping Practices

Californians use about 977 billion gallons of water for landscape irrigation each year. On average, more than half the water consumed in residential development goes to landscape irrigation. This is particularly true in the Sierra where dry summers require significant water to keep lawns and gardens green.

Landscaping affects both water quantities, in terms of the supplies needed for irrigation, and water quality, due to impacts of chemical fertilizers and pesticides that end up in runoff.

Our gardens and landscapes are important to our quality of life, but if not tailored to local conditions, they can have negative impacts to water quality and quantity. One of the most ubiquitous examples of a common front yard in California is a conventional "turf" lawn.

Lawns may be the largest "crop" in California, and a standard feature of typical suburban development. Incidentally, turf lawns are not indigenous to the state or the Sierra Nevada region. To survive in our highly variable climate, our lawns require an enormous amount of water as well as chemical fertilizers and pesticides.

Changing the common "lawn" culture of many Sierra residents involves not just asking residents to plan for a different kind of landscape, but helping them envision it by designing homes to accommodate alternative landscaping options.

Water-wise landscaping makes use of plants, soils, planting materials, irrigation technologies and other practices to increase water efficiency while providing a beautiful landscape. According to the California Urban Water Conservation Council, water-wise landscaping can reduce outdoor demand by up to 75%.[6]

Water-wise landscaping often selects for drought-tolerant and native plants. Because these plants are accustomed to local conditions they tend to require fewer or no pesticides and fertilizers, two significant contributors to water contamination.

Native and drought-tolerant plants also tend to be plant species that require little or no irrigation or mowing. Water-wise landscaping also has the benefit of reducing emissions from mowing equipment.

Lawn runoff isn't water-wise.

Cutting Residential Lawns in South Lake Tahoe

Lawns are the most water-thirsty option for residential landscaping. From an environmental perspective, lawns tend to be over-watered and over fertilized. Nonfunctional lawns – lawns that are rarely used – waste water and represent an ongoing cost in time and resources for the home or business owner.

As a rule of thumb, if you only walk on your lawn when you mow it, it's nonfunctional.

The South Tahoe Public Utility District's "Turf Buy Back Program" offers residential customers a cash rebate for reducing the amount of lawn area in their yards. The District has been awarded two State of California water conservation grants that allow for voluntary lawn buy-backs at $2 per square foot for customers who wish to replace their lawns with attractive, but less water-intensive, landscaping options. The incentive for lawns over 1,500 square feet is $1.50 per square foot.

Pre-conversion eligibility requires a minimum of 400 square feet of irrigated, maintained lawn to be removed. Landscape requirements for the converted area include water-efficient irrigation systems, surface treatments (mulch), a 50% living plant cover at maturity, and native/adapted plant selection.

For more information:
www.stpud.us/water_conservation.html

Comprehensive water-efficient landscaping programs combine outreach, appropriate incentives and policy measures to ensure that homeowners, developers, property managers, landscape professionals and neighborhood associations incorporate water efficiency into their landscaping practices.

■ Landscape Design: Hydrozoning

A well-designed landscape can greatly reduce water demand. Hydrozoning is a technique that groups plants according to their water needs. The layout can take advantage of shading and windbreaks to reduce evaporation and retain soil moisture. The timing and amount of water applied reflects the plant's actual needs, which reduces over-watering.

■ Native and Drought-Tolerant Plants Reduce Water Use

Communities can greatly reduce water use by encouraging the selection of native drought-tolerant plants that are adapted to dry-weather conditions and thrive in California's hot, dry summers. Not only do native plants require less water but they are also more resistant to disease and pests, reducing the need for chemical treatments.

While plants native to an area are often a great choice from a water use perspective, they may not meet preferred landscape aesthetics. A mix of natives and adapted-landscape plants can provide the desired mix for landscape aesthetic, as well as for rapid establishment, pollutant assimilation, and drought and saturation tolerance.

The planting materials used, and the way that they are prepared and maintained, also influence watering needs and infiltration rates. Mulching, for example, increases soil moisture and infiltration, so less water is needed.

For a guide to plant selection and irrigation in consideration of water needs: www.owue.water.ca.gov/landscape/faq/faq.cfm

■ Smart Sprinklers

Irrigation systems can play a significant role in how much water is used for outdoor watering needs. Irrigation also can affect water quality because runoff from over-watered lawns often carries high concentrations of fertilizers and pesticides. Several factors determine whether a sprinkler system increases or reduces the problem of over-watering:

- ➢ Schedule – Watering should only occur when needed and should take place at a time of day that minimizes evaporative loss.
- ➢ Quantity – To avoid over-watering, irrigation should apply only as much water is needed to satisfy the needs of the plants.

Preventing the Water Waster – South Tahoe Public Utility District Landscape Irrigation Restrictions

Water is a precious and finite resource in the Sierra. The South Tahoe Public Utility District implements a "Water the Right Day and the Right Way" Program. All of the district's drinking water sources are groundwater, with no water available from Lake Tahoe. Due to the inordinate cost of producing high-quality drinking water for landscape irrigation use, efficient irrigation proves crucial.

The district has established designated watering days to conserve water resources and minimize cost to the district and its customers. Even-numbered street addresses water only on Monday, Wednesday and Friday. Odd-numbered street addresses water only on Sunday, Tuesday and Thursday. Because of peak demands, there is no landscape irrigation on Saturday.

The district also stresses watering the right way, in addition to on the correct day. Before landscaping, the district recommends the property manager properly amend soils with organic material such as compost or planting mixtures. Properly amended soils will retain more water and require less fertilizer. Because Lake Tahoe basin soils are composed primarily of decomposed granite and have limited water holding capacity, only one-half to one inch of water per application is considered acceptable.

For more information: www.stpud.us/water_conservation.html

- ➢ Plant Type – Different plants have different needs. In a well-planned garden, plants can be arranged in a manner that allows watering to reflect those differences (hydrozoning).
- ➢ Precision and Leaks – Too many sprinklers literally miss the mark. Ensuring that the system is getting water to where it is needed (instead of on the sidewalk) is essential.
- ➢ Weather – Recent weather can affect how much water is needed. Irrigation is not needed when it is raining.

Though many people are familiar with sprinkler conservation concepts, many traditional sprinkler systems make compliance with these principles a job that requires time and effort. Fortunately, new automatic irrigation technologies do much of the "thinking" for

Mariposa County Encourages the Use of Natives…

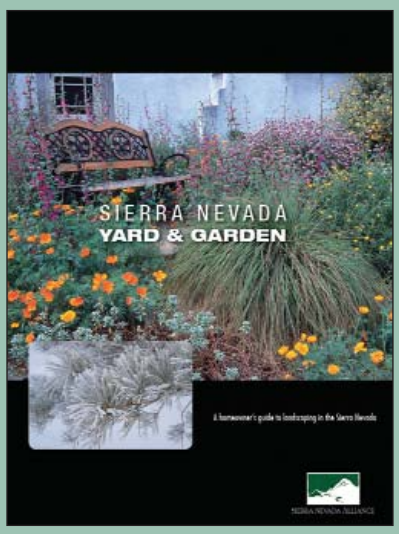
Investing in outreach is investing in water savings. Mariposa County encourages the use of low-water-using natives to help conserve water and thus decrease the need for water delivery, treatment, infrastructure and management.

