Water Resources and Land Use Planning

Watershed-based Strategies for Amador and Calaveras Counties

Local Government Commission

Acknowledgements

We would like to the Stakeholder Advisory Committee members for their time and effort throughout the process of developing this planning document, their interest in protecting watersheds and water quality, and their commitment to creating more sustainable communities.

This project was made possible through the generous support of the State Water Resources Control Board.

We would like to thank the many individuals who helped make this project happen: County Supervisors Merita Callaway, Steve Wilensky, Brian Onetto and Ted Novelli; Ibyang Rivera, our grant manager with the Water Board; Duke Foster; Dick McCleary; Krista Clem; Debbie Dunn; Muriel Zeller, Colleen Platt and the rest of MyValleySprings.com; Cathryn Bailey; Pat Jackson; Holly Mines; Stephanie Moreno; Katherine Evatt; Pete Bell; Chris Wright; Nathan Lishman; Dave Pastizo; Dave Andres; Connie Gonsalves; Mike Daly; John Benoit; Terri Daly; Susan Grijalvida; Bob Dean; Ellie Routt; Rob Duke; Jeff Davidson; Mary Boblett; Keith Johnson; and Nate Roth.

We owe a special debt of gratitude to Terry Strange and Ed Pattison, who were instrumental in making this project happen. Their ideas, energy and commitment to their communities were an inspiration to the project team.

The Local Government Commission would like to thank Jeff Loux, Tim Lawrence and Rachel Ragatz with the UC Davis Center for Water and Land Use for their expertise and assistance throughout the project. Additional photos provided by the Local Government Commission.

About the Local Government Commission

The Local Government Commission is a nonprofit, nonpartisan, membership organization that provides inspiration, technical assistance, and networking to local elected officials and other dedicated community leaders who are working to create healthy, walkable and resource-efficient communities.

1303 J Street, Suite 250
Sacramento, CA 95814
(916) 448-1198
www.lgc.org ▼ water.lgc.org

Water Resources and Land Use Planning

Watershed-based Strategies for Amador and Calaveras Counties

December 2008

AUTHORS

Clark Anderson

Josh Meyer

Laura Podolsky

Patrick Stoner

EDITING+DESIGN

Dave Davis

FUNDING

California State Water Resources Control Board

Table of Contents

Executive Summary

The future of the region's water is intrinsically linked to local land use planning. Few decisions have greater impact on the quality, reliability, and overall sustainability, including availability, of water resources than how and where we grow. This watershed plan outlines challenges with prevailing land use patterns, and their impacts on the region's water resources, infrastructure, and natural values.

This project received regular input from a group of local stakeholders that included county supervisors, city managers, city and county planning and public works staff, water agency staff and directors, watershed groups, developers and local advocacy groups. The input from this Stakeholder Advisory Committee (SAC) was provided during committee meetings, conference calls, individual visits and other public meeting opportunities.

Two public workshops, one sponsored by the Sierra Nevada Alliance in March 2008 and the other sponsored by this project in May 2008, focused on the land use-water connection and were attended by SAC members and other members of the community.

Goals about land use and water planning issues in Amador County and Calaveras County were developed in SAC meetings. These goals provide direction and the foundation for developing planning principles as well as policy and program recommendations for Amador and Calaveras counties.

The most important recommendation of this plan is to improve the pattern and character of development in the region to better protect and manage water resources. If development practices and patterns continue to extend new low-density growth outside of existing communities, the region's watersheds and the water supplies they provide will suffer. Each of the goals below support that end.

- **Use Water Efficiently and Sustainably:** Plan and design new development and associated infrastructure to make the most efficient use of existing water supplies in tandem with expanding water conservation and reuse efforts in the region.
- **Protect Natural Assets and Infrastructure:** Invest in and promote the protection and restoration of "natural infrastructure" systems that provide water and community benefits such as healthy lands, soils, streams and forests.
- **Minimize Watershed Impacts of Development:** Plan and design development to prevent and minimize its impacts on water resources and watershed health.
- **Strengthen Existing Communities:** Focus growth and investment towards existing communities to ensure efficient use of land, water, infrastructure and fiscal resources as well as to ensure communities remain physically separate, unique entities.
- **Maintain Rural Character:** Support new development patterns that respect traditional rural character, lifestyles, culture and economies, protect natural habitats, and preserve the aesthetic quality of the surrounding countryside.
- **Support a Prosperous Region:** Align development decisions with economic development goals to ensure new growth supports regional prosperity and the ability of residents to live and work in their communities.

- **Increase Coordination and Collaboration:** Create programs and policies that encourage greater cooperation locally and regionally within and between different agencies, promote public involvement and balance different interests.

The plan contains:

- An assessment of existing conditions and policies.
- A narrative explaining the links between land use decisions, watershed health, water quality, and water quality regulations in a simple, non-technical form.
- Strategies and recommendations that match local needs/conditions.
- Suggestions for planners, administrators and developers as they plan future developments, both residential and commercial.
- Implementation measures including model policies, tools and resources.

The plan also includes local perspectives from SAC members and other local experts.

Project Background (Chapter 1)

This watershed plan examines the relationship between development trends and water management challenges in Amador and Calaveras counties. Despite their integral nature, water and land use decisions are often disconnected. In 2004, with funding from the California Water Boards, the Local Government Commission developed the Ahwahnee Water Principles. The Water Principles provide guidelines for aligning water management with local land use decisions, and help communities protect valuable water resources as they grow.

The purpose of this plan is to better align land use planning with water resource planning and to provide the analysis, policy recommendations and tools and resources necessary to help make the important connection between land use planning and watershed-based planning strategies in Amador and Calaveras counties.

This plan differs from most other watershed plans in that it is focused on local land use planning and development decisions that determine where and how development occurs. This plan does not intend to replicate the efforts of local watershed groups or ongoing general plan updates, but to provide a land use lens for approaching watershed management.

The following list summarizes the major issues for land planning and water management that were identified by the SAC.

Watershed-scale Issues Related to Growth and Development

- Inefficient/dispersed land use patterns.
- Conversion of open space and working landscapes.
- Loss of habitat and natural infrastructure.
- Riparian areas impacted by growth.
- Fire management – growth in urban-wildland interface areas.
- Development impacts to watersheds and natural processes.
- Infrastructure "nightmare" – extensions, upgrades, etc.
- Poor connection between land use policies and infrastructure.

Water Quality Related Issues

- Stormwater pollution and runoff.
- Changes to hydrology.
- Increases in impervious surfaces.
- Wastewater and septic impacts.
- Growth in floodplain areas and flood control.
- Erosion and sedimentation.
- Groundwater overdraft and contamination.
- Fire management – fuel loading.

Water Supply Related Issues

- Threats to water reliability and availability.
- Higher demands for water.
- Inefficient use of existing water supplies.
- Need for more reuse and recycling.

Institutional Issues

- Rapid growth without sufficient planning.
- Lack of regional coordination and planning.
- Competition between agencies.
- Private property rights.
- Aging and/or inadequate infrastructure.
- Policy barriers and conflicts.
- Lack of financial resources.
- No economy of scale to improve management.
- Costs and impacts of extending and/or fixing aging infrastructure.
- Recreational areas and public access to those areas.
- Challenge of implementing state and federal regulations.

Area Overview and Issues (Chapter 2)

Amador County and Calaveras County are located in the central portion of California's Sierra Nevada. Known as the Mother Lode region, this area encompasses a transitional zone between the San Joaquin Valley and the Sierra Nevada Mountains. The landscape is diverse, with elevations ranging from 250 feet in the western foothills to over 9,000 feet at the Sierra crest.

Foothill communities in both counties are about 30 miles from Sacramento, Stockton or Modesto, placing them within commuting distance to these urban job centers. The proximity to jobs and availability of relatively inexpensive land has stimulated new growth. The region's natural amenities, small-town feel, rural character, sense of safety and recreational access are also drawing new residents and associated businesses.

The land use and development patterns that unfold as the region grows will determine the amount of land and water used, infrastructure needed, and environmental and fiscal impacts generated by new development.

Land use patterns and the form that new development takes will be central to addressing concerns underlying community dialogues about growth such as traffic, open space, economic development and community revitalization.

The pressure to grow has significant implications for water resources in Amador and Calaveras counties. Development patterns to accommodate this growth have caused strains on water and sewer systems and other public infrastructure (e.g., congested roadways). Current policies and regulations do not favor alternatives to land consumptive, inefficient development patterns that undermine water quality and supply.

Local planning efforts are often met with resistance from local landowners concerned with the impact of land use regulations on their property rights. This debate has significant ramifications for Amador and Calaveras as the counties and cities therein update their General Plans and implement codes and ordinances.

Sierra snowpack is California's largest water storage system. The 24 major watersheds of the Sierra Nevada supply around 65% of California's drinking water, an essential source of water for the state's multi-billion dollar economy. At current levels of per capita water use, the water demand generated by California's future residents will require a 40% increase in supplies. Since 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.

Stormwater is an issue of growing importance in both counties. The Lower Calaveras River, the Lower Mokelumne River and the Comanche Reservoir are listed as impaired waters at least in part because of urban storm water runoff. The Lower Calaveras River has elevated levels of pesticides, nutrient enrichment and pathogens (most likely from on-site wastewater treatment systems, a legacy effect from other systems.).

Wastewater is sewage (either treated or untreated) from residential, commercial, industrial and institutional sources, and is a reality of human settlement. Several factors come into play when considering the relationship of wastewater management to land use and development. Infrastructure constraints in both Amador and Calaveras counties are pushing

the need to repair, upgrade or build new community-based treatment plants.

On-site wastewater treatment systems (OWTS) are the predominate means of wastewater treatment in Amador and Calaveras counties. No regular monitoring is required for septic permits and, therefore, there is no documentation on how many systems are either functioning properly or contributing pollutants to the watershed. A number of these systems are old, however, and near the end of the time expected for functional use.

Another major concern for both Amador and Calaveras counties is the availability of sewage treatment operations that will accept OWTS solids. There are no wastewater treatment plants in either county that will accept OWTS loads. And an increasing number of jurisdictions that have traditionally accepted OWTS loads, are refusing to take septic tanks loads from areas outside of their boundaries.

Watershed-based Planning (Chapter 3)

Growth pressure seen in recent decades is likely to continue in Amador and Calaveras counties. Today, the question is not if the area will grow, but how? Communities throughout the Sierra Nevada are looking at ways to accomodate new growth and development while retaining their unique historic and rural character. With the sustainability of water resources in mind, current policy tools will need to be changed, augmented or removed.

This chapter sets the format for the succeeding chapters that cover watershed-based planning strategies designed to address key issues and goals identified through this project. The focus is on land planning and development decisions that affect water quality, reliablity and watershed health.

Open Space and Natural Infrastructure (Chapter 4)

Natural systems and processes within a watershed provide valuable benefits including flood control, water filtration and groundwater recharge. Economists call these benefits ecosystem services. Areas or systems that provide these services are referred to as natural or green infrastructure.

Strategy 1: Open Space Conservation

This chapter focuses on protecting, restoring and benefiting from the natural infrastructure systems that are embedded within the region's watersheds. This includes various types of open space (working landscapes and undeveloped open lands) and functioning ecosystem areas such as wetlands, streams and riparian zones, as well as elements of the built environment (landscaped areas) that can be designed and managed to provide watershed benefits within the community.

For watersheds, open space acts to:

1. Capture and store rainwater, snowmelt and runoff.
2. Control flooding and stormwater runoff.
3. Facilitate groundwater recharge.
4. Filter and assimilate pollutants in rainwater and runoff.
5. Sustain natural hydrologic processes.
6. Sustain ecological systems and underlying watershed health.

Strategy 2: Natural Infrastructure in the Built Environment

Low Impact Development (LID) design strategies are intended to mimic a site's predevelopment hydrology by protecting existing drainage and incorporating naturalistic features designed to infiltrate, filter, store, evaporate and detain runoff from impervious areas.

LID techniques fit into a range of development settings and conditions: urban and rural, commercial and residential, and in various soil types, topographies and climate conditions. The techniques can be applied at site, neighborhood or regional scales to create a reliable green infrastructure to address drainage and reduce water-related impacts from development-related land conversion.

Community Design and Planning (Chapter 5)

Land use patterns are critical to water quality, reliability and watershed health. The location and form of development affects water quality, demand and reliability, infrastructure costs and needs, and the health of the watershed as a whole. This makes community design an essential, but often-overlooked component of watershed planning and water management.

This chapter recommends town-centered development with a greater mix of land uses and housing types, connected by safe and walkable streets. The strategies and recommendations address the threats that sprawling development patterns pose to water quality, reliability and watershed health:

Strategy 1: Strategic Location

Encourage infill development that is within or directly connected to existing communities. Support the "recycling" of developed land through revitalization efforts.

Strategy 2: Compact Design

Support compact community form in the design of buildings, neighborhoods and the community as a whole.

Strategy 3: Mixed Use Development

Mix appropriate land uses and development types to support compact community form and reduced travel distances and automobile dependency.

Strategy 4: Transportation Network and Street Design

Support interconnected transportation network with complete streets design that encourages all types of mobility, supports the needs of all types of users, and incorporates natural drainage practices.

Sustainable Water and Watershed Management (Chapter 6)

This chapter focuses on strategies that local governments and water agencies can use to make the most of current water supplies by reducing demand, managing a more diverse portfolio of water resources, and protecting water quality through improved development patterns. The strategies are broken into the following areas:

Strategy 1: Water Conservation and Efficiency

Provide incentives to reduce indoor and outdoor water use. Drought-tolerant landscaping, water smart irrigation systems, reduced-flow fixtures and appliances, and water rates that capture the true cost of service are examples.

Strategy 2: Water Reuse (wastewater and greywater recycling)

Treated wastewater and water from sinks, bathtubs, and clothes and dish washers can reduce the amount of fresh water supplies that agencies must procure.

Strategy 3: Collaborative Water Resource Planning

Water agencies and local governments share the burden of ensuring the delivery and reliability of local water supplies, though land use planning and water planning are not always coordinated.

These strategies support solutions to creating a reliable and high quality water source that do not rely on the investment of high finance water projects, such as redirecting water away from streams and rivers; building new reservoirs, or enlarging or draining existing reservoirs. Instead these strategies can be used to take advantage of water supplies by increasing water use efficiency through conservation, reuse, and collaboration.

Water Quality Monitoring Guidelines (Chapter 7)

This water quality monitoring plan does not implement a specific program, such as a stream restoration, but supports integration of water management and land use planning policies within Amador and Calaveras counties. While it is not possible to measure the direct benefits of any one policy, much less the range of policy recommendations included in this plan, it is increasingly important for local land

use agencies to be able to assess the impacts of planning and development decisions on water quality and watershed health.

The purpose of this water quality monitoring Plan is not to propose a new monitoring program but to offer guidelines for expanding and coordinating existing monitoring efforts and management programs, particularly those that have the potential to link watershed conditions with local planning and development decisions, and ongoing water and watershed planning efforts.

With these efforts and the purpose of this plan in mind, three interrelated programmatic opportunities are presented:

1. Build on and expand the technical watershed assessment work completed by the Upper Mokelumne River Watershed Management Authority (UMRWA) to include additional watersheds in Amador and Calaveras counties, prioritizing areas expected to see the largest amount of growth.
2. Calibrate the existing Watershed Analysis Risk Management Framework (WARMF) model developed through the UMRWA effort to other watersheds in Amador and Calaveras to carry out the first opportunity.
3. Integrate the work of updating and expanding the WARMF and related assessment tools into future Integrated Regional Watershed Management Plan work plans and General Plan efforts.

Appendices

The narrative of this plan is followed by appendices that include the full text of the Ahwahnee Water Principles for Resource-Efficient Land Use, the roster of Stakeholder Advisory Committee members, and fuller descriptions of Transfer of Development Rights programs and Low Impact Development techniques.

1. Project Background

How will future growth affect water resources in Amador and Calaveras counties? How can the impacts of development be minimized? How can water resources be managed in a sustainable manner that accommodates community needs?

This watershed plan examines these questions by looking at the relationship between development trends and water management challenges in Amador and Calaveras counties. It explores connections between land use policies, development patterns and water resources, and how these connections relate to local planning efforts.