Policy Language from the Mariposa County General Plan: "The County shall publish landscaping guidelines for the use of site-appropriate native plant species."

…and Water Conservation

Mariposa County made water conservation a goal and includes language in the general plan to encourage water conservation by setting forth specific standards for new development.

Policy Language from the Mariposa County General Plan: "Implement standards for water conservation that are consistent with State guidelines, including requirements for the installation and use of low-flow plumbing fixtures in all new construction, and for the use of drip irrigation systems and drought-tolerant or low water using landscaping (including retention of existing native plant material) in all multi-family, commercial, resort, industrial and public developments."



Sierra Nevada Alliance's *Sierra Nevada Yard and Garden Guide* Links Landscaping Decisions to Water Conservation, Defensible Space and More

The Sierra Nevada Alliance recently published a guide to gardening and landscaping with conservation in mind. With assistance from the Sierra Nevada Conservancy, the California Association of Resource Conservation Districts and the University of Nevada Cooperative Extension Service, the guide uses an integrated approach to bring together water quality and conservation, native and adapted vegetation, healthy soil, wildlife and fire defensible space into yards and gardens. Benefits of adhering to the guide's recommendations include: observing and getting to know the Sierra in your own backyard; a low-maintenance landscape; and knowing that your land is working in-step with the surrounding environment. This integrated approach provides a powerful tool for conservation organizations and Sierra Nevada residents to reduce nonpoint source pollution, conserve water, incorporate native plants, help animals live in harmony with people, and better protect homes from wildfire.

For a copy: info@sierranevadaalliance.org or call (530) 542-4546

Harlan Ranch Gets Water-Wise with Smart Irrigation Systems

Harlan Ranch is a new residential development being built in Clovis, CA, that is using a variety of water conservation practices to reduce water demands for outdoor landscaping.

Conserving water was a project goal from the start. Recycled water provided by the City of Clovis will be used for irrigation to decrease the dependency on potable water for landscaping. The state-of-the-art irrigation system is controlled by a central satellite system and uses pressure-regulated sprinklers and other water saving devices.

For more information: Glenn Bowlin CID, CIC, CLIA, CGIA, Broussard Associates, (559) 325-7284 x312

photo: Nevada Tahoe Resource Conservation District

Spray hoses and soaker hoses are two examples of water-efficient irrigation.

us. Unlike conventional systems that apply water arbitrarily, these systems are designed to provide water based on current conditions and the actual needs of the plants.

Using sensors that can evaluate soil moisture, temperature and weather, and even "evapotranspiration" rates, the systems irrigate based on how much water plants actually need. Smart irrigation technology solves the water quantity and quality problems of over-watering, and makes landscape maintenance easier for residents.

Strategy 4: Install Water-Efficient Technology

California's Water Code Section 375 allows any public entity that supplies water to adopt and enforce a water conservation program that requires installation of water saving devices. Existing conservation technologies include low-flow toilets and showerheads, efficient clothes washers, weather-based irrigation controllers, and more efficient commercial and industrial cooling equipment.

Converting to water-efficient toilets, showers and clothes washers results in household water savings of about 30% compared to conventional fixtures. High-

efficiency toilets alone reduce indoor water use in a household by an average of 16%. This translates into a savings of 15,000 to 20,000 gallons of water per year for a family of four.[7]

More efficient plumbing products also result in lower wastewater flow and increase the available capacity of sewage treatment plants and on-site wastewater disposal systems.

To encourage implementation of such water-efficient plumbing, cities and counties can work with water agencies to incorporate water-saving devices into new and existing development. Local governments can also work with water suppliers to develop incentives, rebates and outreach programs to help residents, property managers and developers incorporate more efficient technologies into their homes and projects.

Another option is to mandate implementation through local codes that require new development to include efficient toilets, shower and faucet heads, washing machines and other technologies. For existing development, simple upgrades can be required so that homes are retrofitted with more efficient appliances and plumbing at the time of sale.

Conclusion

The site-level design details of a home, neighborhood, subdivision or commercial building can make a big difference in how much the structure impacts water resources. Planning new development with consideration for the natural infrastructure of a site is an obvious first step, however, even existing buildings have the potential to implement site design practices that can improve water infiltration, drainage and water use efficiency.

Site-level design, combined with appropriate location decisions and achieving compact community form, goes a long way towards improving and protecting our community water resources.

At the same time, land use planning to achieve these strategies requires improved coordination among land use planning departments and water and wastewater agencies. Water conservation and efficiency programs and integrated wastewater management are programs often led by water and wastewater agencies. The next chapter explores the challenges these agencies face and the opportunities for increased coordination to protect Sierra waters.

Chapter 5.

Policy Choices at the Intersection of Water, Wastewater and Land Use

Major challenges to water management include reliability of supplies, increasing demand, outdated and failing infrastructure, and the disconnect between land use planning and water and wastewater agencies. This chapter suggests strategies to address and overcome such challenges. Principal strategies include improving coordination between land use planning agencies and water and wastewater agencies; implementing water conservation and efficiency programs – including water reuse and recycling; and integrated wastewater management practices.

These strategies offer environmentally friendly solutions to some of our water supply and water quality concerns because their implementation does not require drastic measures such as redirecting surface water from streams and rivers, building new reservoirs, or enlarging or draining existing reservoirs.

photo: Rick Knepps

Mono Lake suffered dramatic environmental damage when the Los Angeles Department of Water and Power began diverting its tributary streams to the greater Los Angeles area.

Water Supply, Demand and Other Management Challenges

Most of the water stored and flowing through the Sierra is surface water in the form of rivers, lakes and streams, and this surface water supplies nearly 70% of water used for domestic needs in the region. However, since this surface water is also the main water supply for the rest of California, much of the water originating in the Sierra is not available for use here.

Prior water rights appropriations for downstream or out-of-basin users demand a large portion of the surface water collected in the Sierra. For example, the Upper Mokelumne and Tuolumne River watersheds provide water supplies for large Bay Area cities like San Francisco and Oakland, and much of the water collected in the Owens Valley watershed supports the water needs of the greater Los Angeles area.

Water supplies also vary seasonally and from year to year, depending on precipitation, snow pack and corresponding runoff. Overall, despite a relative abundance of supplies, many unincorporated areas in the Sierra are dependent on small, independent municipal water systems, and some areas still rely on untreated water diverted from ditch systems that are supplemented by bottled water.[1]

High Sierra Development in Need of Water

One proposed project that highlights many concerns familiar to Sierra residents is a new resort development proposed for Donner Summit that would include 1,000 new housing units, an unknown number of hotel rooms and time shares, two new lakes, ski runs and lifts, new roads, four new commercial centers, and other new buildings and infrastructure. The development plan would also require dredging and draining water from nearby lakes (Serene Lakes) to fill the two new lakes, and raising the dam at another lake.

Located at approximately 7,200 feet on the crest of the Sierra Nevada, Donner Summit is known for its spectacular views and recreational opportunities. The region includes the headwaters of the North Fork American, Truckee, and South Yuba rivers as well as pristine old-growth forest habitat. Outdoor enthusiasts and tourists frequent the region each year.

Development proponents have not yet addressed key issues related to water and wastewater infrastructure or the impacts on water supply and quality.

Water is a scarce commodity at the crest of the Sierra, and a water source for the proposed homes, hotels, commercial centers and snowmaking has not been identified. Drilling wells to tap into groundwater supplies is one option but due to the Sierra's unique geomorphology, most of the available groundwater at the summit is contained in fractured bedrock. This makes groundwater supplies hard to locate. It also casts doubt as to long-term sustainability of the potential supply since some studies show that fractured rock water aquifers are being drained much more quickly than they are being recharged.

Adding to the infrastructure dilemma are wastewater concerns. Wastewater treatment facilities in the area are close to their maximum capacity. The developer will therefore have to either build another wastewater treatment center or help local wastewater agencies expand their current facilities. Another concern is the discharge of treated effluent. The developer's original plan was to release treated wastewater into the South Yuba River. However, existing sewage treatment facilities already discharge the maximum amount of treated effluent allowed into the Yuba during the winter. Therefore, the developer will have to look at other alternatives such as building a holding tank or creating underground detention areas.

For more information: www.sierrawatch.org Conservation Campaigns, Donner Summit

Groundwater is the other important source of Sierra water, and the use of private wells is widespread in places that lack water service. Groundwater is defined as water located beneath the earth's surface and found in geologic formations called aquifers, which are capable of storing, receiving and transmitting water.

Due to the Sierra's unique geomorphology, most of the available groundwater in the foothill and mountain areas is contained in the underlying fractured rock geology. The capacity of the Sierra foothill and mountain area to store groundwater is on average 10 times less than the capacity of the valley aquifer to store water. In general, aquifers found in the Sierra are not as dependable or sustainable as other water sources because they are slow to recharge, hard to locate and difficult to model in regard to quantity or sustainable water yield.

The use of groundwater is almost always unregulated – so it is unclear what effect the increasing number of individual wells is having on the region's supplies as a whole. Some studies indicate that groundwater supplies are becoming increasingly strained. A 2005 study of well depths over time in eastern Fresno County found that, in the three areas chosen for the study, well depths have doubled from approximately 250 feet to 500-plus feet since 1975.

Water directors from Calaveras County have also expressed concern over depleting groundwater supplies and believe local groundwater systems are being drawn down due to pumping in the Central Valley below.

Water and sewer infrastructure pose additional concerns to water quality and supply. Even in areas with abundant supplies, water and sewer infrastructure is often

deficient or non-existent. Many areas depend on small, independent and isolated municipal water and sewer agencies, which individually lack the technical or financial capacity to upgrade their treatment facilities and infrastructure. Unfortunately, they are often not able to (or chose not to) consolidate to take financial advantage of a larger customer base that could enable needed repairs.

Outdated and unconsolidated water supply and wastewater treatment systems contribute to disorganized patterns of growth in the region. Additional growth will not only place greater demand on water supplies for use within the Sierra, but will also increase strain on water and wastewater infrastructure, creating additional challenges to protecting water quality. Problems such as malfunctioning septic systems that leak pollutants into local waterways and groundwater supplies also impact Sierra water resources.

Combined, these and other issues present numerous challenges to water management that are only compounded in light of current growth trends and development patterns. Fortunately, there are common-sense, economically feasible and environmentally responsible steps that local governments, developers, water agencies, non-profit organizations and the community as a whole can take to use water more efficiently, protect existing supplies, and promote locally reliable sources of water for the future.

■ Sustainable Options for Increasing and Diversifying Local Water Supply

Many parts of California are approaching the limits of their water supply resources. As population increases and the impacts of global warming begin to be tabulated, there is no doubt that at present levels of per capita demand existing water supplies and means of distribution will not be sufficient to meet future demands.

Traditional ways to increase water supplies have relied heavily on development of large surface storage and conveyance systems. These systems are essential to the state's water system, but come with many economic and environmental costs. Alternatives include water recycling, grey water re-use, simple conservation strategies, water transfers and groundwater aquifer recharge injections, among others.

Data indicate that dramatic savings of water can be achieved by implementing simple conservation measures. In *Waste Not Want Not*, a 2005 report by the Pacific Institute, researchers found up to one-third of California's urban water use can be saved at costs below what it will cost to tap into new sources of supply. The report concluded that: "The potential for conservation and efficiency improvements in California is so large that even when the expected growth in the state's population and economy is taken into account, no new water-supply dams or reservoirs are needed in the coming decades."

All water sources have impacts and consequences. As California continues to grow, it is imperative to make sound choices about where and how we receive our water based on community preferences and understanding of the associated impacts. For most Sierra communities, increased efficiency is the "low-hanging fruit" for meeting future needs. It is less expensive and much faster to implement than water storage projects that offer a short-term fix to the eternal problem of water security.

Water and Wastewater Agency Strategies for Improving Water Use Efficiency

Explored below are three alternative practices for increasing water efficiency: water efficient pricing, wastewater recycling and grey water re-use. These practices offer a more sustainable alternative to traditional approaches for developing new, locally reliable sources of water with multiple benefits and fewer environmental costs.

■ Strategy 1: Water-Efficient Pricing and Rate Structures – Charge for the True Costs of Water Service

The rates charged for water service can have a big impact on water usage and development patterns. Water rates can be a sensitive subject – all utilities are under pressure to keep rates low and affordable for their customers. Rates that do not reflect the true costs of different consumer choices can promote inefficient water use and development practices, and penalize certain customers for less-efficient choices and practices of others.

Most water utilities do not set rates that capture the true costs of providing service or reflect the impacts that development types or consumer conservation

choices have on overall costs and water-usage.[2] Rate structures can be designed to account for variability in costs and consumption that result from different development locations and consumer conservation practices.

Customers typically pay for water in two ways – through hookup or connection fees, and through use charges. Uniform or "flat" connection fees and use charges do not recognize the influence that development location and density have on service costs.

Users in compact, centrally located development subsidize the costs of extending service to customers in suburban development on the community fringe. Ultimately, this creates a subsidy for more dispersed development patterns and surcharge on more efficient development. When everyone pays the same rate, there is no incentive to locate in an area that is easier or less expensive to service. Conversely, connection fees can be structured to reflect variables like the distance of the connection from the treatment station, or lot size, which more accurately reflect costs for providing service to different development types.

Conservation Pricing: Volume water rates can be configured to encourage less water consumption and more accurately reflect the value of water and costs of securing, treating and delivering it to customers. Uniform use rates charge the same amount regardless of the level of consumption, meaning that a customer using water-wise landscaping and efficient indoor appliances, and who practices conservation (e.g., turns water off while shaving) will be charged the same monthly fee as a customer who does none of those things and uses far more water.

Alternatively, "block pricing" applies variable rates depending on the amount of water used. Tiered block rates charge incrementally higher rates as consumption increases. The lowest rate or "base rate" covers an initial volume of water deemed reasonable for basic household needs. The base rate increases with surcharges on additional "blocks" (e.g., at 2,500 gallon increments) of water used.

Block rates can be a highly effective way to encourage conservation while covering costs of service provision. Block rate structures can also increase revenue for water agencies as they reflect costs more accurately – those who cost more to serve pay more for service.

Zone Pricing: Another way to account for true costs and assess fair rates is to base rates on the actual costs of service provision. While uniform rate structures spread costs evenly without regard for differences in delivery costs related to development location, zone pricing sets rates in different zones based on variables such as distance, pressure zones or lot size.