Despite their integral nature, water and land use decisions are often disconnected. In 2004, with funding from the California Water Boards, the Local Government Commission set out to address this disconnect by developing the Ahwahnee Water Principles. These principles provide guidelines for aligning water management with local land use decisions, and help communities protect valuable water resources as they grow. They can be tailored to meet local needs and conditions, allowing communities to translate appropriate best management practices (BMPs) into effective policies and programs. (The Water Principles can be found in Appendix A.)

Amador-Calaveras Regional Watershed-based Planning Strategies

In 2006, in partnership with local governments and organizations in Amador County and Calaveras County, the Local Government Commission received additional funding to conduct a watershed planning project with communities in the two counties. The goal of the watershed planning process has been to support integration of local planning, stormwater management and watershed planning efforts. The final product of this process is a regional watershed plan, which will provide regionally appropriate solutions to challenges at the nexus of water and land use planning.

This project came at an opportune time for the counties, both of which are in the process of updating their general plans. Early project meetings affirmed that the general plan updates provided an ideal focus for the project.

Stakeholder Advisory Committee

The project received regular input from a group of local stakeholders that included county supervisors, city managers, city and county planning and public works staff, water agency staff and directors, watershed groups, developers and local advocacy groups (see Appendix B). The input from this Stakeholder Advisory Committee (SAC) was provided during committee meetings, conference calls, individual visits and other public meeting opportunities. The committee met in March, June, September and December 2007, and again in April and September in 2008. Two public workshops, one sponsored by the Sierra Nevada Alliance in March 2008 and another sponsored by this project in May 2008, focused on the land use-water connection and were attended by SAC members and other community members.

A Land Use-based Watershed Plan

This plan differs from other watershed plans because it focuses on local land use planning and development decisions that determine where and how development occurs. The issues

this plan addresses were identified in SAC meetings, interviews with local residents, officials and experts, and a review of research, planning documents and other data. This information provided the foundation for this plan and the strategies it recommends.

This plan does not intend to replicate the efforts of local watershed groups or the general plan updates, but to provide a land-use lens for approaching watershed management. The purpose of this plan is to better align land use planning with water resource planning and to provide the analysis, policy recommendations, tools and resources necessary to help make the important connection between land use planning and watershed-based planning strategies in Amador and Calaveras counties.

This plan contains:

- An assessment of existing conditions and policies.
- A narrative explaining the links between land use decisions, watershed health, water quality and water quality regulations in a simple, non-technical form.
- Strategies and recommendations that match local needs and conditions.
- Suggestions for planners, administrators and developers as they plan future developments, both residential and commercial.
- Implementation measures including model policies, tools and resources.

Early project meetings were dedicated to an assessment of needs and issues at the water

Summary of the Ahwahnee Water Principles

I. Grow in a Water-wise Manner [Principles 1-2]

Principles 1-2 work together to improve the form and pattern of development, by steering new growth to appropriate sites and preserving valuable natural areas. These principles explain how to accommodate population growth and its accompanying development and transportation needs without destroying watersheds, wasting water supplies or stressing infrastructure. They call for compact community form and the protection of natural infrastructure, including wetlands, flood plains, recharge zones, riparian areas, open space and native habitats that supply our water.

II. Water-friendly Site Design [Principles 3-5]

Principles 3, 4 and 5 explain how to integrate "green infrastructure" into the built environment to promote watershed health and water reliability. They call for neighborhood and site-scale planning and design strategies that can be used to protect water quality, maximize existing supplies, reduce flood risks, and handle runoff more effectively.

III. Stretch Water Supplies [Principles 6-9]

Principles 6 through 9 are intended to help communities make the most efficient use of existing water supplies. They promote planning and design for water reliability by reclaiming and reusing recycled water for appropriate uses; implementing water-efficient technologies and designs in the home and for landscaping; and stretching groundwater supplies through sustainable management practices including monitoring, treatment, and groundwater protection.

IV. Implementation Principles

The water principles are guided by five implementation strategies that can help put the other nine community guidelines into action to encourage compact growth patterns, water-friendly site design and water efficiency and conservation – practical steps to make the physical changes necessary to ensure water sustainability.

and land use nexus. These discussions provided the backdrop for the types of solutions that would be examined and areas for focus. The list below summarizes major issues for land planning and water management identified during the stakeholder meetings:

Watershed-scale Issues Related to Growth and Development

- Inefficient/dispersed land use patterns.
- Conversion of open space and working landscapes.
- Loss of habitat and natural infrastructure.
- Riparian areas impacted by growth.
- Fire management – growth in urban-wildland interface areas.
- Development impacts to watersheds and natural processes.
- Infrastructure "nightmare" – extensions, upgrades, etc.
- Poor connection between land use policies and infrastructure.

Water Quality Related Issues

- Stormwater pollution and runoff.
- Changes to hydrology.
- Increases in impervious surfaces.
- Wastewater and septic impacts.
- Growth in floodplain areas and flood control.
- Erosion and sedimentation.
- Groundwater overdraft and contamination.
- Fire management – fuel loading.

Water Supply Related Issues

- Threats to water reliability and availability.
- Higher demands for water.
- Inefficient use of existing water supplies.
- Need for more water reuse and recycling.

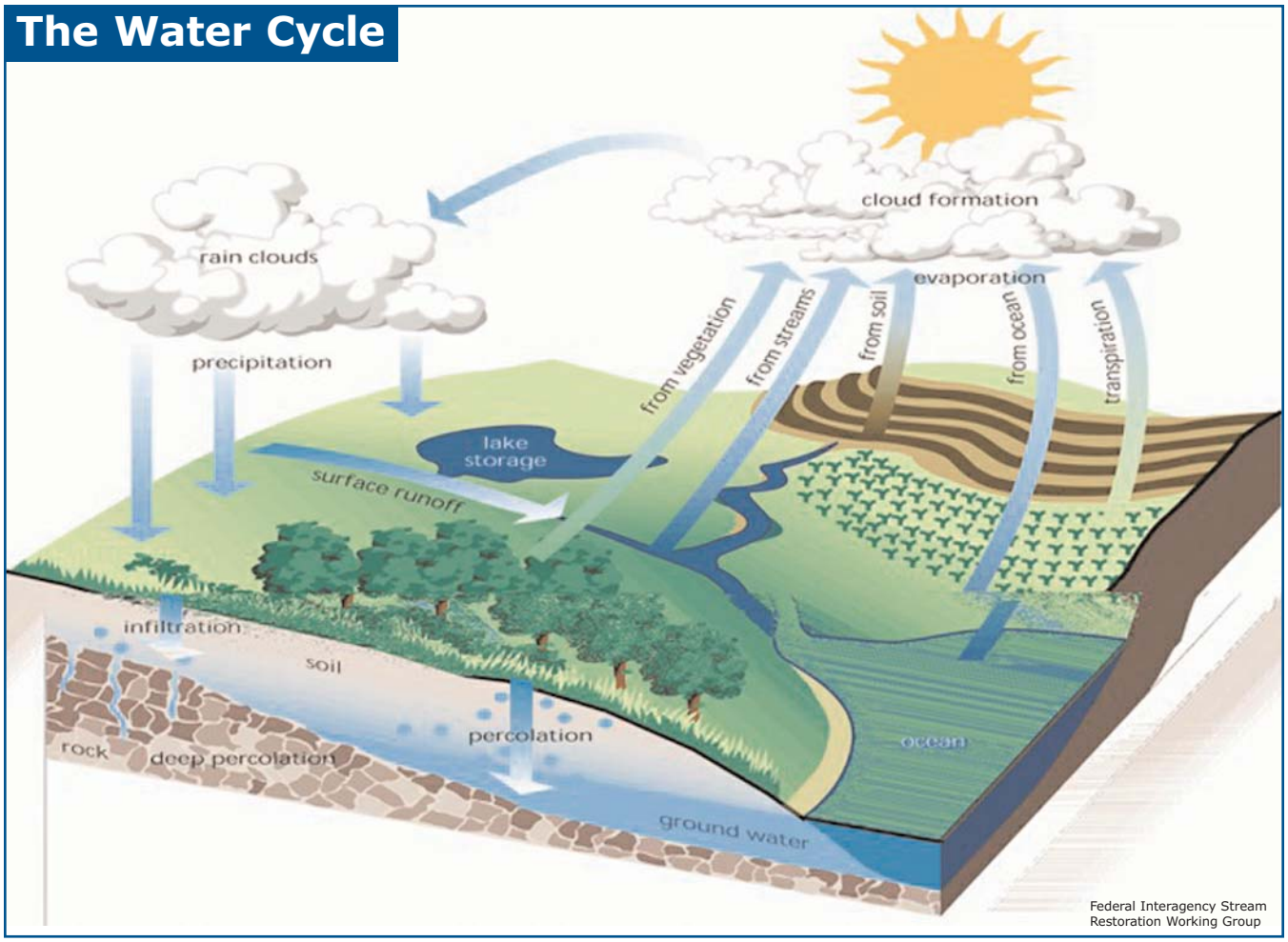
Institutional Issues

- Rapid growth without sufficient planning.
- Lack of regional coordination and planning.
- Competition between agencies.
- Private property rights.
- Policy barriers and conflicts.
- Lack of financial resources.
- No economy of scale to improve management.
- Costs and impacts of extending and/or fixing aging infrastructure.
- Recreational areas and public access to those areas.
- Challenge of implementing state and federal regulations.

The future of the region's water is intrinsically linked to local land use planning. Few decisions have greater impact on the quality, reliability, availability and overall sustainability of water resources than how and where we grow. This plan outlines challenges with prevailing land use patterns, and their impacts on the region's water resources, infrastructure, and natural values. Within this context, the most important and fundamental recommendation in this plan is to improve the character and pattern of development in Amador and Calaveras counties.

If development practices and patterns of past decades continue, the region's watersheds, and the water supplies they provide, will suffer.

A number of "institutional challenges" cross-cut issues associated with physical development patterns, including coordination within and between local agencies, differing views about the need and value of new growth and development, a misunderstanding of how natural infrastructure is impacted as growth occurs, a lack of understanding of how to implement low impact development and water wise design elements into new projects, lack of awareness about the water implications of different development decisions, threats to property rights, economies of scale for infrastructure, and a range of legacy impacts from past management challenges and failures.



BASIC CONCEPTS

A few key concepts, and their meaning in this document, are important to understand and merit additional discussion here.

The water cycle is the continuous movement of water on, above, and below the surface of the Earth.

The water, or 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. Sun and gravity drive the process, which has cycled and recycled water around the planet as liquid, ice or vapor for millennia.

Every site is in a watershed.

All land, developed or not, is part of a watershed. A watershed is the drainage area for a given body of water. It can be small, as with the land draining to a local creek, or large, such as the entire Sacramento or San Joaquin River watersheds.

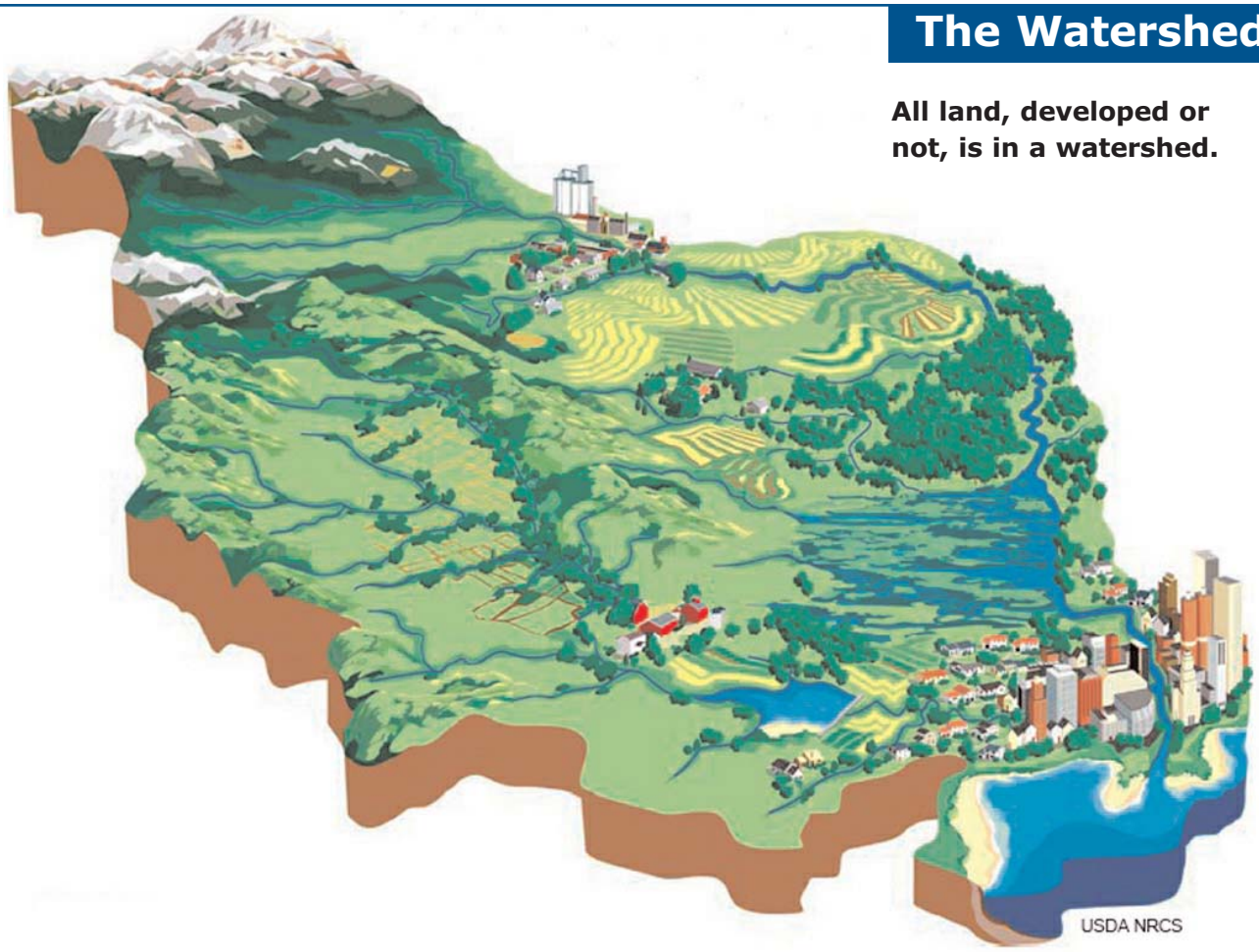
Watersheds include both the streams and rivers that convey the water as well as the landscape systems (natural or developed) from which water drains. The watershed acts both like a funnel, collecting water that falls within the basin and directing it into a water body, and like a sponge, capturing and absorbing water within soils, vegetation and surface and groundwater systems. Larger watersheds are made up of smaller watersheds called sub-basins, which are all connected by and nested within the larger drainage system.

Natural drainage and the water cycle.

When precipitation falls in a watershed, the water moves with gravity through any number

The Watershed

All land, developed or not, is in a watershed.