A zone structure can be relatively simple – it can be based on costs and lengths of transmission lines and energy needed for delivery so that further out development pays incrementally more than development that is centrally located in existing communities. Zones can also reflect general plan land use designations to account for cost variability related to density. Lower density areas cost more to serve and consume more water than higher density areas. Thus, pricing can be linked to zoning districts.

Mariposa County Supports Water Recycling

Reusing wastewater allows Mariposa County to get more out of its water supply by making the water serve double duty. Water is used more efficiently if it can serve more than one use before it is discarded and returned to wastewater facilities.

Policy Language from the Mariposa County General Plan:

"Cooperate with the Mariposa Public Utility District and other wastewater generators in implementing programs for reuse of treated wastewater."

■ Strategy 2: Maximize Water Recycling

Wastewater management is one of the great challenges for local governments, water managers, environmental health professionals and water quality regulators. However, many communities and water purveyors are starting to realize that wastewater is an important and often overlooked supply resource.

Wastewater systems can treat effluent to a degree that it can be reused for needs such as irrigation or fire-fighting. This practice, called "water recycling," is a means of developing a locally reliable source of water and reducing wastewater discharges. Water recycling encompasses the collection, treatment, storage, distribution and reuse of municipal wastewater. It involves

photo: Marsha Prillwitz

Purple water faucets and water tanks alert users that this water is recycled.

reclaiming, treating and reusing highly treated wastewater for a variety of purposes.

Uses of recycled water may include, but are not limited to, commercial landscape irrigation, residential or multi-family dual-plumbed landscape irrigation, construction water, cemeteries, industrial process water, golf courses and car washes.

Recycled water has actually been used in California since the 1800s, but it has only been in recent decades that a dramatic surge in interest, coupled with improved treatment technologies, has enabled widespread use of recycled water. As communities develop their capacity to treat and reuse wastewater, the very idea of wastewater is becoming obsolete – what was once a waste is now a key resource. Some of the benefits and characteristics of recycled water include:

Augmentation of Local Supplies: Recycling existing water supplies creates a new supply source to diversify a region's water supply portfolio.

Matching Water Quality to End Use: Use of recycled water is based on an understanding that not all water demands require the same quality of water. While drinking water needs to be high quality, only a fraction of domestic water is for used drinking. California Water Code Section 13550-13556 states that the use of potable domestic water for non-potable uses, including cemeteries, golf courses, parks, industrial and residential irrigation uses, and toilet flushing is an unreasonable use of water if recycled water is available.

Reduced Effluent Discharge: Potential water quality benefits can accrue from reuse of recycled water because the amount of effluent discharged to local waterways is reduced. It is important to note that, from an ecosystem standpoint, reduced discharge – if it is relatively clean – is not always considered positive. For areas subject to frequent flooding, reduced instream flow may be a benefit. However, in areas where wastewater discharge provides a significant portion of a stream's volume, the reduced flow may be detrimental to stream health.

How Much Water Can We Recycle?

California generates about five million-acre feet of municipal wastewater annually. Currently, 500,000 acre-feet of recycled water are being used in the state. An acre-foot is roughly enough to cover a football field with one foot of water or the amount needed by a single family for one year.

According to the California Recycled Water Task Force, California has the potential to recycle up to 1.5 million acre-feet per year, saving enough potable water to satisfy the needs of 1.5 million homes annually.

photo: Marsha Prillwitz

Purple signs alert visitors not to drink this reclaimed water.

Water Safety: Recycled water is safe. In the U.S., there has never been a documented case of illness or public health effect related to the use of recycled water that meets established standards.[3] The California Department of Health Services and the Regional Water Quality Control Boards regulate the use of recycled water. Each use of recycled water must have a permit from the local authority administering the recycled water program, which has the responsibility of enforcing the rules and regulations.

Sierra Communities Explore Water Recycling

The El Dorado Irrigation District is investigating construction of up to 5,000 acre-feet of seasonal storage to more efficiently use recycled water in the district. The storage would allow for meeting recycled water demands, without supplemental water or shortages, through 2025.

The City of Auburn is developing a proposal to sell up to 5,000 acre-feet of recycled water to agricultural users by 2020. The water is expected to be delivered near Lincoln, on the valley floor. This option is included in the Sacramento River Region management plan.

In Calaveras County, the City of Angels Camp is developing plans to expand its reclaimed water deliveries by 300 acre-feet to agricultural, environmental and landscape users by 2020.

Though highly treated and safe to use, recycled water is considered non-potable. A dual-plumbing system of purple-colored pipes, valves and other equipment is used to distinguish fresh and reclaimed systems, and to prevent the unintentional misuse of recycled water or cross-connection with the potable water system. California's regulations and guidelines, some of the most stringent in the world, have been developed to address public health concerns with potential misuse. State law prohibits a connection between the recycled water and the potable water systems. Tests are conducted before connecting new sites to recycled water supplies to ensure this does not happen.

Costs of water recycling vary greatly by locality and depend upon factors such as the demand for reclaimed water, intended uses, proximity of a recycling facility, quality of wastewater and the level of treatment needed, availability and capacity of a distribution network, and reasonable applications (uses) for the recycled water.

Recycling existing water supplies creates a new source to diversify a region's water supply portfolio. Currently, surface water provides a majority of local supplies in the Sierra. Where groundwater is not a viable option, recycled water is a means of increasing and diversifying local supplies.

■ Strategy 3: Use Your Greywater

Greywater is any water that has been used in the home, except water from toilets. Greywater reuse entails the capture and reuse of household water for landscaping or to infiltrate into the ground. Because greywater typically comprises 50% to 80% of residential wastewater, reusing greywater reduces strain on wastewater infrastructure and can completely or partially replace the need for irrigating with fresh water from municipal systems or wells.

Greywater irrigation is an old practice, used all over the world in areas where water is in short supply. Reusing greywater is different than wastewater recycling in that greywater does not involve treating sewage (which wastewater recycling does) and is usually associated with actions on a per unit or per site basis, as opposed to on a municipal scale. State law permits cities and counties to allow the sanitary reuse of greywater. (See Section 14875-14877.3 of the California Water Code.)

Lake County General Plan's Water Resources Element (Draft)

Lake County recently developed a Water Resources Element for its General Plan. The General Plan is in the process of environmental review and has not yet been adopted. The plan's Environmental Impact Report was released in March 2008. The Water Resources Element provides several sound water management policies. A selection of them are included here.

Goal: "Encourage efficient use of water for new and existing land uses."

Policy: "Water Use Efficiency for New and Existing Development

The County shall encourage the use of water conservation techniques appropriate for new and existing development. Such techniques include, but are not limited to: requiring low-flow fixtures on new construction, the use of high efficiency irrigation systems, the integration of stormwater runoff into passive groundwater recharge, the use when feasible of reclaimed water resources for reasonable and beneficial use, and the use of vegetation types which use less water."

Policy: "Water Use Efficiency for Agricultural Uses

The County shall encourage the use of agricultural and forest resources management practices that result in the efficient use of water resources. Those practices include but are not limited to: drip and micro drip irrigation systems and appropriate forest thinning. The County will also encourage agricultural and forest resource operators/managers to participate in watershed management and restoration efforts."

Policy: "Efficient Use of Water Supplies

The County shall promote efficient use of surface and groundwater resources to maintain a supply for all reasonable and beneficial uses within the County that is affordable and reasonable to the type of use of the water supply, and shall take appropriate measures to discourage unreasonable use and waste in the issuance of discretionary entitlements."

To read the entire Water Resources Element in the Lake County General Plan: *www.co.lake.ca.us/Government/DepartmentDirectory/Community_Development/2008_General_Plan_Draft_Documents.htm*

Efficient use of greywater requires installation of a greywater system. A greywater system collects and filters greywater to a point where it can be used on site for landscaping purposes. Greywater systems require specific design criteria, particularly in many parts of the Sierra where cold climate and variable soils make certain sites less suitable than others.

In principle, the systems are quite simple – they involve diverting greywater, allowing it to filter though a soil or sand medium, and storing it for later use or applying it to landscaping.

In cold climates, the filtering system must be sited below the frost line, or simply not used during the winter.

A Historical Disconnect Between Water Supply and Land Use Planning

Water agencies and local governments share the burden of ensuring the delivery and reliability of local water supplies. Unfortunately, the two groups typically do not integrate their planning efforts, despite the critical connections between them. More often than not, county and city planning departments do not engage water agencies until the environmental review portion of the land planning process, and many times that is only to comply with state legislation requiring verification of water supplies for certain development projects.

A related problem is that there are often disincentives to conservation and institutional barriers to regional coordination. Western water law still operates under a "use it or lose it" management regime. This system, based on the doctrine of prior appropriation, or "first in time – first in right," gives senior water users first priority to water rights as long as they show "beneficial use" of that right. This compels water agencies to prove (use) their water rights to ensure that they do not lose them and thus creates a barrier to conservation.

The lack of coordination between water agencies and land use agencies can lead to the approval of development projects that lack water to meet projected needs. Other results of this disconnect are development projects that require excessive amounts of water because they are not designed for the environment in which they are placed.

Show Me the Water Laws

On a statewide level initial steps have been taken to realign water with land use decisions. Two laws approved in 2001 attempt to increase coordination between water and land use agencies and ensure water supplies are considered in land use planning decisions.

Senate Bill 221 (Government Code Section 66473.7) requires a city or county to provide written verification of sufficient water supplies by the water agency for proposed development projects above certain size thresholds (above 500 units or more). A sufficient supply is defined as enough to meet the needs of the proposed development project in normal years as well as during a drought. Approval of the subdivision map or parcel map is prohibited until such supplies are documented. Meeting the terms of SB 221 is solely the responsibility of the city or county, even though it is the water agency that documents the availability of water for the new project.

Senate Bill 610 (Water Code Section 10910-10915) requires a water supply assessment to be included in the Environmental Impact Report for projects

Recent State Supreme Court Decision Makes Cities Responsible for Proving Adequate Water for New Development Projects

Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova

In 2007, the California Supreme Court issued an important ruling on the responsibility of cities to prove there will be adequate water supplies for new developments before projects are approved. The case was brought against the Sunrise Douglas project, which would develop 22,000 homes on 6,000 acres in Rancho Cordova. The plaintiffs argued that the Environmental Impact Report (EIR) for the Sunrise Douglas project failed to prove the sufficiency of long-term water supply or disclose the foreseeable environmental impacts of the development. The court agreed with the plaintiffs and stated that an EIR must recognize the degree of uncertainty concerning water supply, suggest alternative water sources, and provide the environmental impacts of each alternative.

The *Vineyard* ruling has important implications for coordinated water and land planning: it clarifies the information a city must include and prepare in the water analysis portion of its environmental review documents for new developments, which may up the ante for integrating water into local planning processes.

For more information: http://blog.aklandlaw.com/A&K%20Events%202007.pdf

large enough to trigger the law and thus provides the administrative process for implementing SB 221.

These two bills, often referred as the "show me the water" laws, make cities and counties responsible for ensuring adequate water supplies are available to meet the demands of new development prior to approving larger projects. They also compel increased coordination between water agencies and land use agencies to ensure that water supply verification and assessments are completed within the 90-day time frame required in the legislation.

The "show me the water" laws take an important step towards coordinated resource management, but there has been concern that the thresholds triggering the legislation (projects over 500 units) are too high for most of the Sierra. Upcoming legislation may change the current provisions of the law and lower the thresholds.

Another consequence of the "show me the water laws" is the creation of an incentive for designing water efficiency into new projects. The realization by local governments and the development industry that water conservation practices can assist with project approval has led to increased interest in strategies such as water recycling and efficient irrigation technology.

For example, developers of the Serrano project, a large master-planned development in Placer County, decided to use recycled water for irrigation on lawns, golf courses, common areas and other landscaping to lower the water-demand projections for the project.

Similarly, water conservation may be the easiest way to meet the water needs of new development in areas that lack sufficient supplies.

Strategies for Improving Coordination between Land Use Planning and Water Agencies

Strategy 1: Integrate Water Data into Land Use Planning Documents

Planners can incorporate water supply and demand analysis into general plans and specific plans. This is best achieved during the initial development or with significant amendments of the land use map. In their seminal guide on water and land use,[4] Jeff Loux and Karen Johnson outline the following steps:

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

Up-to-date and technically sound Urban Water Management Plans, Water Master Plans or other integrated water planning documents will provide needed data for analysis, making coordination with planning documents easier. In communities where these water planning documents do not exist, purveyors will need to do more research and analysis. In either case, integrating water planning data into land use planning documents can streamline procedures for complying with the state's "show me the water" laws.

State Support for Integration and Regional Planning: Recognizing both the importance and the challenge, the California Department of Water Resources has initiated funding incentives for "Integrated Regional Water Management" (IRWM) planning and projects. This program is funded though voter-approved bonds (Propositions 50 and 84) to provide a reliable water supply and preserve water quality. The bond money provides grants for local projects if they are part of a collaborative regional planning effort.

The incentive to coordinate through IRWM programs may be the best tool available for local governments to plan future projects with water suppliers and develop mutually beneficial strategies. Ultimately, the program is helping to usher in a watershed-based framework to everyday water and land use decisions. The reasons for the State's increasing emphasis on integrated water management are because it:

- ➢ Makes better use of existing local resources.
- ➢ Provides for coordination and improved efficiency and flexibility in the actions of local agencies and governments within a region.
- ➢ Integrates all aspects of water management, including water quality and local surface water.

- ➢ Supports groundwater monitoring, water conservation, recycled water, conveyance, ecosystem restoration and imported supplies.
- ➢ Reflects regional diversity and values when setting management objectives. (From the 2005 California Water Plan Update)

There are many organizations and agencies that offer support to communities interested in developing IRWM plans and projects, including the Sierra Nevada Alliance. For more information: www.sierranevadaalliance.org/programs/program.shtml?type=pgm09

■ Strategy 2: Integrate Land Use Data into Water Planning

Just as land use agencies should account for water in their planning efforts, water agencies should incorporate land use data into analysis and planning of future water demands. Different types of land use and development have differing implications for water demand.