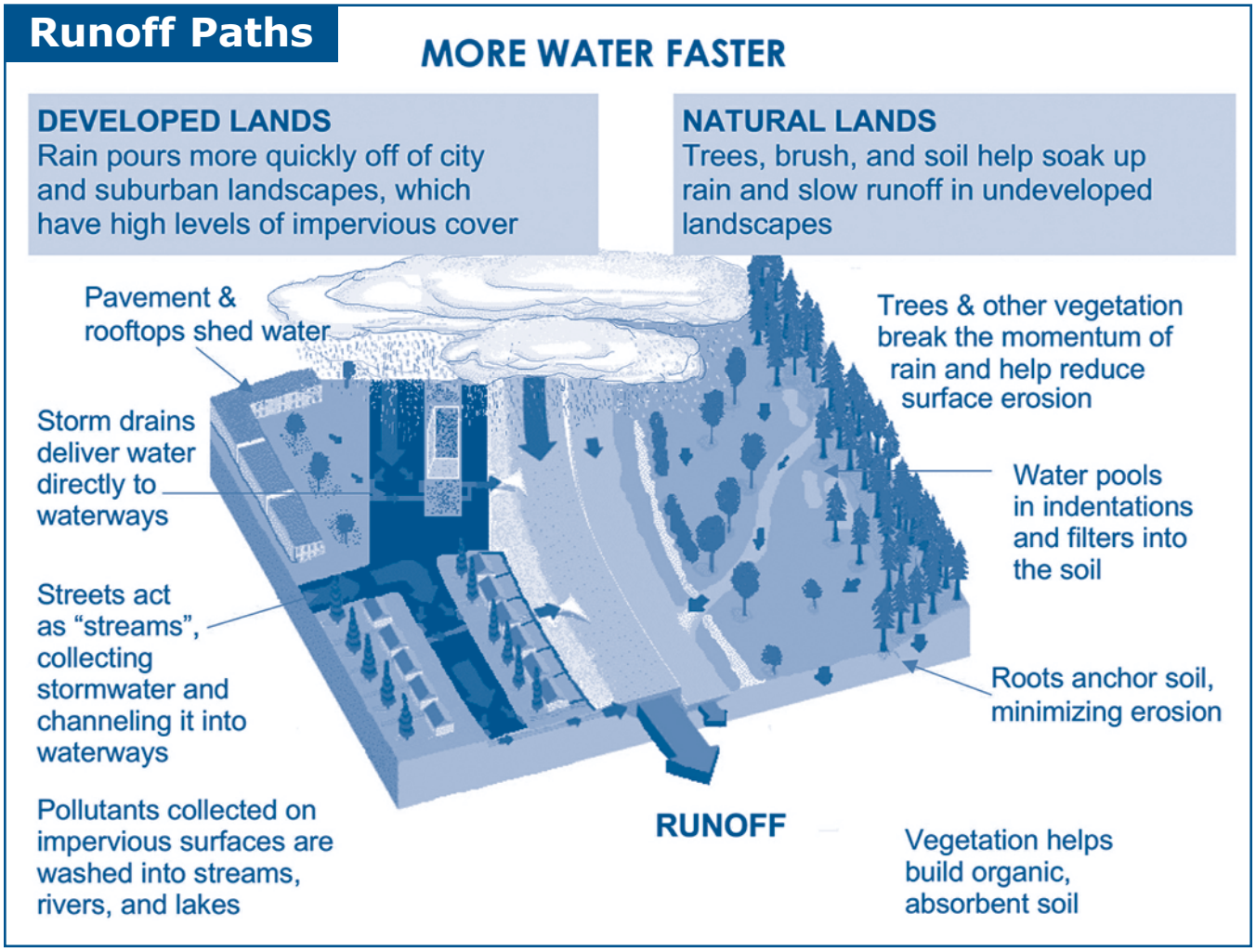
of natural drainage processes. These drainage processes depend largely on the biophysical conditions of the land where it falls (e.g., soil, vegetation and topography). It might soak into the ground through a process called infiltration, or flow over the land as surface runoff. Most often it will do both.

Some water that soaks into soils is absorbed by plant roots and released as vapor back into the atmosphere in a process called evapotranspiration. Water that infiltrates deeper into the ground becomes "base-flow," which replenishes ground water systems (aquifers) and also feeds back into surface waters such as rivers or wetlands, which may rely on this flow during dry periods. These systems are interconnected. The health of the system as a whole, as well as the quality of the water within it, depends largely on the land over and through which it follows.

Watersheds are a vitally important part of natural infrastructure.

Watersheds are composed of soils, vegetation and natural processes that make up larger systems like wetlands, meadows and floodplains. These systems perform numerous services. They capture, store, filter and convey water supplies, and maintain healthy, functional landscapes. Increasingly, water managers and natural resource experts view these as a "natural infrastructure" system that provides essential services communities depend upon.

The many benefits provided by 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."



The capacity of watersheds to function as natural infrastructure depends on the health of the ecological systems within them. When those systems are degraded, the watershed is unable to provide services such as clean water and groundwater recharge. The risks of wildfire, flooding, water contamination, invasive species, drought, and habitat degradation increase when watershed functions that normally keep such threats in check are mismanaged or compromised.

Land development alters the water cycle and impacts watershed health.

Historically, land use planning and resource management have not only ignored the benefits of ecosystem services, they have compromised and even destroyed them by degrading or completely replacing the natural infrastructure that provided them.

When land is developed, impervious surfaces, like pavement and buildings, replace absorbent land, preventing water from infiltrating into the ground. This 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. As a result, habitat and property can be severely damaged, requiring expensive structural fixes.

The runoff also collects a variety of pollutants from roads, parking lots, buildings, lawns and other areas that are then carried and discharged into local rivers and streams. The kinds of pollutants in developed areas that can be picked

up in runoff include heavy metals, oils and grease, pet waste, fertilizers and pesticides, and noxious air pollutants that settle on the ground. These pollutants in stormwater runoff create a toxic stew that is destructive to the quality of receiving waters, aquatic vegetation and wildlife.

Studies indicate that when 10% of a watershed is covered in impervious surfaces, it begins to show signs of an unhealthy ecosystem.[1] More recent research indicates that in California, initial watershed impairment occurs at levels as low as 3% to 5% impervious cover.[2]

Local land use decisions are central to the future of the region's water resources.

With respect to water resources in California, the key question is not if the region will grow, but how. How and where land is developed have enormous implications for water quality and availability, infrastructure needs, the costs of providing water and sewer, and the overall health of the region's watersheds. The built environment is the accumulation of decisions at multiple scales of planning and design – from individual buildings and lots to neighborhoods, communities and regions. Ultimately, these decisions form development patterns that shape the way growth occurs on the land, the way we live in our communities, and consequently how development impacts water resources.

Sustainability

Sustainability is defined by the U.S. Environmental Protection Agency as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable development typically considers the impacts to the environment throughout the development process and takes steps to minimize negative impacts to valuable resources such as energy, water, materials and the natural infrastructure more efficiently than other development.

Wetlands serve as natural infrastructure.

2. Area Overview and Issues

Amador County and Calaveras County are located in the central portion of California's Sierra Nevada. Known as the "Mother Lode" region, this area encompasses a transitional zone between the San Joaquin Valley and the Sierra Nevada Mountains. The landscape is diverse, with elevations ranging from 250 feet in the western foothills to over 9,000 feet at the Sierra crest.

The region is characterized by a variety of natural and cultural landscapes, ranging from low-elevation foothill lands and their associated rural ranching and mining landscapes, to higher-elevation, "upcountry" forest regions and their associated logging and wilderness landscapes.

The eastern high country is mostly public land and generally steep, rugged and unpopulated. The western foothills are typified by rolling oak-studded hills and grasslands, and are the most developed and fastest growing parts of each county. The counties sit between two major tourist destinations – Lake Tahoe and Yosemite National Park – and include popular year-round recreation destinations for snow sports, golfing, hiking, camping, boating, fishing and bicycling.

Both counties have an abundance of working landscapes (farms, ranches and forests) and high-quality, contiguous open space that includes intact natural habitats and relatively pristine watersheds. The two counties are characterized by a variety of small towns dating back to the Gold Rush era.

Foothill communities in both counties are about 30 miles from Sacramento, Stockton or Modesto, placing them within commuting distance to these urban job centers. The proximity to jobs and availability of relatively inexpensive land has stimulated new growth. The region's natural amenities, "small town feel," rural character, sense of safety and recreational access are drawing new residents and associated businesses as well.

GROWTH AND DEVELOPMENT TRENDS

Both Amador and Calaveras counties have experienced relatively high growth rates in recent decades, particularly in the 1970s and 1980s, they have had a marked impact on land use patterns, corresponding with larger socioeconomic shifts as the Sierra region transitions from traditional resource-extraction economies to amenity and service-based industries.

Current data suggest that future growth will be somewhat slower and it is uncertain what effects rising gas prices and the current housing downturn will have on local and regional development. Still, both Amador and Calaveras counties can expect to experience new growth in step with statewide and regional trends.

California: According to projections released in July 2007 by the California Department of Finance, the state's population is projected to reach 40 million people by 2012, 50 million people by 2032, and almost 60 million people by 2050.

Sierra Nevada: The Sierra Nevada is the third-fastest growing region of California; it grew by 16% between 1990 and 2000. The current population of 650,000 is projected to grow to somewhere between 1.5 million and 2.4 million by 2040[1], adding an additional 850,000 to 1.75 million people. The number of annual building permits between 1990 and 2004 increased by 22%.[2]

Central Valley: The Department of Finance forecasts that the population of California's Central Valley will more than double by 2040 to almost 10 million people.

Amador County: The county's estimated population was 38,435 in 2007 and is projected to be 54,788 by 2030. The Regional Housing Need Allocation suggests approximately 6,400 more housing units will be needed between now and 2030.[3]

Calaveras County: The estimated population was 46,028 in 2007 and is projected to be 47,750 by 2010 and between 56,318 and 70,337 in 2020. Between 2000 and 2005,[4] Calaveras sustained a 13.5% growth rate, relatively high compared to the national rate of 5%.[5]

These trends suggest pressure for new development will continue in both counties. The land use and development patterns that unfold as the region grows will determine the amount of land and water used, infrastructure needed, and environmental and fiscal impacts generated by new development. Land use patterns and the form new development takes will also be central to addressing concerns underlying community dialogues about growth, such as traffic, open space, economic development and community revitalization.

Demographic data suggest that, in the future, the two counties will have a higher proportion of older residents, more workers will need to commute outside the county for jobs and many services, and the number of households may grow faster than the population, which means housing demand could outpace population growth.[6] These trends point to a mix of factors influencing growth and development in the region:

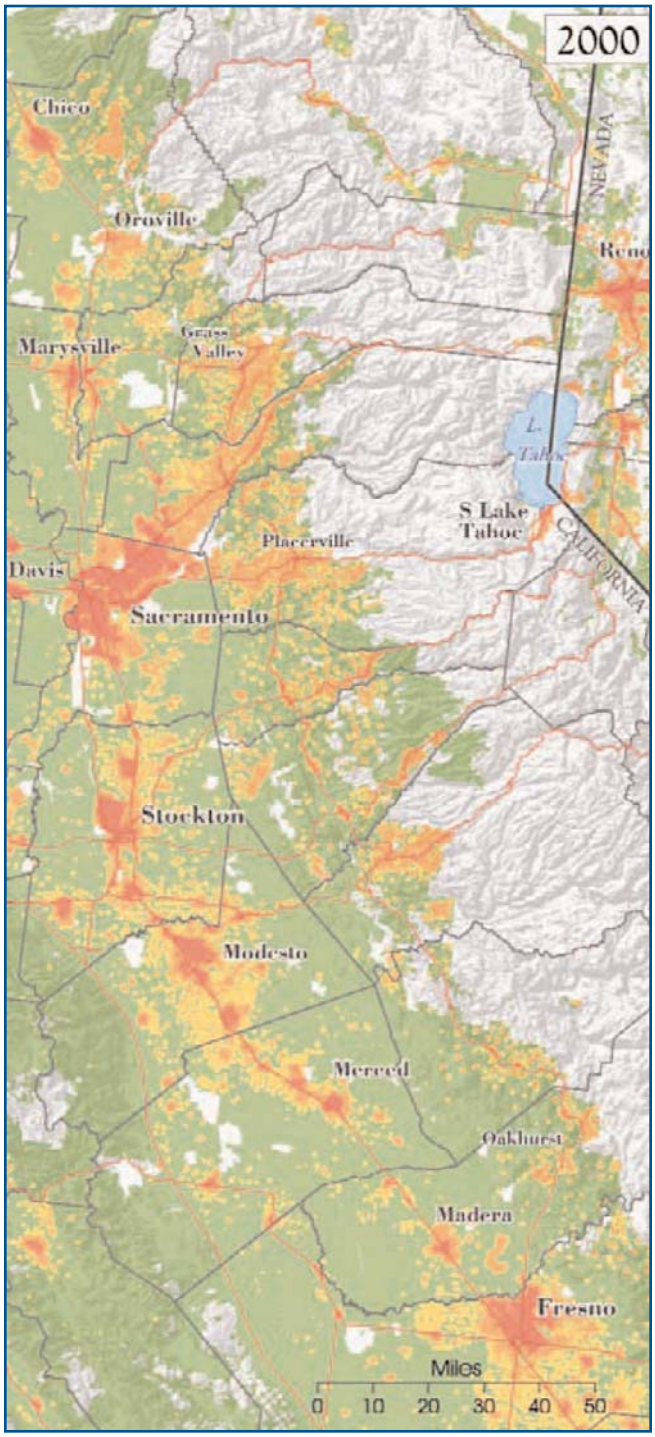
Amenity Draw: Amador and Calaveras counties are alluring places to live and visit. Numerous "quality of life" benefits, including recreational opportunities, open space, rural "small-town" charm and scenic beauty, draw retirees, "urban refugees" and second-home owners to the area. These "amenity drivers" make both counties popular destinations for new residents and visitors, and create new development demand.

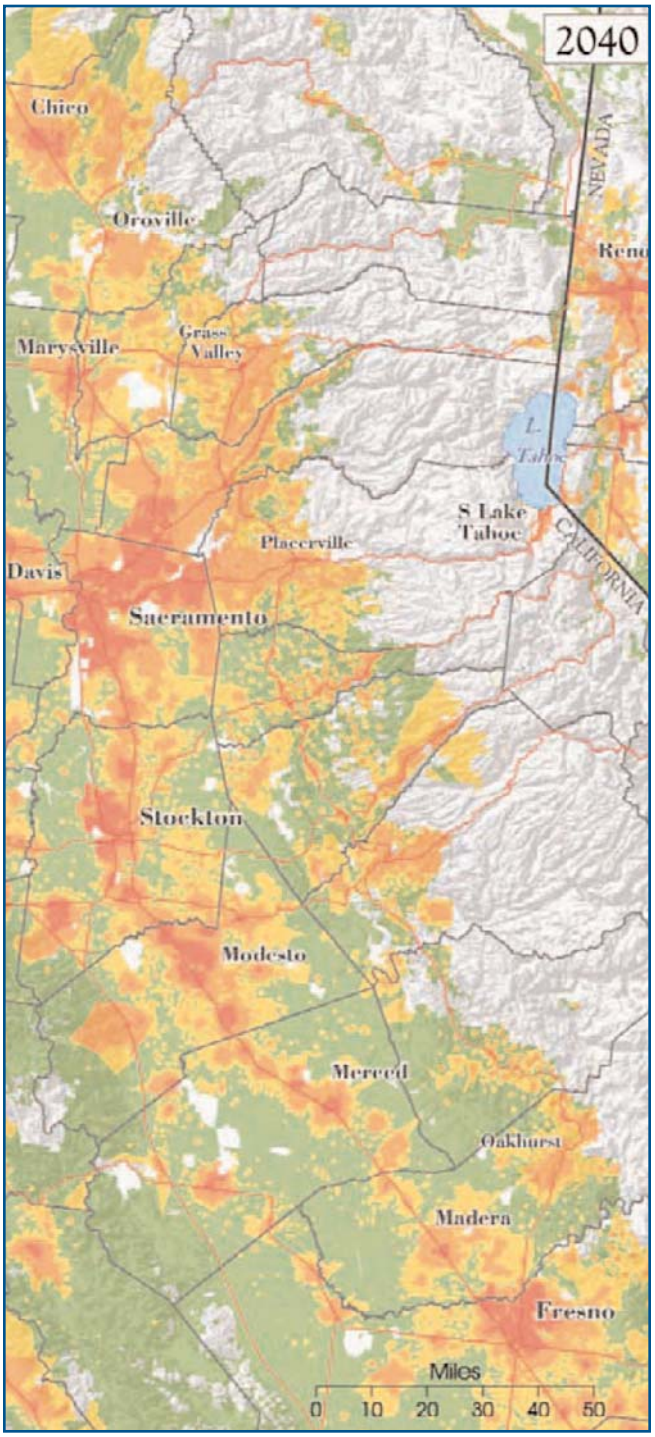
Retiring Baby Boomers: Amador and Calaveras counties are popular destinations for the relocation of retiring baby boomers choosing to move outside of a city in exchange for open space, rural charm, and scenic beauty. A relatively large proportion (around 18%) of residents in both counties are 65 or older, and that proportion is increasing.[7]

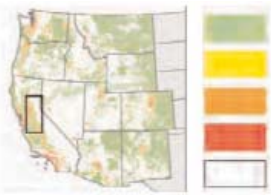
Second-Home Owners: Many second-home owners are buying property in Amador and Calaveras counties due to the amenities mentioned above and availability of cheaper land compared to coastal and inland urban metropolitan areas. Second-home owners receive many of the benefits and services (water and sewer) of permanent residents in the community but do not pay year-round service fees or spend money within the community, both of which help to maintain and upgrade infrastructure. The increase in second-home ownership supports data forecasting future housing demand outpacing actual population growth.