One of the best methods of forecasting future water demands is to use land use based analysis, which is more accurate and defensible than simply relying on population-based projections or socioeconomic modeling because it recognizes the association between water usage and various patterns and forms of development.[3]

Moreover, using a land us-based method for projecting future water demands enables simpler integration with land use planning documents. One example of land use planning being incorporated into water planning comes from arid Santa Fe, NM, where a water budget was developed that limits the annual increase in water demand from new development.

Wastewater Infrastructure and Development

Wastewater is sewage (either treated or untreated) from residential, commercial, industrial, and institutional sources. Major pollutants found in wastewater include ammonia, organic matter, nutrients, pathogens, metals and suspended solids. Untreated, wastewater poses numerous threats to public health and the environment, especially when it enters drinking water supplies, as it sometimes does when wastewater treatment systems, such as individual septic tanks, fail.

All new development requires a system for handling wastewater. Decisions about where and when to expand or construct new wastewater treatment facilities affect where it is possible to develop. Decisions about where and how to grow affect the capacity of and need for wastewater infrastructure.

■ State Water Quality Regulations

The State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards perform the primary regulatory functions related to water quality, including issuance of wastewater discharge permits; other programs on stormwater runoff; and underground and above-ground storage tanks.

California is currently drafting new requirements for on-site systems that will set higher minimum standards requiring system inspections at least once every five years.

Wastewater Treatment – Title 22 Standards: Title 22, a section of the California State Water Code, requires filtration of any reclaimed effluent used for full-body contact recreation or fresh food crop irrigation when the receiving water dilution is less than 20-to-1. Title 22 requires lesser levels of treatment for other uses of reclaimed effluent.

LAFCo: Local Agency Formation Commissions (LAFCos) play an increasingly important role in facilitating coordination of wastewater planning and land use planning. LAFCos are required to conduct municipal service reviews before an agency can update its sphere of influence.

■ The Infrastructure Challenge

Many rural communities in the Sierra face grave infrastructure challenges. In many cases, numerous, uncoordinated wastewater agencies provide service to relatively small community areas. In many of these areas, there is not a sufficient customer base to support, or economies of scale to generate, adequate resources to maintain, fix and upgrade existing sewer infrastructure. When there is inadequate capacity to serve growth within a wastewater agency's service area, that growth may be pushed into more remote areas, thereby encouraging the kind of low-density sprawling development pattern that threatens watershed health, water quality and water reliability.

Federal money for central sewer systems, the construction of which was heavily subsidized in the 1960s and 1970s, has largely disappeared since the 1980s. This leaves many small communities and wastewater

agencies scrambling to secure resources to fix and upgrade outdated infrastructure or to rely on aging septic systems for wastewater treatment.[5]

Wastewater management, including collection, treatment, disposal and associated infrastructure is essential to development, but land use planners are rarely involved in deciding where and how a community's wastewater treatment will take place.

The relationship between growth and wastewater planning and management is such that wastewater influences development patterns. This in turn influences wastewater treatment options and infrastructure demands for an area, ultimately impacting development options. Too often these connections are not made during local-level planning.

photo: South Tahoe Public Utility District

A centralized wastewater treatment plant in the High Sierra.

Types of Wastewater Treatment

There are two main types of wastewater treatment, centralized sewer systems and decentralized or "on-site" treatment systems. The aim of both is to treat the wastewater sufficiently to protect water quality while removing the wastewater from the community. Centralized systems utilize a vast system of collection sewers, pumping stations and treatment plants to collect wastewater from homes, businesses and many industries, and deliver it to plants for treatment. Generally, a wastewater treatment facility will treat sewage to a sufficient level to either be discharged to a local waterway or to be reused.

Decentralized systems are not connected to a central sewer system. Some use various means to treat wastewater on-site, or near the development that it comes from. Thus, many decentralized systems are referred to as "on-site wastewater treatment systems." These include traditional septic-leech field systems as well as a range of other engineered solutions, some of which can be shared between multiple residences. These systems offer flexibility and, if properly used, can support efficient development patterns. However, when not planned and managed well, they can spur inefficient development patterns in unsuitable areas.

It is important to look at ways that decentralized systems can be used to manage wastewater while supporting broader planning goals because the reality of current growth patterns is that much development is occurring in areas without sewers or in areas that have a sewer infrastructure that has no capacity to accommodate additional growth.

Problems with On-site Wastewater Treatment

Decentralized wastewater treatment systems use natural and/or mechanical means to collect, treat, and discharge or reclaim wastewater from single homes or groups of homes and businesses that are close together. The majority of decentralized wastewater systems are on-site septic systems using a septic tank and drainfield located on the property.

Many areas of the Sierra do not have adequate wastewater infrastructure, yet are under significant development pressure. Development in those areas usually utilizes "on-site" septic systems since the costs of

Sonora's General Plan Encourages New Development to Connect to Public Sewers

The City of Sonora encourages new development to connect to the public sewer system to avoid harmful and costly impacts associated with potentially leaky private systems.

Policy Language from Sonora's General Plan:

"Require connections to public sewer for new development where reasonably available or where potential harmful area-wide impacts to groundwater exist based on known hazards as a result of outdated private systems."

photos: Marsha Prillwitz

Constructed treatment wetlands, such as the one shown in these photos, can clean water and support wildlife.

extending infrastructure to areas that are far from community centers is prohibitively expensive. This can result in water quality problems because the site characteristics of many parts of the Sierra often preclude proper function of conventional septic systems, or those systems are simply not well-designed or maintained and they fail.

When a septic system fails, both ground and surface water may be impaired leading to watershed impacts and public health and safety concerns. For example, according to the Upper Mokelumne River Watershed Management Plan, many of the estimated 3,000 permitted septic systems in the watershed are thought to be failing and in need of repair. The plan identified leakage from failing systems as the highest priority threat to water quality in the watershed.[6]

Despite these serious draw backs, advancements in technology are leading to designs for decentralized systems that can protect water quality and support good community form. Often these practices involve the use of "natural infrastructure," such as wetlands, as a part of a "treatment train" that cycles wastewater through multiple cleansing systems and ultimately back into the environment.

In some parts of the Sierra, where future development is expected but central sewer systems aren't available, these on-site systems may be a part of the solution. However, the best answer is not to allow development into areas that can not be serviced by central systems.

Strategies for Protecting Water Quality by Improving Septic System Reliability

On-site septic systems pose serious water quality and health impacts if not properly installed and maintained. Septic systems also contribute to sprawl development since they often require larger lot sizes. Between 10% and 20% of all on-site systems are not adequately treating wastewater and are considered the second greatest threat to groundwater quality in California.

■ Strategy 1: Conduct Septic Inspections

Maintenance is critical to the function of septic and other on-site systems. No regular monitoring is required for septic permits, and so there is very little documentation as to how many systems are not functioning properly and/or contributing pollutants to a watershed. Currently, state standards are being revised and two options, mandatory two-year inspection and inspection at point-of-sale, are being discussed.

Mandatory two-year inspections could be implemented by counties, which could provide consistent and regular means for monitoring and enforcing needed repairs. This option would not address non-permitted systems.

Inspection at point-of-sale could be implemented through the home purchase process, which may create delays and increase costs associated with the selling

process, but it would address non-permitted septic systems when those properties are sold. Point-of-sale septic transaction fees could be collected and used to fund future inspection activities and/or future sewer system infrastructure needs.

State septic system inspection regulations would provide an incentive for cleaning up and inspecting current systems, but local government does not have to wait for the state before it acts.

In some areas, such as Nevada County, local jurisdictions require a contractual maintenance agreement with a third party for all on-site wastewater treatment systems. These agreements ensure that systems are regularly inspected and pumped by a third-party service provider.

A variety of alternative wastewater treatment systems are also available that require less land area and can be suited to fit more efficient development patterns. Communities should explore options, such as the ones in the next strategy, which fit local environmental conditions as well as their community form and development pattern goals.

■ Strategy 2: Consider Advanced Treatment Practices for Decentralized Wastewater Systems in Areas without Sewers

Advanced decentralized treatment technologies can help minimize septic impacts when a centralized system is not a feasible option. A growing number of technologies can be used, depending on the development context. Some practices applicable to the Sierra region include:

Cluster Septic Systems: Cluster septic systems are wastewater treatment systems that serve a group of homes or businesses that are within close proximity of one another to treat their wastewater collectively. These systems can be sized to treat waste up to an entire neighborhood while using a drainfield for final treatment and dispersal. Cluster systems allow for smaller lot sizes and higher density development compared to traditional septic systems since they rely on a shared drainfield.

Like individual on-site septic systems, cluster systems still have maintenance drawbacks. Cluster systems need appropriate soils and groundwater recharge and require regular inspection and upkeep. Because the use of cluster systems can accommodate more housing, careful planning is needed to prevent unintended growth consequences in remote areas.

Package Plants: Package plants are above-ground units that can be used to treat wastewater for small communities and discharge the treated effluent to nearby surface waters. Package plants essentially operate as smaller-scale wastewater treatment plants, allowing treatment in areas that do not have suitable soil characteristics for in-ground treatment options or that are presented with other on-site disposal constraints. Package plants can support mixed-use development since they can be designed to treat a range of wastewater types from domestic to commercial.

Constructed Treatment Wetlands: Constructed treatment wetlands are designed to recreate the water-cleansing properties of natural wetlands – removing pollutants such as organic matter, suspended solids, metals, coliform bacteria, phosphorus and nitrogen from wastewater via natural chemical, physical and biological processes. Constructed wetlands can treat all types of wastewater, including agricultural, municipal, industrial and mining waste.

Because advanced decentralized treatment systems enable development in areas without sewer, they can contribute to rural sprawl and leap frog development. It is important to develop ordinances that constrain the use of advanced treatment systems to only designated growth areas.

Wastewater treatment solutions need to be based on community goals of how best to use its land, rather than allowing wastewater infrastructure to determine land use outcomes. It is important to consider the appropriate options for on-site or cluster water supply and wastewater systems through a watershed or community planning process.

When planned and maintained carefully, decentralized wastewater systems can provide a flexible tool for integrating wastewater treatment with land use planning and environmental protection, and can help to direct the location and form of growth as desired by communities.

Virginia's Fluvanna County Links Density and Location to Water

Fluvanna County recognizes the impact that location and density of new development has on the cost and supply of water. To reduce the cost and impact of new development, the County encourages development to be located in existing communities as well as utilizing current infrastructure.

Policy Language from Fluvanna County's Comprehensive Plan:

If a water and sewer system is developed, it should be provided in a cost-efficient and effective manner. Service costs associated with this type of infrastructure are strongly influenced by a development's location and density. Therefore, any new system should be located within existing communities that are also growth areas. This provision will allow for the county to build upon existing infrastructure while providing new infrastructure in the areas where it is most needed.

Strategy 3: Fix It First – Support Wastewater Infrastructure and Efficient Development

Water utilities must balance the need of expanding service, replacing old infrastructure, and maintaining the overall system, while providing water or sewer service at reasonable rates for their customers. As growth expands to outlying areas, utilities are forced to extend service to accommodate new development, often at the cost of not maintaining current infrastructure.

Fix-it-first policies help prioritize and direct funding towards updating, maintaining, and replacing current infrastructure as opposed to allowing new infrastructure to control the allocation of funds.

Establishing policies to encourage replacement and maintenance of current infrastructure is an important planning strategy because it takes advantage of and invests in current infrastructure to ensure a reliable and safe system in already developed areas. If those areas have infrastructure that is over capacity, supporting investment in system upgrades can attract new infill and redevelopment projects.

By adopting fix-it-first policies, utilities can conserve water, offer lower rates to customers, and save money. Instead of incurring the cost of building new infrastructure, a water utility can impose an expansion fee on the developer or customers in a new development. This takes the financial burden off water utilities and at the same time creates an incentive to build in areas already being served by a wastewater system.

Local governments can promote the use of current infrastructure by controlling the extension of water and sewer services into new development areas. For example, a community can work with LAFCos and neighboring jurisdictions to coordinate planning documents, establish fair policies regarding extensions by annexations, explore cost and revenue sharing programs, and develop mutually beneficial agreements to align growth decisions with infrastructure planning and management.

Fix-it-first policies can also conserve water by prioritizing the replacement of outdated and leaky pipes. To achieve system updates, local government and utilities can make it a priority to repair or update a specific length of pipe each year or set a goal to update a certain percentage of existing infrastructure. By establishing these goals, local governments and utilities are ensuring the reliability and efficient delivery of water.

Allocating monies towards updating current systems with new technologies and additions can also increase performance, and thus efficiency, and reduce cost to customers.

Conclusion

Water management in the Sierra is challenged every day with reliability of supplies, increasing demand, outdated and failing infrastructure, and the disconnect between land use planning and water and wastewater agencies. To ensure adequate water supply to Sierra residents, business and agriculture, and healthy ecosystems, communities should work with water and wastewater agencies to employ a range of strategies to achieve community goals.

Dramatic savings of water can be achieved by implementing simple conservation measures. Incentives such as rate structures can help account for variability in costs and consumption that result from different development locations and consumer conservation practices. "Zone pricing" sets rates in different zones based on variables such as distance, pressure required or lot size, and can reflect general-plan land-use designations to account for cost variability related to density. Other options include water recycling, a means for augmenting local supplies, and utilizing greywater.

Beyond water conservation, there are other ways to address water challenges. One is integrating water planning with land use planning. Planners can incorporate water supply and demand analysis into the General Plan and Specific Plans by establishing existing water use patterns, determining water use factors for each land use, mapping current and potential land uses, and calculating total future water demands on water use factors. Similarly, water agencies can incorporate land use data into analysis and planning of future water demands. Using a land use-based method for projecting future water demands enables simpler integration with land use planning documents.

Monitoring water quality in the Sierra.

Finally, wastewater management is critical for protecting Sierra waters. Decisions about where and when to expand or construct new wastewater treatment facilities affect where it is possible to develop. Though centralized systems are usually the best option for water quality protection, when decentralized systems are necessary, natural infrastructure and clustered sewer plants can be part of the solution for improving septic system reliability.

Chapter 6.

Conclusion: Planning Tools for a Water-Wise Future

For Sierra communities confronted with population growth, climate change, old water infrastructure and predominantly rural environments, planning ahead to ensure reliable water supplies, clean water and healthy ecosystems is challenging. At the same time, protecting and restoring Sierra water to ensure future generations of Sierra residents and visitors experience the high quality of life we do today is paramount.