Extreme Commute: Many Amador and Calaveras residents commute to nearby urban job centers for employment, with affordable housing and rural living offsetting time spent commuting. This trend has led to long driving trips as residents travel to Sacramento, Modesto and Stockton, and even as far as the Bay Area, while living in the western portions of Amador and Calaveras counties. This means that regional or "outside" growth trends will play an increasingly important role in development within the two counties.

Sierra Nevada Development Projections, 2000-2040



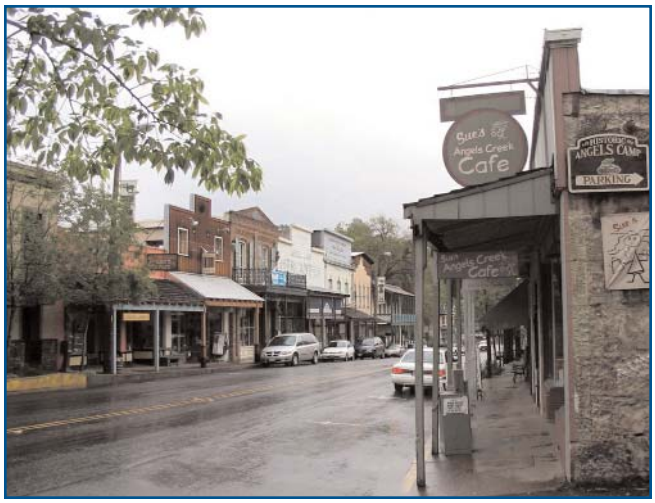




Land Use Categories

- Rural (<1 unit per acre)
- Exurban (1 unit per acre)
- Low Density Suburban (1unit per 0.5 to 10 acres)
- Urban/Suburban (>2 units per acre)
- Not Buildable

Actual and projected housing densities for the Sierra Nevada region.



Historic compact development in Angels Camp.

Changing Economies: Sierra communities have been traditionally dependent upon natural resources for their income. Mining, logging and ranching were the cornerstone of the Sierra economy in past decades. California's recent real estate boom, the advent of telecommuting and the exodus of retiring Baby Boomers from urban centers have resulted in changes in the Sierra economy. Construction and real estate development, business services and consumer services are all growing segments of the Sierra economy.[8]

CHANGING DEVELOPMENT PATTERNS

Amador and Calaveras counties, and the Sierra region as a whole, are in transition. Historically, towns were arranged in small blocks with a central commercial main street. Residences were included in the town center, and residential neighborhoods were adjacent and connected to the town core.

The prevailing pattern of recent growth has been relatively more dispersed. Lower density residential development is scattered beyond the fringe of existing communities, often extending well beyond the reach of existing services. Newer commercial uses are separated from the residential areas they serve and occur in highway strip and regional-box formats rather than in downtowns.

A mix of market forces and local policies have driven development of new and often bigger homes on larger lots at lower prices in comparison to the cost of homes in nearby urban centers.

In combination, these characteristics spread development over a wider area, with a greater proportion of development relying on wells and septic systems.

While growth has provided new opportunities to preserve and revitalize the communities of Amador and Calaveras counties, development patterns to accommodate this growth have also caused strains on water and sewer systems and other public infrastructure (e.g., congested roadways). These changes are evident from a variety of social, economic and environmental indicators:

Increasing Vehicle Miles Traveled: Long distance commuting as well as relatively dispersed patterns of development – housing located outside and often well beyond existing communities – impact travel patterns. Vehicle Miles Traveled (VMT) is a measure of the number and length of auto trips in an area, and is rising regionally and locally. In the Sierra region, VMT increased by 30% from 1990 to 2000.[9] In Amador County, VMT increased 23% between 1999 and 2006, while Calaveras County saw a 16.2% increase over the same period.[10] The linkage between development patterns, commute patterns, employment and retail locations, and higher VMT are important to watershed conditions and water resources because of their influence on transportation infrastructure and pollutants associated with it.

Conversion of Agricultural Land: Growth patterns in recent decades have resulted in the conversion of farmland to other uses. Amador County had 5,707 fewer acres of farmland in 2004 than in 1984. Between 2002 and 2004, 261 acres of agricultural land – primarily grazing land – in Amador County were converted to urban development. During that same period, 3,100 acres of agricultural land in Amador County were converted to ranchettes. Ranchette development in the county is outstripping all other forms of development by a 10-to-1 ratio.[11]

Dispersed development pattern in Calaveras County

In nearby Placer County, 27,600 acres of agricultural land were lost between 1992 and 2002, a decline of 14% in just 10 years.[12] Approximately 35,000 acres of large ranches and forest holdings in the Sierra are converted to residential development every year, according to the Sierra Business Council.

Development in Fire-prone Areas: Recent data also show that dispersed development patterns are pushing development into high fire risk areas in the urban-wildland interface. Between 1990 and 2000, 97% of the population growth in the Sierra occurred in areas classified as extreme or very high fire threat by the California Department of Forestry and Fire Protection.

Future growth is poised to continue this trend, with 94% of the land slated for residential development in the Sierra located in extreme or very high fire threat areas. Development in these areas increases the potential for large wildfires due to human activity. After an area is extremely burned, it acts like a giant impervious surface causing rapid runoff containing sediment and other pollutants to nearby waterbodies. Low-density development in fire prone areas also requires more land and property to be protected against fire, thus increasing the cost of providing fire protection.[13]

Wildlife Impacts: The Sierra is home to 50% of California's wildlife populations. Sixty-nine species of plants and animals found in the Sierra are considered at risk by state or federal agencies, and habitat loss is the greatest threat to their continued survival.[14] Between 1990 and 2000, the size of the wildland-urban interface in the Sierra grew by 130,000 acres, an 11.5% increase.[15]

Land Use Policies and Water

The pressure to grow and the development patterns to accommodate this growth have significant implications for water resources in Amador and Calaveras counties. Current policies and regulations do not favor alternatives to land consumptive, inefficient development patterns that undermine water quality and supply.

Ultimately, the alignment of water and land use must occur through decisions made at the local level. The shape and configuration of growth is largely a reflection of local land use policies. In California, the General Plan serves as the foundation for addressing the highly diverse development issues and interests, providing a basis for integrating policy solutions with multiple budgets, plans, and resources involved.

Both Amador and Calaveras counties are undergoing General Plan updates at this time. Decisions that are made during the process will need to be reflected in local codes, including zoning and subdivision regulations. These codes and ordinances implement the broader strategies outlined within the General Plans.

Together, these planning tools shape the ways communities are built; they specify the type, intensity and configuration of development, which leads to the patterns of development both within a given community and more broadly in a region. Growth and land use patterns that are established now will affect future development, infrastructure, transportation, economic, ecological and social conditions in the two counties.

Property Rights and Land Use Planning

Local planning efforts are often met with resistance from local landowners concerned with the impact of land use regulations on their property rights. A locally relevant example can be drawn from a planning effort in Nevada County called "Natural Heritage 2020" that sought to apply

landscape scale conservation to county planning. The effort spurred a backlash from property owners in the area who perceived the effort to be a threat to their values and property rights. The dispute was divisive for the county and lead to a polarized planning process.

This debate has significant ramifications for Amador and Calaveras as the counties and cities therein update their General Plans and implement codes and ordinances. This raises important questions to consider as local planning processes look to preserve open space, agricultural land, habitat and other valued areas that also have development potential. Retaining the broadest range of those benefits is likely to take a combination of policies and programs that respect local values and avoid the divisiveness of a full-blown property rights debate.

LOCAL PLANNING EFFORTS

Amador County

Amador County is considering revisions to its General Plan Land Use Classification system. Key policy ideas that have emerged thus far are described briefly here, and in more detail in relevant sections later in this document. The proposed land use classifications include:

- A new Special Planning Area-Residential (SPA-R) designation that has been added to certain locations to maximize residential development yield in these areas for low- and moderate-income households. This can help provide affordable housing at densities that are less water consumptive and less costly to provide water and sewer service.
- Mixed-use Activity Centers: The Town Center (TC) designation and a new Regional Service Center (RSC) designation are intended to provide a greater mix of uses than is allowed under current zoning. Both create a target area for growth, which would help reduce sprawl-type growth patterns. Both would introduce higher levels of density, but the RSC areas would feature higher density and intensity uses than those found in the TC designation.

  More broadly, this development strategy offers a means to focus growth into specified areas at residential densities and commercial intensities sufficient to fund public utilities and infrastructure, increase access to jobs and services, and limit the spread of development onto undeveloped land.
- The Watershed Overly designation would be applied to lands within identified watershed areas. Parcel size will be determined by the underlying designation. Any new construction (including structures, infrastructure, roads) occurring within the designation shall implement County-defined low-impact development (LID) techniques to prevent water quality impacts. Agricultural activities on land overlaid by this designation will use County-defined best management practices to prevent water quality impacts.

  The intent of this designation is to ensure the best feasible or appropriate practices are followed in lands most affecting the water quality and riparian habitat functions of streams and rivers within the County. In applying these policies to individual properties over the course of implementing the General Plan, the County will ensure that recommended best management practices do not deprive property owners of reasonable use of their land.

Proposed Land Use Alternatives

Working with an advisory committee, the General Plan consultant originally prepared three land use alternatives for consideration in developing the General Plan land use map.

Broadly speaking, the first alternative represents a continuation of Amador County's existing pattern of development. In the second alternative, a small number of service centers are introduced, which offer the opportunity to encourage growth in targeted areas. The third alternative introduces a larger number of service centers, along with broader agricultural designation areas that work to focus development into the service centers and community areas.

In response to community input, a fourth alternative was developed that encompasses some aspects of the second and third scenarios.

The land use alternatives were used in a planning workshop in May 2008 where more than 100 community members from Amador and Calaveras counties viewed computer simulations of where growth would occur in the alternative growth scenarios. Water-related impacts were calculated for the alternatives.

Results from the analysis found that the "business as usual" alternative would consume more land, create more impervious services, serve only one-quarter of all residents with central sewer, and place people an average of 5 miles from city centers. This dispersed pattern of growth translated into more roads, more infrastructure and more water quality issues stemming from septic systems.

A smarter growth alternative (next page) was created by combining the second and third General Plan scenarios. Results from this analysis found that the average distance to cities would be reduced by half, the amount of residences served by sewer infrastructure would double, and more housing would be accommodated on less land and thus the rate of raw land converted by urbanization would be reduced.

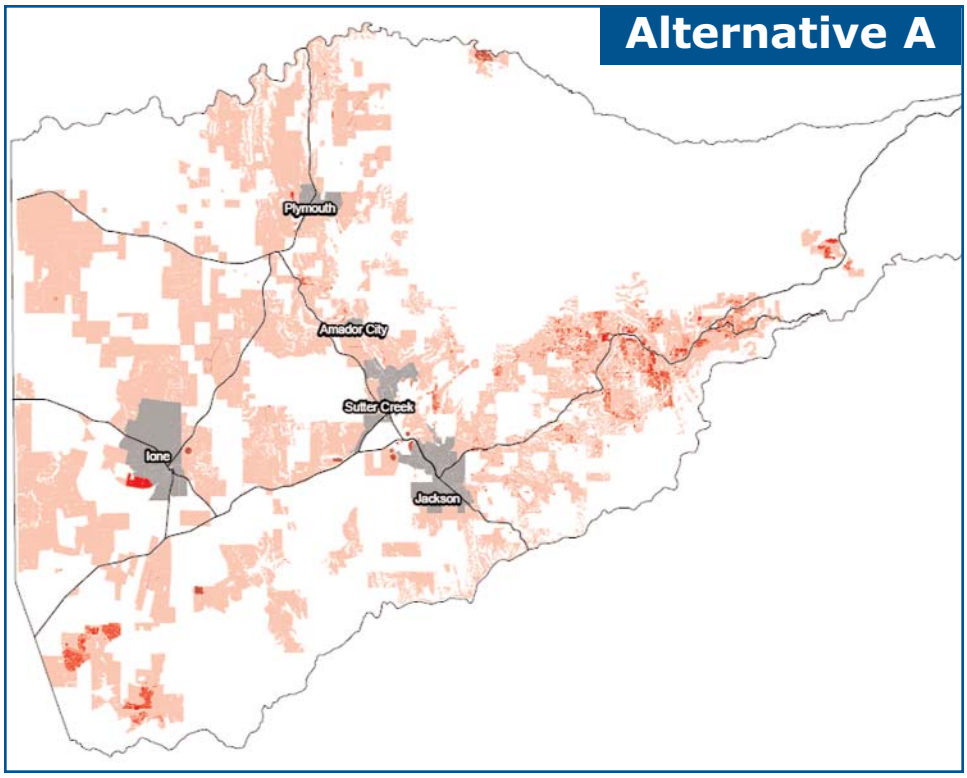
The alternatives to the existing development pattern introduce innovative planning strategies including the use of form-based codes, a greater mix of uses, targeted growth areas and minimum densities (not just maximums).

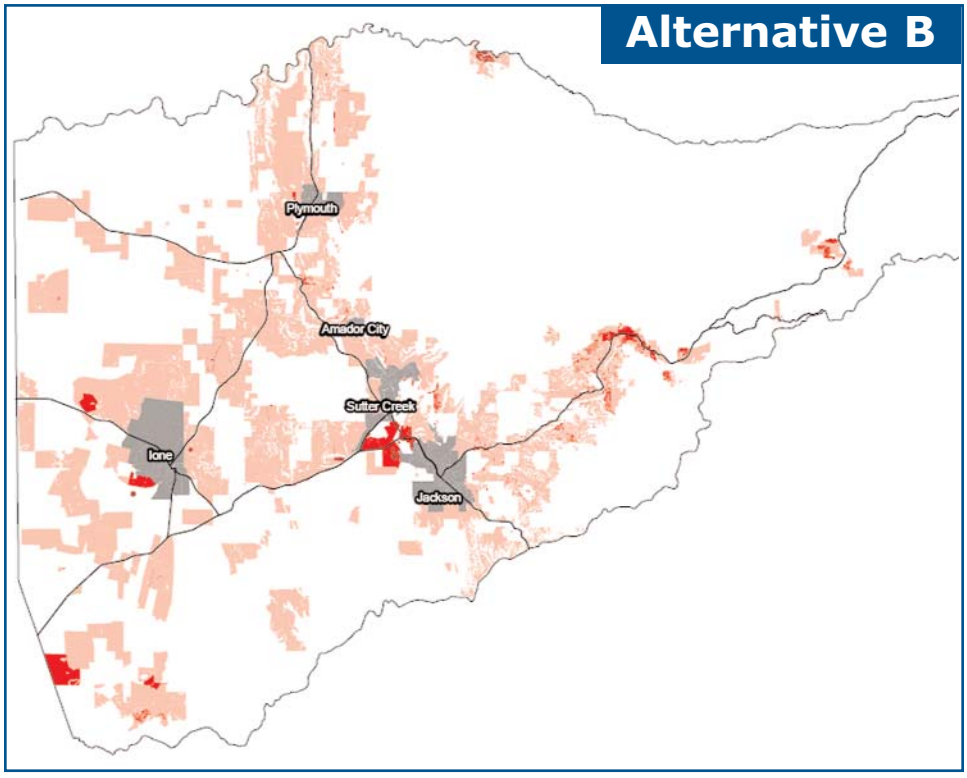
Calaveras County

The Calaveras General Plan Update consultant has produced a baseline report with findings that will influence policy for the County. Several implications can be drawn from the report:

- A significant proportion of the county is "vacant" private land with high development potential. Unimproved private lands classified by the County as "vacant" make up approximately two-thirds (65.9%) of the unincorporated planning area. Most of this land is in private ownership, particularly in the western part of the county.
- The largest single classification of the county is zoned "unclassified" and is likely to face increasing development pressure. In 2007, 224,821 out of the 662,791 acres in the Planning Area (33.9%) were zoned "unclassified." This classification creates uncertainty about the future location and pattern of development, particularly when coupled with the county's relatively high proportion of single-use, low-density zoning.
- Most growth will occur in the western portion of the county. The western portion of the county is flatter, has developed water supplies, poses fewer constraints to development, has more road access, and is closer to nearby urban areas and job centers. Lands owned by federal, state and local governments form slightly over one-fifth (21.3%) of the Planning Area. While public lands are dispersed throughout the county, the largest concentration is in the higher-elevation eastern part and around major reservoirs.
- There is currently a high proportion of low-density zoning. Existing residential land uses constituted only 2.3% of the land base in the Planning Area (15,307 acres) in 2007. However, the 1996 General Plan designates 28.8% of the Planning Area (more than 190,000 acres) as low-density (5-acre or 20-acre) "Future Single Family Residential." As of 2007, only 396 of the 662,791 total acres in the Planning Area were devoted to more compact, medium-density and high-density residential uses.
- Development patterns are highly dispersed. At the 2000 Census, some 12,832 (32%) of the county's 40,554 residents lived in unincorporated areas outside of existing communities. Most lived along state highway corridors.

Recently, a draft "Issues and Opportunities Report" was released that highlights several policy questions to consider in the development of policies and land use alternatives. The report





These maps show countywide build-out in 2015 based on land use alternatives being considered for the Amador County General Plan. Alternative A represents "business as usual," and Alternative B includes higher-density development nodes and mixed-use centers. When comparing open land converted by development, Alternative A uses 49,680 acres while Alternative B requires 7,270 acres. Alternative A consumes an extra 20,000 acres of land and accommodates less development when compared to Alternative B.

makes important connections between the design and configuration of future development and community character, open space, economic development, balancing jobs and housing, infrastructure planning, and other issues.

County supervisors also voted to work with local water agencies to develop a Water Element for the General Plan. This provides an opportunity to connect water, land use and development decisions, and to bring together various interests in the county that are engaged in these issues.

The existing General Plan does not establish a clear direction for growth or set forth a blueprint to create vibrant communities with services and diverse opportunities. The large portion of vacant and unclassified land within the county leaves those areas open to interpretation, allowing development to occur without regard to larger planning or land use strategies. The majority of the county's unimproved lands are also privately held and located in the western portion of the county, where future development will most likely occur.

Strategies will have to include strong incentives to enlist private landowners in partnerships to accommodate growth in preferred areas and with development patterns that preserve water quality and supply.

WATERSHED DESCRIPTIONS AND ISSUES

Watersheds in the Sierra Nevada are an essential source of natural capital for the state's multi-billion dollar economy. Sierra snow pack is California's single largest water storage system. The 24 major watersheds of the Sierra Nevada supply around 65% of California's drinking water.[16]

Water accounts for 60% of the total dollar value of all natural products or services produced by the region – more than forest products, agricultural products, recreational services or residential development.

Direct value of this water for irrigation, municipal and hydroelectric use is $1.3 billion a year, based solely on water rights. That doesn't include value-added sale or use of that water – such as the electricity generated or the crops produced.[17]

Amador and Calaveras counties are in the heart of the water-rich Sierra region and possess some of California's most important watershed systems. Amador and Calaveras counties contain parts of four major watersheds: the Calaveras River Watershed, the Cosumnes River Watershed, the Mokelumne River Watershed and the Stanislaus River Watershed.

Upper Mokelumne River Watershed

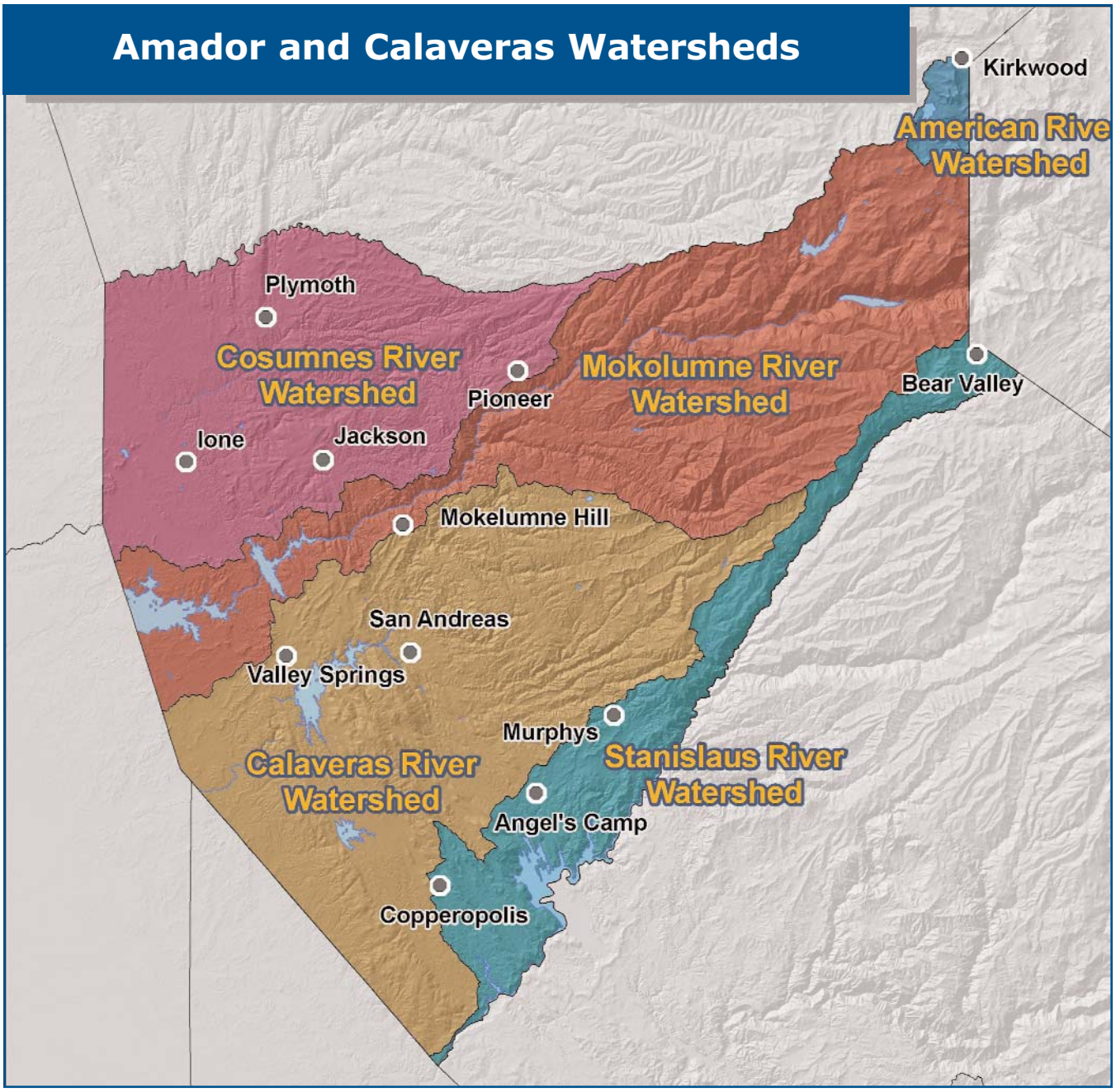
The Upper Mokelumne River Watershed is a critical source of water for the state. It is the primary source of drinking water for both Amador and Calaveras counties, and also the primary water supply for the millions of people served by the East Bay Municipal Utility District (EBMUD).

Starting at an elevation of 10,400 feet in the Sierra Nevada, the Mokelumne River drops through the foothills to the Central Valley where it joins the San Joaquin River. Along the way, it passes through several lakes and reservoirs. Approximately 660 square miles of land drains to the Mokelumne River. The river and associated watershed provide critical water resources at the local, regional and state level. Communities found within and outside of the watershed depend on it as a water supply for municipal and agricultural uses, hydroelectric power, wildlife habitat and aquatic ecosystems, and recreation.

The Pardee Reservoir is the general dividing line between the upper and lower watershed. The upper watershed is characterized as "wilder" than the lower watershed due to the large amount of open space (including public and private timberlands) and sparse population.

Several local leaders and community groups are advocating for wilderness designation, but other watershed stakeholders are opposed because wilderness designation would limit certain activities.

Amador and Calaveras Watersheds



Due to its importance at the local, regional, and state level, the Upper Mokelumne River Watershed has received significant attention and funds for watershed planning and water management in recent years. State bond money and federal grants have supported watershed management efforts, including the Mokelumne/Amador/Calaveras Integrated Regional Water Management Plan (M/A/C IRWMP) and the more recently completed Upper Mokelumne River Watershed Assessment and Management Plan (UMRWAMP).

The UMRWAMP is primarily focused on water quality, identifying pollutant sources and activities that contribute to water contamination. The plan includes an assessment that was completed using a modeling tool known as the Watershed Analysis Risk Management Framework (WARMF). The WARMF model was used to identify threats and pollutant sources within the watershed and also enabled detailed analysis of the watershed impacts of various land use activities.

The UMRWAMP's assessment was used to develop a framework of recommended management measures and implementation activities. Over one-third of the proposed management measures address land development, land use or the organization of the built environment in relation to watershed health and water quality. Specific recommendations include:

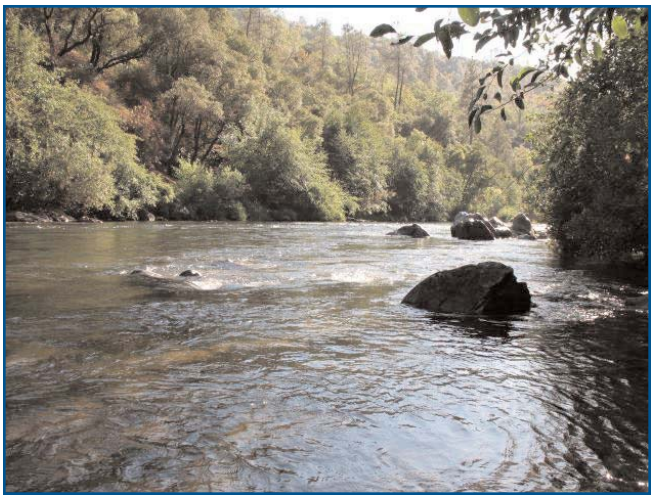
- Encourage compact development.
- Purchase development rights and conservation easements.
- Include policies within the General Plan to protect watershed health and water quality.
- Eliminate leakage from septic systems.
- Use green street design to minimize stormwater runoff, reduce peak flows and remove contaminants.

The plan was completed by the Upper Mokelumne River Watershed Authority. Members of the Authority include the Alpine County Water Agency, the Amador Water Agency, the Calaveras County Water District (CCWD), the Calaveras Public Utilities District, EBMUD, the Jackson Valley Irrigation District, and Alpine, Amador and Calaveras counties.

The WARMF model is one of the most powerful watershed modeling and assessment tools available anywhere. Currently, the model is only set up to work in the Upper Mokelumne watershed, which is a critical basin from a water supply and ecosystem health perspective but is not expected to see as much growth as other watersheds, particularly those in the western portion of the county.

The Authority is contemplating extending the tool to other watersheds, but that will require additional resources to load various data into the model. If this is done, the WARMF model would become a valuable tool for watershed assessment and water-quality monitoring in both counties.

The Mokelumne/Amador/Calaveras Integrated Regional Water Management Plan (M/A/C IRWMP) was completed in November 2006 with Proposition 50 funds. It encompasses the



The Mokelumne River

majority of the Mokelumne and Calaveras River watersheds, Amador County and parts of Alpine, Calaveras and San Joaquin counties.

The project was initiated through adoption of a Memorandum of Understanding (MOU) between the Amador Water Agency, EBMUD, Amador County, the City of Jackson, the Amador Regional Sanitation Authority, the City of Plymouth, the CCWD and the City of Sutter Creek.

Stakeholders are preparing to update the M/A/C IRWMP. This provides an opportunity for better land use integration. The M/A/C IRWMP identified five specific regional goals:

- Water Supply – Improve regional water supply reliability; reduce dependence on imported water; promote water conservation; and water reuse; and protect watershed communities from drought with a focus on interagency conjunctive use of regional water resources.
- Flood Protection – Ensure flood protection strategies are developed and implemented through a collaborative and watershed-wide approach and are designed to maximize opportunities for comprehensive management of water resources.
- Water Quality – Protect and improve water quality for beneficial uses consistent with regional community interests and the Regional Water Quality Control Board Basin

Plan through planning and implementation in cooperation with local and state agencies and regional stakeholders.

- Environmental Protection and Enhancement – Work with the community and environmental stewards to preserve the environmental wealth and well-being of the Mokelumne and Calaveras River watersheds by identifying opportunities to assess, restore and enhance natural resources of streams and watershed when developing water supply, water quality and flood protection strategies.
- Regional Communication and Cooperation – Develop a forum for regional communication, cooperation, and education, including models for partnerships and inter-basin cooperation, protocols for reducing inconsistencies in water management strategies between regional entities, and strategies for maintaining resource costs within the local socio-economic environment.

Upper and Lower Calaveras River Watershed

Like the Mokelumne, the Calaveras River is a tributary to the San Joaquin River Delta system. Flow in the Calaveras River is derived almost exclusively from rainfall, with minimal contributions from snowmelt. There is a series of small flow impoundments in the upper watershed, including New Hogan Reservoir and White Pines Lake near the town of Arnold. White Pines Lake is owned by the CCWD and has a storage capacity of about 262 acre-feet.

The Calaveras River has an associated watershed of 470 square miles, which captures annual runoff of around 166,000 acre-feet of water. Approximately 363 square miles of this area is located above the New Hogan Reservoir. The entire upper watershed and a small portion of the lower watershed are located within Calaveras County.

The watershed encompasses the communities of San Andreas, Mountain Ranch and Sheep Ranch, and developments in Valley Springs, Rancho Calaveras and Jenny Lind.

Flooding along Cosgrove Creek

Major tributaries and smaller creeks within Calaveras County flow into the Upper Calaveras River. Cosgrove Creek, originating north of the town of Valley Springs, confluences with the Lower Calaveras River downstream of New Hogan Reservoir. The Creek supports sensitive habitat for endangered and threatened species. There have been recent flooding problems in areas along Cosgrove Creek, due in part to development within its drainage basin.

In addition to problems associated with flooding, portions of the Lower Calaveras River are included on the State Water Board's 303(d) listing due to the presence of diazinon, organic enrichment and pathogens. Potential sources of these pollutants identified by the Central Valley Regional Water Quality Control Board include urban runoff, storm sewers, and recreational and tourist activities. Leakage from failing residential septic systems is a significant problem throughout the project area, as indicated by the relatively high level of pathogens in the Lower Calaveras River.

The Calaveras River Watershed has not seen the level of assessment or planning as the Mokelumne River Watershed. The Calaveras River Watershed Stewardship Group was initiated to encourage "preservation and proper management of the Calaveras River Watershed through watershed-wide cooperation between landowners, water users, recreational users, conservation groups, and local, state, and federal agencies."

The group is largely comprised of agencies and interests in the Stockton area and focuses on the lower reaches of the watershed in San Joaquin County. Its goals are to protect private property rights, restore and conserve riparian habitat, protect threatened and endangered species, coordinate public and private efforts in the creation of a resource conservation and land use plan, promote best management practices for water management, prevent the spread of non-native invasive species, provide education and outreach, and improve recreational use of Lower Calaveras River Watershed.

The CCWD and the Stockton East Water District (SEWD) have partnered to examine drinking water quality in the Calaveras River Watershed. As part of their two-phase Watershed Plan, data were collected and analyzed, revealing acceptable water quality within the watershed, with the exception of fecal coliform bacteria found in concentrations throughout the watershed. Nutrient concentrations and subsequent eutrophication, dissolved oxygen and surface water temperature are all water issue areas that could potentially be affected by fecal coliform bacteria, raising the concern that the water quality in the Calaveras River Watershed may not fully support its designated beneficial uses.