The good news is that there are tools and strategies that our communities can implement to meet these challenges.

Location, Location, Location

The location of development on a watershed-wide scale is a major factor in the equation that determines the amount of land, resources and infrastructure needed to accommodate a growing population. To protect water resources, planners must identify and protect areas of land that are valuable to preserve, and channel growth into areas of land that have the greatest capacity for accommodating growth. To protect water resources, development should be targeted to those areas that:

- ➢ Are already developed and thus disturbed.
- ➢ Are served by water and sewer infrastructure.
- ➢ Have sufficient water supplies.
- ➢ Enable compact community form and efficient development patterns.

If cities and counties work together with their communities, they can use a broad range of strategies to divert development to more suitable areas. The list of options, from revising zoning codes to supporting watershed restoration, provides a wide range of tools to consider.

Compact Form

A second critical component is to ensure a city or county has compact form, reducing the pressure to accommodate additional population by expanding outward into valuable natural infrastructure. Compact form reduces the amount of impervious surfaces per unit and therefore is a development style that protects water quality by reducing stormwater runoff and preserving natural infiltration. Because compact form prevents development from spreading across a wider area, it requires less infrastructure to serve a given number of homes and businesses. This reduces costs related to providing water and wastewater services and may ease pressure on groundwater supplies, which would otherwise be tapped into to provide residential or commercial structures outside of a municipal service area with water. Mixed-use development, infill and redevelopment, and encouraging complete and connected streets are all development practices that support water smart location and compact community form.

Conventional planning codes and ordinances can present obstacles to communities interested in developing in a

more compact way. In many areas communities may need to assess and update local codes and ordinances to address such barriers including removing separation of uses, changing dimensional standards for lots and buildings, and increasing densities in appropriate locations.

Whatever tools a city or county is considering to help define their community's form, gaining community participation in the process is a key to success. Significant citizen participation is critical to implementing tools that work for each specific county or city.

Sustainable Site Planning and Design

Even compact form located in the best areas of a watershed can have impacts to water resources. The site-level design details of a home, neighborhood, subdivision or commercial building can make a big difference in how much it affects water resources.

From a site-level perspective, the first step to reduce stormwater runoff and improve natural drainage is to protect a site's natural assets. When determining where development should occur on a parcel or group of parcels, avoid steep slopes, erosive soils and sensitive areas; and protect water features, existing vegetation and soil health. Within the area selected for construction, development should be clustered onto a small portion of the site to reduce land disturbance and the amount of impervious surfaces.

Once constructed, homes and businesses should consider treating, reducing and reusing stormwater with green infrastructure. Alternatives to conventional conveyance-based stormwater systems include Low Impact Development techniques. Low Impact Development is a stormwater management approach that is modeled after nature and includes stormwater management options such as filter strips, vegetated swales and bioretention systems.

Other site specific elements such as landscaping, sprinkler systems and water saving appliances are also means for improving efficiency and encouraging conservation. Any public entity that supplies water in California may adopt and enforce a water conservation program that requires installation of water-saving devices. Existing conservation technologies include low-flow toilets and showerheads, efficient clothes washers and weather-based irrigation.

Capturing and storing rainwater runoff in cisterns or rain barrels is another simple means for reducing runoff while creating a new water supply for use in outdoor landscaping.

Water and Wastewater Policy and Integration

Site-level design, combined with development location and compact community form, go a long way to im-proving and protecting our community water resources. At the same time, these strategies require improved coordination among land use planning departments and water and wastewater agencies.

Most areas of the Sierra are unincorporated and dependent on small, independent municipal water systems. Water and sewer infrastructure pose further concerns to water quality and supply. Even in areas with abundant supplies, water and sewer infrastructure is often deficient or non-existent.

Fortunately, there are practical, economically feasible and environmentally responsible steps that can be

taken. Dramatic water savings can be achieved by implementing simple conservation measures. Rate structures can account for variability in costs and consumption and be configured to accurately reflect the value and costs of securing water.

Water Conservation: Water recycling, an umbrella term that encompasses the collection, treatment, storage, distribution and reuse of municipal wastewater, is another water-saving option. Some of the benefits and characteristics of recycled water include augmenting local supplies, matching water quality to end use, reducing effluent discharge, and keeping water safe. Greywater systems, another great efficiency option, capture and reuse household water (except from toilets) for landscaping or to infiltrate into the ground.

Integrated Planning: Beyond water conservation, there are other ways to address water challenges. One is integrating water planning with land use planning. Planners can incorporate water supply and demand analysis into the general plan and specific plans by establishing existing water use patterns, determining water use factors for each land use, mapping current and potential land uses and calculating total future water demands on water use factors. Updating Urban Water Management Plans and Water Master Plans or other integrated water planning documents will provide data for analysis. This incorporation of water planning data into land use planning documents will streamline procedures for complying with the state's "show me the water" laws.

Wastewater Management: Wastewater management is critical for protecting Sierra waters. Decisions about where and when to expand or construct new wastewater treatment facilities affect where it is possible to develop. Decisions about where and how to grow affect the capacity of and need for wastewater infrastructure.

photo: W. Fields

California is currently drafting new requirements for on-site systems that will set higher minimum standards. Sierra communities should be aware that because decentralized wastewater treatment systems enable development in areas without sewer, they can contribute to rural sprawl and leap frog development. However, in areas where decentralized treatment is necessary because of the rural nature or natural geography of a region, it is critical that communities consider decentralized treatment technologies, and septic inspection programs that can help minimize impacts to groundwater when a centralized system is not a feasible option.

In the larger picture, compact community form in a good watershed location far outweighs the benefits of developments scattered throughout the watershed and served by even the best managed septic system.

Real Solutions, Next Steps

The strategies presented in this guidebook are not new or revolutionary policy ideas. Most of them have a track record of implementation success in the Sierra and other parts of the state. They provide real and relatively easy solutions for better dealing with the water strain that the Sierra region and the rest of California faces in the coming years.

Especially in light of recent information about the transformative consequences that global warming will have on the health of our ecosystem and its water resources, these simple, cost-effective and practical tools are important steps for communities across the Sierra Nevada to begin taking charge of their water future.

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The Sierra Nevada Alliance invites you

to join the Alliance and help protect the Sierra Nevada's amazing rivers, lakes, wildlife and magnificent vistas.

The Sierra is facing many challenges. Population in the region is projected to triple. Climate change scientists are predicting the Sierra snowpack will be reduced 25% to 40% in 20 to 40 years. Historic practices have impaired 23 out of the 24 major river systems, put over 69 species at risk, and created traffic and sprawl around the region.

The Sierra Nevada Alliance is committed to ensuring the beauty of this "Range of Light" will continue to inspire our children and our grandchildren. To accomplish this, we work through four main programs:

- The Sustainable Sierra Land Use Campaign
- The Sierra Water & Climate Change Campaign
- The Sustainable Watersheds Program
- The Sustainable Community Group Program

We need the support of people like you who care about our environment and natural resources. **To join the Alliance, please fill out the form below or join on our website at www.sierranevadaalliance.org.**

Supporters will receive our quarterly *Sierra News* with updates on Alliance campaigns, insider information on key environmental issues across the region and invitations to Alliance events.

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