The study also suggested that increased water temperature and dissolved oxygen levels "might potentially be exacerbated by the absence of an adequate and healthy riparian zone in the watershed."

Upper and Lower Stanislaus River Watersheds

While the Stanislaus is one of the largest watersheds in California, it is also less studied than many other rivers in the state. There has been long-term monitoring and data collection, but mostly relating to anadromous fish populations and dams due to extensive water diversion and surface storage projects (i.e., New Melones and Lake Tulloch in Calaveras County). Restoration efforts have largely focused on impacts from these types of projects as they relate to salamonid populations.

Lake Tulloch is a major reservoir on the Stanislaus River.

The river creates the dividing line between Calaveras and Tuolumne counties with a portion of the Upper Stanislaus Watershed located in Calaveras County. The town of Copperopolis and numerous residential subdivisions around Lake Tulloch are located in the Upper Stanislaus watershed while the towns of Dorrington, Arnold, Murphys and other adjacent smaller communities are located along the Highway 4 corridor that follows the ridgeline separating the Upper Stanislaus Watershed from the Upper Calaveras Watershed. Currently, the Stanislaus River does not have a watershed plan.

Cosumnes River Watershed

The Cosumnes River is the last remaining "undammed" river on the western slope of the Sierra Nevada Mountain range that contributes to the Bay-Delta ecosystem. Stretching just over 80 miles, the river begins high in the mountains at an elevation of 7,200 feet and drops down through the foothills and converges with the Mokelumne River in the San Joaquin Valley. The South Fork of the Cosumnes River runs through northern Amador County.

The Cosumnes River Watershed drains a total of 936 square miles. Rainfall makes up most of the river's flow with snowmelt accounting for a small portion. The river flows year-round in the upper watershed but is intermittent during the summer in the lower watershed.

The upper watershed is relatively untouched and has little to no development. The lower

Wetlands along Cosumnes River provide habitat and the opportunity for floodwaters to recharge groundwater supplies.

reaches of the watershed are mostly dominated by agriculture but land is increasingly being converted to urban uses. The rapidly urbanizing City of Elk Grove has the most influential role on the Cosumnes flow regime and interestingly enough is located outside of the watershed boundaries.

Water resources within the Cosumnes Watershed are managed by multiple agencies, including the Army Corps of Engineers, the U.S. EPA, the U.S. Fish and Wildlife Service, local water agencies, the California State Water Resources Control Board, cities, counties and private landowners. In 1996, a total of 133 water diversion rights existed on the Cosumnes River with the majority of diversions used for urban water needs.[18] Grazing and agriculture in the watershed rely primarily on groundwater.

Water quality in the Cosumnes River is high, but groundwater overdraft is a priority concern. Overdraft of groundwater both in the upper and lower watershed has caused the baseflow of the Cosumnes to drop, even resulting in the river running dry during summer months in the lower reaches of the watershed. In Sacramento County, the groundwater table has been falling one foot each year for the past 50 years.[19] This means that floodwaters that would normally provide the base flow for the Cosumnes are being "sucked" out of the basin to fill depleting aquifers.

In the upper watershed, overdraft of aquifers is problematic but for a different reason. Groundwater in the upper portions of the watershed is held in small granite fissures that are hard to locate and produce an unpredictable water supply. Once these granite "holding tanks" are depleted, there are only a few available water sources to recharge them. Water scarcity in the upper portions of the watershed will be a limiting factor for growth in the region and will exacerbate problems in the lower watershed.

WATERSHED ISSUES

Water Supply and Demand

There are increasing demands on the region's limited water resources. Surface water accounts for approximately 98% of the Amador Water Agency's total supply and is the primary supply source for the Calaveras County Water District.[20] However, surface water in the Sierra is also the principal water supply for the rest of California, meaning prior water rights appropriations for downstream or out-of-basin users demand a large portion of the surface water collected in the Sierra.

The Upper Mokelumne and Tuolumne River watersheds provide water supplies for large Bay Area cities on the San Francisco Peninsula and in the East Bay region.

At current levels of per capita water use, the water demand generated by California's future residents will require a 40% increase in supplies. Since 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, cutbacks on the amount of Colorado River water coming to California, the consistent threat of water shortages and drought, groundwater contamination, and the impacts of climate change. This means there is greater need for water but less of it to go around. Water supplies also vary seasonally and from year to year, depending on precipitation, snowpack and corresponding runoff.[21]

Climate change, which is predicted to shrink the Sierra snowpack by 25% to 40% by mid-century, increase the magnitude of wet or dry year extremes, and cause early spring runoff peak flows, will also limit water supply. Water management professionals, local governments, land use planners, air quality districts and other local, regional and state agencies are just beginning to understand potential impacts of climate change on watersheds and water resources in the Sierra Nevada region. Work on the issue has not occurred in Calaveras or Amador counties.

Local water use and management practices are not reflective of these challenges. Groundwater use is unmonitored, infrastructure is inadequate and getting worse, conservation is not widely embraced in policy or practice, and perhaps most importantly, the numerous agencies and districts managing water, wastewater and watersheds are not well-coordinated and have a history of infighting and conflict, which often prevents meaningful coordination. Furthermore, local planners and water managers are not well aligned – water and land use decisions are made in relative isolation.

Water quality concerns within Amador and Calaveras counties will impact the reliability of future supplies as well. Leaking septic systems, which are dispersed widely throughout both counties, threaten both surface and groundwater sources. In more developed areas, stormwater runoff is becoming a more important issue as well.

In combination, these factors mean that demand for the region's water supplies are likely to increase, while the availability of those supplies can be expected to decrease, particularly under projected climate change scenarios.

Stormwater

Stormwater is an issue of growing importance in both counties. The Lower Calaveras River, the Lower Mokeumne River and the Comanche Reservoir are listed as impaired waters at least in part because of urban stormwater runoff. The Lower Calaveras River has elevated levels of pesticides, nutrient enrichment and pathogens (most likely a legacy effect from older, on-site wastewater treatment systems).

Many contaminants that affect water quality are washed into rivers and streams via stormwater runoff. Runoff carries pollutants deposited on streets, parking lots, lawns, rooftops, cars and anything else it encounters as it travels over the built environment.

Many pollutants are related to automobiles. Metals such as lead, copper, zinc, chromium and manganese can either be "shed" directly from automobiles or can be deposited from auto-related air pollution onto impervious surfaces. Gasoline, oils, antifreeze and other chemicals that can commonly be seen dripping from cars are also found in stormwater runoff.

Contaminants can also come from lawns and gardens, including pesticides, fertilizers and pet waste.

Given the universality of these problems from other urban and urbanizing areas, Amador and Calaveras can expect additional problems in protecting their streams from urban runoff unless steps are taken soon. Fortunately, there are lessons that can be learned from communities that have already altered their ways of doing business to conform to new environmental regulations.

Stormwater Planning and Management Activities

Amador County is not designated as a Phase II MS4 permittee and, therefore, is not under the stormwater provisions of the NPDES program. However, construction activities are under the provisions of the general construction permit. Amador County has established a drainage permit for new development and addresses grading and drainage in Title 17 of the County Code. Goals and policies emerging from the General Plan update also address stormwater. In particular, there is interest in applying low impact development (LID) practices, which are designed to manage stormwater impacts of new development.

Runoff from roads carries pollutants into local waterways.

The Amador General Plan update addresses site-level stormwater considerations in the Draft Policies Workbook:

- Goal C-3: Minimize negative effects of point and non-point sources on water quality.
- Policy C-3.1: Encourage site plan elements in proposed development such as reduced pavement/cover and permeable pavement, as well as drainage features, which limit runoff and increase infiltration and groundwater recharge. Measures may include reduced pavement or site coverage, permeable pavement and/or drainage features.
- Policy C-3.5: Develop and implement a comprehensive stormwater management program to limit the quantity and increase the water quality of runoff flowing to the county's streams and rivers.
- Policy C-3.6: Maintain and improve existing drainage and stormwater infrastructure, and develop new drainage and stormwater infrastructure as needed. Consolidation of this function to a single County department or responsible agency is desirable.

In 2007, Calaveras County was designated a Phase II community by the Central Valley Regional Water Quality Control Board, meaning that the County needed to adhere to the six minimum control measures outlined in the State's General Permit. Calaveras County's Phase II designation has initiated local efforts to update stormwater management requirements and practices in the county.

Until now, Calaveras County has not had a local ordinance for regulating grading, drainage or erosion control and has relied instead upon the provisions of California Building Code. However, having come under the provisions of NPDES Phase II municipal stormwater regulations, and citing gaps in authority and enforcement that have led to failures of practice and frustration among and between developers, County staff and the community, the County moved to develop:

- A stormwater quality control ordinance.
- A grading and drainage ordinance.
- A design manual for grading, drainage and erosion control.

The County's ordinance is intended to provide:

- Clearly articulated local authority.
- A tiered permitting strategy recognizing that "one size fits all" is not a successful strategy for encouraging comprehensive compliance.
- A tiered fee schedule that encourages cooperation and compliance.
- Performance-based compliance standards backed by progressive enforcement.
- A design manual to assist with compliance.
- Maintenance security to assure ongoing functionality of pollution prevention measures.

Wastewater

Wastewater is sewage (either treated or untreated) from residential, commercial, industrial, and institutional sources, and is a fact of human settlement. In addition to procuring water supplies for growth, new development

Regulatory Background for Stormwater Management:

The Clean Water Act and the National Pollutant Discharge Elimination System Program

Passed in 1972, the Clean Water Act is the principal law governing water quality in the United States. The Act gave the U.S. Environmental Protection Agency authority to set water quality standards and made it unlawful to discharge pollutants from point sources (such as a pipe discharging waste from a factory or other discrete outlet) into navigable waters without a permit. In California, the Porter-Cologne Water Quality Control Act gave 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.

Initially, the National Pollutant Discharge Elimination System (NPDES) program was geared toward addressing pollution from factories and other "point sources" of pollution. In 1987, the NPDES program expanded to address discharges from stormwater systems.

Stormwater runoff had previously been considered a "non-point" source (NPS) of pollution (i.e., pollution from multiple indiscrete sources such as pollutants collected on roads or lawns and washed into waterways). The expansion of the NPDES program to include stormwater runoff was based on the concept that stormwater runoff effectively becomes a "point source" of pollution once it is collected in a city's storm sewer system and discharged into local waterways. 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.

The NPDES program was instated in two phases. Phase I regulations were directed at areas with a population of 100,000 or more. Phase II regulations were issued in 1999 to expand permit coverage to smaller communities with a population of less than 100,000, but generally over 10,000 residents. Until recently, the new stormwater regulations had not been a concern in Amador and Calaveras counties because of their size. That changed with the issuance of Phase II requirements.

To comply with the General Permit, Phase II communities are required to develop a Storm Water Management Program that implements appropriate best management practices (BMPs) to reduce the discharge of pollutants to the maximum extent practicable. Small MS4s permits now prescribe a set of six minimum control measures that must be implemented along with evaluation and assessment efforts: (1) public education and outreach, (2) public participation, (3) illicit discharge detection and elimination, (4) construction site runoff, (5) post-construction runoff control, and (6) pollution prevention and good housekeeping.

Measure 5 is particularly relevant to the connection between water and land use planning. Post-construction runoff control refers to management measures that address stormwater in areas once they are developed. This includes a growing array of planning and design strategies intended to reduce the impacts of development and impervious cover on water quality. According to the State's General Permit:

"The Permittee must require long-term post-construction BMPs that protect water quality and control runoff flow to be incorporated into development and significant redevelopment projects. Post-construction programs are most efficient when they stress (i) low impact design (LID); (ii) source controls; and (iii) treatment controls."

requires a system or systems for handling wastewater. Major pollutants found in wastewater include ammonia, organic matter, nutrients, pathogens, metals and suspended solids.

Different types of wastewater systems have been developed for a variety of circumstances.

- Centralized Sewer Systems use 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. A wastewater treatment facility (WWTF) will treat sewage to a sufficient level to either be discharged to a local waterway or be reused.
- Decentralized Systems include traditional septic-leach field systems, as well as a range of other engineered solutions, some of which can be shared between multiple residences.

The relationship between wastewater management, development and land use decisions, as well as water quality and reliability is multi-faceted. Options for wastewater management differ by development context, and will affect development patterns. For instance, development within existing service areas can use central sewers and treatment plants more easily and at less cost than development far from existing infrastructure, which would require major investment to extend and maintain infrastructure.

For outlying development, on-site or decentralized systems, including septic systems, are used for wastewater treatment but have land area requirements that result in larger lots, thus driving lower density development. Failing septic systems are also a common problem and have been associated with health concerns and water quality – particularly groundwater.

There is an important link between the prevalence of these system and recent development patterns, which has resulted in development that is beyond central sewer systems and spread out. In addition to the amount and distribution of these systems, many are older, not maintained and are failing.

Several factors come into play when considering the relationship of wastewater management to land use and development. At the most basic level, infrastructure constraints in both Amador and Calaveras counties are pushing the need to repair, upgrade or build new community-based treatment plants.

The Upper Mokelumne River Watershed Project Authority's Watershed Management Plan indicates that extending wastewater collection and treatment systems may be the best option to reduce the volume of pollutants from failing septic systems entering local water bodies,[23] but this is likely cost-prohibitive, and may induce growth in outlying areas. As a result, the plan calls for coordinating future growth with existing infrastructure as one of its management measures.

These decentralized systems, also called on-site wastewater treatment systems (OWTS), are the predominate means of wastewater treatment in both Amador and Calaveras counties. According to a 2003 assessment conducted by the California State University at Chico, Amador County had 9,600 OWTS serving 64% of the total housing units in the county, while Calaveras County had 15,378 units serving 69% of the housing units. No regular monitoring is required for septic permits and, therefore, there is no documentation on how many systems are either functioning properly or contributing pollutants to the watershed. A number of these systems are old, however, and near the end of the time expected for functional use.

Environmental health officials in both counties indicate that on-site systems installed at this time are under greater oversight and are able to use a variety of engineered solutions to overcome challenges of conventional septic systems. Those officials indicate that the legacy effects of older systems, which may have been improperly sited or installed, or have not been properly maintained, are a more significant problem than newer systems. However, continued proliferation of on-site systems in areas that are beyond the reach of centralized sewer systems is one of the greatest water quality threats in the area.

Local Perspective: Watershed Advocacy for the Mokelumne River

By Pete Bell, Foothill Conservancy

I've been involved in upper Mokelumne River and watershed issues for going on 20 years, representing the Foothill Conservancy. It's a complex watershed and there are a number of competing local and regional demands. We've worked on everything from river access to hydroelectric relicensing.

I represent the Conservancy in a number of different river and watershed forums. We try to be a voice for the river, to represent the river's interest. That doesn't mean we don't appreciate all of the river's economic and social values. But someone needs to speak up for the river as a critical part of our regional environment. So that's what we do, and I'm often the one who does it.

When people are willing to work collaboratively on Mokelumne River and watershed issues, we can all accomplish a lot. For example, in the relicensing of PG&E's hydroelectric project, we ended up with a new 30-year license that begins to restore a more natural flow regime to the upper Mokelumne, removed or dismantled small dams on tributary streams, improved recreation, and established ongoing monitoring and adaptive management.

The work done to develop the Watershed Analysis Risk Management Framework (WARMF) model was another example of good collaboration. Now we just need local governments to actually use the model.

At the same time, it's been difficult to get some of the water agencies to acknowledge that any part of the river needs to stay a river, or to work in a truly collaborative way on regional water and watershed planning. I hope that will change as new leadership comes on board.

One of our long-time goals for the Mokelumne is making sure there's actually a river here for future generations to enjoy. We're making good progress toward securing National Wild and Scenic River designation for the river because there's strong local support. Wild and Scenic designation will ensure that 37 miles of the Mokelumne's North Fork and main stem stay a river forever. That would be a win for everyone.

As we work on that, we'll keep showing up and participating in everything from regional water planning processes to general plan updates. Someone needs to remind everyone else at the table that the Mokelumne is more than a source of water and power.

In the Upper Mokelumne River watershed, 3,000 permitted septic systems are thought to be failing and in need of repair.[22]

Another major concern for both Amador and Calaveras counties is the availability of sewage treatment operations that will accept OWTS solids. There are no wastewater treatment plants in either county that will accept OWTS loads. And an increasing number of jurisdictions that have traditionally accepted OWTS loads, are refusing to take septic tanks loads from areas outside of their boundaries. For example, Sacramento County is no longer taking loads from Amador County or Calaveras County and at least one waste hauler is reportedly hauling its loads as far away as Alameda County.

It is clear that with the influx of new residents in these counties, additional sewage treatment capacity will be required. As more OWTS come online to serve new residents in the counties, expansion or upgrading of existing wastewater treatment plants will need to be made to accept these loads from septic tanks.

3. Watershed-based Planning

Growth pressure seen in recent decades is likely to continue in Amador and Calaveras counties. Today, the questions is not if the area will grow, but how? Communities throughout the Sierra Nevada are looking at ways to accommodate new growth and development while retaining their historic and rural character.

As they update their general plans, communities in Amador and Calaveras counties have an opportunity not only for shaping future development, but also for linking planning and water decisions. With the sustainability of water resources in mind, current policy tools will need to be changed, augmented or removed.

This watershed plan focuses on strategies for local governments and water agencies to consider when making land use and water resource decisions for commercial and residential development. We understand that there are many other contributors to watershed issues and challenges in the region beyond the built environment, such as logging, mining, grazing and other agricultural practices. Securing a reliable and high-quality water supply cannot be solely achieved through better land use decisions but many impacts to the region's water supply can be lessened by local governments applying a water-wise approach to growth and development.

The following chapters discuss a set of watershed-based planning strategies designed to address key issues and goals identified though this project. The focus is on land planning and development decisions that affect water quality, reliability and watershed health. Three sections are:

- Open space and natural infrastructure.
- Community design and planning.
- Sustainable water and watershed management.

Each section begins with an overview and discussion of general policy approaches. This leads to a discussion of related planning efforts in Amador and Calaveras counties and includes challenges identified by the Stakeholder Advisory Committee. To complement the broader strategies provided, each strategy concludes with a set of specific recommendations and model policies.

While there are many approaches to consider, these recommendations target specific issues or opportunities identified through project meetings and workshops, and policy analysis.

All strategies align with the following project goals:

Use Water Efficiently and Sustainably: Plan and design new development and associated infrastructure to make the most efficient use of existing water supplies in tandem with expanding water conservation, efficiency, and reuse efforts in the region.

Protect Natural Assets and Infrastructure: Invest in and promote the protection and restoration of "natural infrastructure" systems that provide water and community benefits such as healthy lands, soils, streams and forests.

Minimize Watershed Impacts of Development: Plan and design development to prevent and minimize its impacts on water resources and watershed health.

Strengthen Existing Communities: Focus growth and investment towards existing communities to ensure efficient use of land, water, infrastructure and fiscal resources as well as to ensure communities remain as physically separate, unique entities.

Maintain Rural Character: Support development patterns that respect traditional rural

character, lifestyles, culture, and economies; protect natural values; and preserve the aesthetic quality of the surrounding countryside.

Support a Prosperous Region: Align development decisions with economic development goals to ensure new growth supports regional prosperity and the ability of residents to live and work in their communities.

Increase Coordination and Collaboration: Create programs and policies that encourage greater cooperation locally and regionally within and among different agencies, promote public involvement and balance different interests.

4. Open Space and Natural Infrastructure

Natural systems and processes within a watershed provide valuable benefits including flood control, water filtration and groundwater recharge. Economists call these benefits "ecosystem services." Increasingly, areas or systems that provide these services are referred to as natural or green infrastructure. This chapter focuses on protecting, restoring and benefiting from the natural infrastructure systems that are embedded within the region's watersheds. This includes various types of open space (e.g., working landscapes, undeveloped open lands) and functioning ecosystem areas (e.g., wetlands, streams and riparian zones), as well as elements of the built environment (e.g., landscaped areas) that can be designed and managed to provide watershed benefits within the community.

The strategies in this chapter are designed to maintain and enhance natural infrastructure to serve water protection and management goals. It is broken into two strategies. The first deals with larger conservation planning and design to preserve intact open space and natural resource areas. The second outlines ways to incorporate natural infrastructure into the built environment to reduce the impacts of development on water resources.

Green infrastructure elements can be large (top) or small in scope.

STRATEGY 1: OPEN SPACE CONSERVATION

Land conservation and watershed protection are connected. The physical, chemical and biological properties of natural land cover are essential to ecological and hydrological processes underlying the health and function of watersheds. Because the loss of natural land cover contributes to watershed degradation, open space policies have a crucial impact on water resources. For watersheds, open space acts to:

1. Capture and store rainwater, snowmelt and runoff.
2. Control flooding and stormwater runoff.
3. Facilitate groundwater recharge.
4. Filter and assimilate pollutants in rainwater and runoff.

5. Sustain natural hydrologic processes.
6. Sustain ecological systems and underlying watershed health.

Ecosystem services depend on the properties of soils, vegetation and processes provided by natural land cover. During development, soil and vegetation are removed and/or compacted, and impervious surfaces replace absorbent land. A number of impacts ensue, including reduced infiltration, increased runoff and impaired water quality.

For these reasons, open space has been used for water and watershed management efforts. For example, water managers in New York City invested $1.4 billion dollars to preserve undeveloped land in rural watersheds that are the source of the city's drinking supplies. This was a smaller investment than the alternative of building a water filtration system that would have cost New York $6-$8 billion dollars. By and large, the public understands these benefits: water quality and drinking water protection are the most common reasons voters support funding for land conservation programs.[1]

General Policy Approaches

At a local level, the most fundamental planning decisions affecting land conservation or open space are tied to the location of future development. The question is where to grow and where not to grow. This chapter discusses the question of where not to grow and how to preserve or enhance undeveloped areas as natural infrastructure, while the following chapter addresses the question of where and how to grow.

In Amador and Calaveras Counties much of what people consider "open space" is privately owned land, including 78% of the land in Calaveras County. Local zoning regulations specify how and even if that land is developed, a fact that elicits strong reactions with respect to private property rights. It is essential to recognize the potential tensions between land conservation and property rights, and to craft programs and policies accordingly. This has a tremendous influence on local policies and programs.

Local conservation or open space programs can operate at different scales. At a larger scale, large swaths of land can be preserved through voluntary or regulatory means, including zoning, easements and use of land trusts and transfer of development rights programs.

At a smaller scale, communities use parkland dedication programs as part of development approval processes to provide open space or parks within or adjacent to urban areas and housing. They can also institute policy tools or management measures, such as riparian buffer ordinances, intended to protect particular areas or resources.

At a site or parcel level, conservation goals can be achieved through a variety of site planning and design practices such as tree protection or removal rules, setback requirements, clustering and hillside or slope protection.

The programs or policy tools used for such an effort will vary depending on available resources, local conditions and the political climate. At the most general level, land preservation efforts can take two forms: market-based (voluntary) and regulatory. There are programs and tools that fall somewhere in between these as well. In California, some of the more common programs and tools include:

- Outright Acquisition.
- Open Space Districts.
- Conservation Easements.
- Williamson Act Protection.
- Timberland Preservation Zones.

Local Perspective: The Importance of Open Space in Amador County

By Katherine Evan, Foothill Conservancy

I have mixed feelings right now about the chances for lasting open space preservation in Amador County.

I'm optimistic because most people here really want to protect open space: it's part of the common ground that binds us together as a community, a defining feature of the county. No matter how long we've lived here, where we came from, or what we do for a living, we love this county the way it is today. I don't think people can even imagine Amador County without its rolling oak woodlands and forests.

Foothill Conservancy has done a couple of informal surveys related to this issue that show how much open space matters to local residents. At our 2001 Amador County Fair booth, more than 90 percent of the nearly 200 Amador residents who filled out a short questionnaire said it was "very important" to preserve local open space. And the 125 respondents to an online survey we did in April 2008 strongly supported preserving local working ranches and farms, open space, water quality and scenic beauty in our general plan.

In addition, the county General Plan Advisory Committee – a diverse group of citizens appointed to work on our general plan update – supported protecting open space and agriculture. The general direction of the plan, as it came out of the GPAC, was to focus development in existing towns and cities and preserve the county's rural character.

So if it were up to the court of public opinion, we'd have an open-and-shut case.

But it's not. And that's why I'm somewhat pessimistic at the moment.

At recent general plan hearings, some members of the Amador County Board of Supervisors and Planning Commission voiced more concern about private property rights than anything else. The boards weakened policy language that wasn't very strong to begin with. They rejected proposals that would have helped prevent conversion of ranch land to residential uses, including the county agriculture department's recommendation. There was little support for strong, mandatory policies, and they even rejected some incentive-based approaches.

So there seems to be a disconnect between what the majority of people in the county value and what's happening in the county general plan update right now.

I still have some hope. If we could have real community dialog on the subject, outside the heated rhetoric of the general plan hearings, I truly believe we could find solutions for preserving open space that would benefit landowners, the community, and the environment.

But as the county becomes more polarized around growth issues and the general plan, that's going to become harder and harder to do.

Grassland Reserve Program Assists Landowners

Grasslands are one of the largest land covers in America on privately owned land, covering around 525 million acres. The Grassland Reserve Program, created in 2002 by the U.S. Department of Agriculture to aid in restoring and protecting grasslands, is a voluntary program that offers financial resources and technical expertise to assist landowners to restore, protect and enhance grasslands on their property.

Participating landowners agree to limit future development and cropping uses of the land, but still retain ownership and the right to continuing common grazing grazes, produce hay, mow or harvest for see production, conduct fire rehabilitation, and construct firebreaks and fences. Common restricted activities are growing crops (such as vineyards and fruit trees) that require breaking the soil and disturbing the surface of the land.

There are several enrollment options for property owners interested in this program:

- Permanent Easement: Payment equals the fair market value minus the grassland value of the land, which is encumbered by the easement. Agreements are made in perpetuity.
- Thirty-year Easement: Payment will be provided equal to 30% of the fair market value minus the grassland value of the land, which is encumbered by the easement.
- Rental Agreement: Participants can choose a 10-, 15-, 20- or 30-year contract. Annual payments will be provided in an amount that does not exceed 75% of the grazing value of the land covered by the agreement.
- Restoration Agreement: The Commodity Credit Corporation may provide up to 90% of restoration costs on land that has never been cultivated and up to 75% of restoration costs for restored grassland and shrub lands that have been previously cropped. A grassland resource management plan must be created that outlines specific restoration activities and be approved to receive funding.

For more information: www.nrcs.usda.gov/programs/farmbill/2002 and www.fsa.usda.gov/dafp/GRP/default1.htm

- Habitat Conservation Plans (HCP) and Natural Community Conservation Plans (NCCP).
- Transfer of Development Rights (TDR) and Purchase of Development Rights (PDR).
- Local Land Use Regulations.
- Greenways and Greenbelts.
- Urban Growth Boundaries Land Trusts.
- Land Trusts.

Two issues that significantly influence how jurisdictions approach conservation and open pace are property rights and financial resources.

Property Rights: Property rights are a politically charged issue throughout the country, particularly in rural areas facing growth pressures such as Amador and Calaveras counties. While regulatory controls, such as general plan designations and zoning, will continue to play a role in land use decisions affecting open space and agricultural lands, there is increasing interest in non-regulatory approaches that are voluntary, market-based and provide alternatives to conventional policy tools.

In discussions with local landowners, it is clear that even the current crop of market-based tools induce a level of commitment and risk that is often uncomfortable for many prospective participants. For example, the term in perpetuity, which is generally part of the legal makeup of a conservation easement, makes many farmers and ranchers uncomfortable.

The idea of "locking up" land forever is the concern. In this respect there is growing interest in alternative tools and programs, including Transfer of Development Rights programs, Purchase of Development Rights programs, carbon credits for ranches and timberlands, and leasing programs that would pay landowners to maintain their land as open space or in agricultural production over a given period to credit the ecosystem services their land provides in its undeveloped state.

Such programs could include stipulations to support sustainable land management practices. The Natural Resources Conservation Service's Grassland Reserve Program (GRP) is an example at the federal scale.

Financing Local Conservation Efforts: There has been a steady reduction in federal dollars dedicated to conservation finance in recent years. California has passed multiple bond measures that can be used to finance strategic conservation efforts that are linked to flood control, water quality and/or water reliability.

The most recent is Proposition 84. Still, local funding is the foundation of any long-term land conservation effort. This poses a challenge because most local government budgets are already strapped.

The citizens of Sonoma County approved a local voter initiative that establishes a funding source for an open space district through an increase in sales tax.

Various forms of revenue sharing and local government coordination, such as Ventura County's Guidelines for Orderly Development, are also used to coordinate growth, development and open space protection.

Local Policy Approach in Amador and Calaveras Counties

Amador County: The County's Preliminary General Plan Goals and Policies document included an Open Space Element and Conservation Element (both required by state law but often combined) that housed many of the most relevant policies.

The Conservation Element included policies related to water quality and supply as well as agricultural land. The Water Quality and Supply subsection included a goal to minimize the impacts of non-point source pollution that included a subsection on Conserving and Protecting Agricultural Lands, which stated the importance of farming and ranching to the county's rural character and economy, and highlighted the importance of private property rights, a theme throughout the document. The section focused on voluntary (non-regulatory) programs such as using Williamson Act contracts or easements as tools for maintaining agricultural lands.

One of the more interesting draft policies was to investigate a transfer of development rights (TDR) program, a market-based tool for trading development rights between areas deemed suitable for development (receiving areas) and those deemed worthy of protection (sending areas). It also referred to infill as a means of accommodating growth without converting farm and rangeland, and supported economic programs that sustain local farms and ranches. Unfortunately, only the Williamson Act policy survived the update process so far.

The Open Space Element discussed identifying sensitive lands and resources, and suggested programs or practices to sustain those areas with a strong emphasis on respecting private property rights. Again, most of the strategies were non-regulatory and focused on site level development practices including the use of clustering, setbacks and buffers. At a larger scale, conservation easements were recommended as a means to protect oak woodland and wildlife habitat. Amador County also released a Preliminary General Plan Additional Land Use Goals and Policies document that supported the need for new development to address water quality by promoting Low Impact Development (LID) strategies to handle stormwater runoff.

Calaveras County: Calaveras County is also updating its General Plan. To date, a baseline report has been published and community workshops were conducted. The County recog-

Aquatic Buffers

Aquatic buffers, sometimes also known as stream buffers or riparian buffers, involve reserving a vegetated zone adjacent to streams, shorelines, or wetlands as part of development regulations or as an ordinance. When properly designed, buffers can both reduce runoff volumes and provide water quality treatment to stormwater.

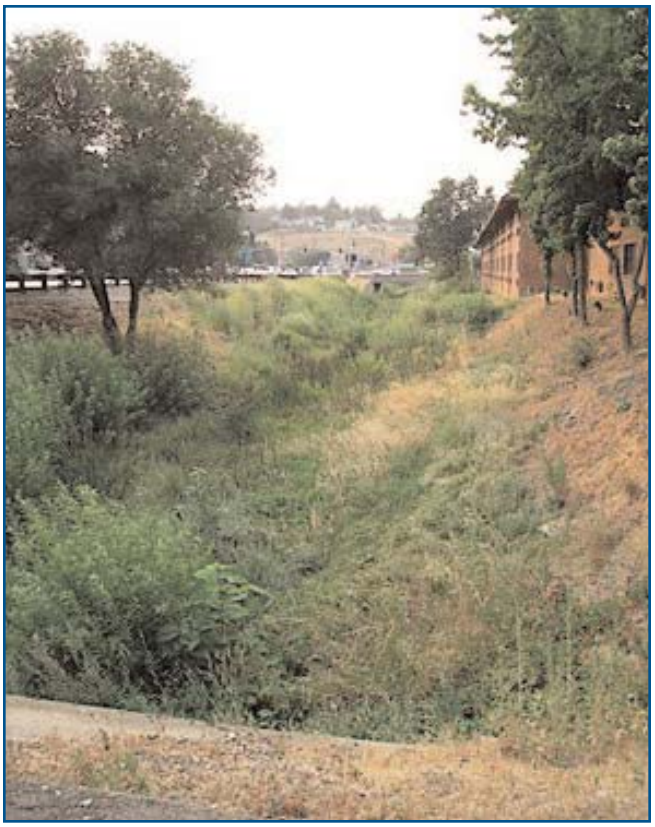
The performance of stream buffers varies according to surrounding land use. Agricultural buffers have been reported to have high sediment and nutrient removal. By contrast, urban stream buffers often receive concentrated surface runoff or may even have a storm drain pipe that discharges directly into the stream. Consequently, the pollutant removal capability of urban stream buffers is limited, unless they are specifically designed to distribute and treat stormwater runoff.

The primary benefit of buffers is to help maintain stream health. Numerous studies suggest urban stream health increases when riparian forest cover is retained over at least 50% to 75% of the length of the upstream network.

The beneficial impact of riparian forest cover is less detectable when watershed impervious cover exceeds 15%, at which point degradation by stormwater runoff overwhelms the benefits of the riparian forest.

nized in its baseline report that in addition to economic and aesthetic benefits, agricultural lands preserve important hydrological functions. For instance, the report stated the "loss of open space changes the existing watershed and may reduce groundwater recharge areas."

Calaveras County residents also voiced their support of open space at the Phase I workshops held in May and June 2007 by voting open space as one of the top three valued assets in their communities and the county. Natural



Preserving natural vegetation along urban creeks, like this one in Jackson, can help to improve water quality and ecological health of waterways.

resources, recreation, tourism, and rural atmosphere also topped the list of valued assets, further affirming the importance of open space and working lands as priorities for Calaveras residents.

City of Jackson: The City of Jackson has created a Creek/Floodplain overlay to provide extra protection of water bodies. The boundaries of the Creek/Floodplain overlay mimic the Federal Emergency Management Agency's 100-year floodplain boundary. The overlay promotes open space along creeks, encourages public use, and discourages development within the floodplain unless approved by the Planning Commission.

Jackson also uses open space to support high functioning natural areas by specifying site-scale development techniques, such as the preservation of natural topography and amenities, as well as using clustered residential development to minimize environmental impacts.

City of Plymouth: The City of Plymouth has policies and actions to identify and protect sensitive lands as well as important viewsheds that contribute to its rural, small-town feel. The City promotes creative site-scale development and preservation of open space by encouraging clustered development and providing incentives to developers, such as density bonuses.

City of Angels: The City of Angels helps developers avoid adverse impacts to biological resources by maintaining reference materials, contact numbers and a consultants list to assist developers in contacting the appropriate regulatory agency necessary for facilitating environmental reviews for new development in the city and to inform developers of current state and federal regulations pertaining to biological resources.

Workshop participants help "map out" issues of concern, goals and strategies.

RECOMMENDATIONS FOR STRATEGY 1

There are several approaches to open space conservation at the local and regional level. The trick is determining where to begin and what programs, or combination thereof, will work best. This section offers specific recommendations tailored for the Amador and Calaveras region. The recommendations listed below are by no means the only approaches to open space conservation but are chosen based on current planning efforts, input from public meetings, and watershed data.

Recommendation 1: Identify and assess strategic conservation areas.

The counties should devote resources (staff time) to assess the conservation values of undeveloped areas. This recommendation is important to achieving eventual alignment of conservation goals with community development needs and property rights interests. It may help alleviate the property rights versus conservation debate because it will help to clarify the value and benefits provided by privately owned lands, which will lend support to market-based conservation strategies.

There are two specific areas the counties can either lead or support. The first is to engage in a process to identify conservation goals and strategies. The second need is to improve data capabilities to enable the county and others to assess conservation and management priorities (Recommendation 2).

The following steps are recommended. Some of these are already occurring as part of various planning efforts and others need to be started.

Step 1. Engage the Community in a Dialogue: The process of determining ways to preserve priority areas can be contentious and requires a continuation of community dialogue.

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.

Step 3. Identify Areas and Assess Conservation Values: Not all lands provide the same value to various conservation goals. Identifying potential conservation areas and assessing their value according to established conservation goals (e.g., water quality protection) allows development of conservation priorities.

Step 4. Prioritize Areas: Prioritizing conservation areas is easier if the community is able to rank the goals they have set for protecting open space. Areas then can be ranked according to their contribution to meeting those goals.

Local Perspective: Conceptual Area Preservation Plan (CAPP) in Amador County

By Ellie Routt, Executive Director
Mother Lode Land Trust

MLLT is currently working on a 600-acre conservation easement for Garibaldi Ranch.

In 2004 the Mother Lode Land Trust (MLLT) in partnership with the Sacramento Valley Conservancy, The Nature Conservancy and Foothill Conservancy created a Conceptual Area Preservation Plan (CAPP) for the western portion of Amador County. A CAPP is basically a mapping plan that identifies areas of interest/concern so that organizations can focus their conservation work in areas that need it most. Specifically, the CAPP is a resource conservation tool that organizations can use in partnership with the Wildlife Conservation Board (WCB), a division of the California Department of Fish and Game. The WCB uses the CAPP to help decide which projects to fund. The WCB provides funding for many wildlife associated acquisitions and/or conservation easement projects and they favor projects that fall within a CAPP area. Thus, a CAPP is a must for organizations seeking large projects that require outside funding.

The process of developing a CAPP involves the community. When MLLT began working on our CAPP we met with local government officials, other conservation organizations, developers, landowners and the community. We asked people to describe what resource values were important to them, what did they envision their community looking like in the future, etc. We compiled all of these responses along with the resource values that aligned with our mission and we created a database of specific values and where they occurred within the area. Specifically, we looked at agricultural lands, endangered species, critical habitat areas and parcels based on size. MLLT then contracted with Green Info Network, a natural resource mapping company, to create the actual maps for our CAPP.

Our CAPP has helped us to better focus our efforts on the priority areas. When a landowner interested in protecting their land approaches us, we can quickly determine what values their property possesses. When there are several inquiries we can prioritize based on our CAPP and this way we are approaching projects unbiased. There are also times when we have the opportunity to apply for grants for certain projects or studies and when this happens, the CAPP helps us decide on potential projects by providing a baseline inventory of local resources.

The MLLT is currently working on three projects that fall within the boundaries of our CAPP. One is the acquisition of a 1600-acre historic cattle ranch, another is the sale of a conservation easement on a 600-acre grazing parcel and the third is a donated conservation easement on a 100-acre wheat plantation. The first two fit into our CAPP because they are large and because they are home to several sensitive plant and animal species. The smaller 100-acre parcel is valuable because it is prime farmland and contributes significantly to the local economy.

Earlier in 2008 MLLT applied for and received grant funding to continue mapping the rest of our service area. This area encompasses eastern Amador County, Calaveras County and Tuolumne County. We are currently in the process of reaching out to the community to get their input on resource values in their area. With the completion of our regional mapping project we will be in a much better position to accurately address resource issues within our service area.

For more information: ellieroutt@sbcglobal.net, (209) 419-2861, www.motherlodelandtrust.org

For example, if the primary goal is water quality protection, then lands that provide that benefit would be ranked highest. GIS mapping, resource assessments and development build-out analysis are tools to help community members understand options and make sound decisions.

This is an important step that demands real dialogue between key stakeholders, including landowners, community groups and local developers. The Trust for Public Land (tpl.org) has created several resources to help communities through this process.

Step 5. Select Strategies: Amador and Calaveras Counties are already using policy and programmatic tools to preserve open space. However, the application of those tools is largely uncoordinated. Planners, landowners, land trusts and other interests should select strategies that fit local goals and apply them in the areas of greatest need.

The best approach involves a combination of incentives, acquisition programs and land use policies. One recommendation in this plan is to conduct a feasibility study for a Transfer of Development Rights program.

A range of tools can assist in the steps listed above. Many of these tools, including computer assisted decision support tools (e.g., UPlan, CommunityViz), have been used and can help in the process recommended above. The Upper Mokelumne River Watershed Management Plan, completed by the Upper Mokelumne River Watershed Authority, also used the WARMF model to identify Water Quality Vulnerability Zones (WQVZ) within the Upper Mokelumne River Watershed.

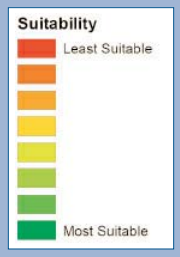
The WQVZs were identified to help local planning agencies prioritize and protect sensitive watershed lands and could also be used to help identify areas most suited for development. The WQVZs provide a good foundation for identifying and assessing conservation and development priorities. However, they would need to be expanded beyond the Upper Mokelumne River Watershed.

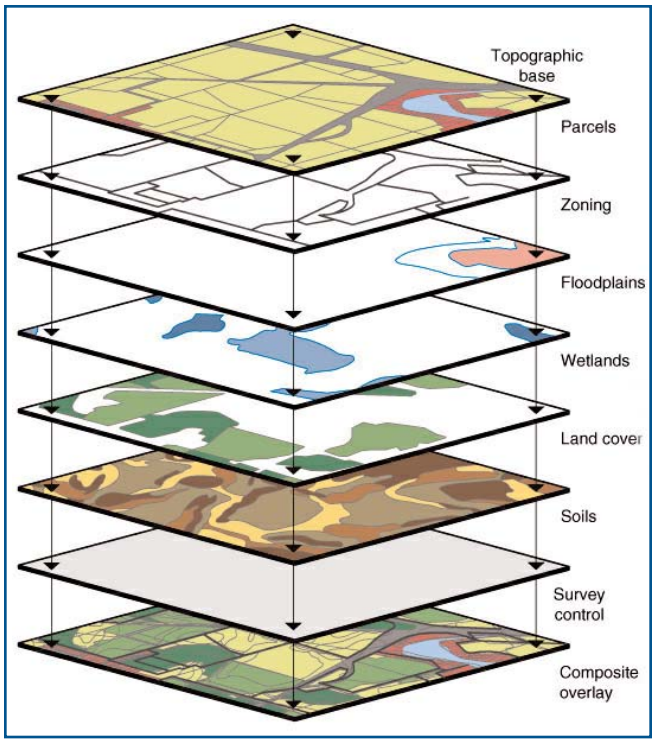
Where to Go and Where Not to Grow

By assessing various site characteristics communities can determine an area's suitability for development. This process is often called a "site suitability analysis." A hypothetical version of this exercise was completed for the larger Valley Springs area by teams at a project workshop in May 2008 using CommunityViz software. Participants at the workshop voted on the relative importance of five different factors that influence development suitability. The voting results below are ranked from most important to least important:

1. Presence of sewer/water infrastructure.
2. Presence of a floodplain.
3. Distance to the town center.
4. Wild fire risk.
5. Proximity to steep slopes.

From these results, a GIS map (above) was generated to reflect least desirable areas (dark red) and more desirable areas (dark green). Participants referred to this suitability map as they continued with the planning exercise, which was to experiment with different ways to accommodate growth in the study area.





GIS mapping can overlay several sets of data.

Recommendation 2: Expand current use of Geographic Information System (GIS) as a planning and analysis tool.

Historically, data for roads, waterways, parcels, etc., was gathered and maintained in a variety of formats and computer programs by independent departments. As a result, this system made using, managing, sharing and analyzing information for planning purposes difficult at best. Both Amador and Calaveras Counties use Geographic Information Systems (GIS) in house, but these are relatively young programs compared to other California counties and much remains to be done. To utilize the full potential of GIS as a planning and analytical tool will require political and public support, and increased funding and staffing.

A GIS is a combination of software, hardware, and data that is capable of creating, storing, mapping and analyzing spatial information. Datasets can be created to represent a range of information, such as developed or vacant land, water features, vegetation or soil types, or special habitats.

Agencies can use GIS to turn datasets into visual maps that can reflect a single feature (such as map of local roads), or they can combine several datasets to create a map that represents multiple features.

Maps can also be created from multiple datasets that identify areas of data overlap, convergence or spatial association. This can be useful when prioritizing areas for conservation since GIS maps can highlight areas of environmental richness where specific land types overlap, such as prime farmland, oak woodlands and riparian habitat. A GIS can also be used to analyze the values associated with different land types. If a community has a list of conservation goals, it can attach appropriate weights to each goal and use GIS to produce a map depicting areas rated from most to least important.

Currently, baseline data on natural resource, infrastructure and development patterns in Amador and Calaveras counties is a limitation to the use of GIS. This concern was expressed at the Mokelumne Hill workshop in May 2008 and at SAC meetings. Gaps in data can lead to relevant information not making its way into important planning decisions.

Many state and federal departments provide free GIS data on a range of topics, such as wetlands, roads, and vegetative cover. While this is useful, often the data are too general and do not provide enough detail to make decisions at a smaller city or county scale.

To gather locally relevant information will take additional funding for staff or consultants. Since GIS data is valuable to many organizations and government agencies, the cost of acquiring new data and the data itself can be shared.

GIS data can also be made available to the general public, community organizations, and regional and state government agencies.

Acquiring, storing and managing GIS data is only the backbone of a usable GIS program. GIS has analytical tools built within the program that can offer a wide range of services for numerous agencies. By investing in education, training and additional software and hardware,

GIS analysis can be included into the day-to-day workflows of county staff, resulting in increased efficiency and better decision-making.

Recommendation 3: Investigate Market-based Conservation Strategies.

Cities and counties nationwide have used market-based conservation to acquire and preserve ecologically significant land while managing growth using strong financial incentives for landowners.

Developing market-based conservation strategies is especially relevant in areas with a high percentage of privately held, high quality open space that are facing development pressure, such as Amador and Calaveras counties. Both counties have expressed interest in, and support for, market-based conservation in recent General Plan update planning documents and at public workshops (Mokelumne Hill workshop in May 2008 and Valley Springs Conservation Strategies workshop in August 2008).

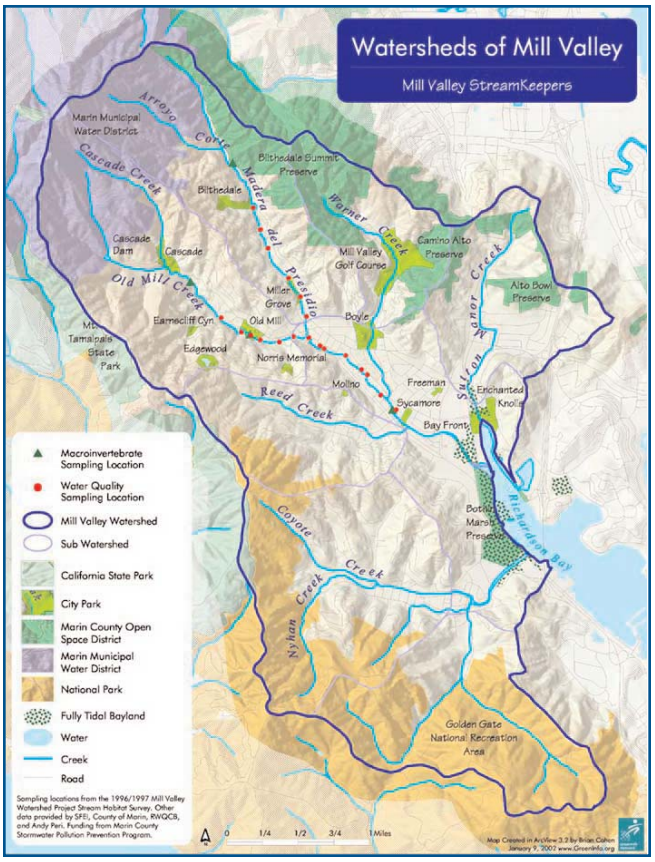
The appeal of a market-driven conservation approach is the potential to preserve open space, protect private property rights, and direct community growth into existing areas, through a voluntary approach as opposed to a regulatory one.

There are several market-based approaches that communities can use to preserve open space. This section will focus specifically on Transfer of Development Rights (TDR) programs but will also briefly cover other approaches, such as conservation easements, publicly or privately funded purchase, and payment for ecological services programs.

Transfer of Development Rights (TDR)

A TDR program uses the market to direct growth towards targeted areas while protecting valuable open space. There are now over 130 jurisdictions nationwide using TDR programs to balance conservation and urban growth at the regional, county and city level all within the context of private property rights.

A TDR program requires land to be designated as either a "sending" or "receiving" area. A

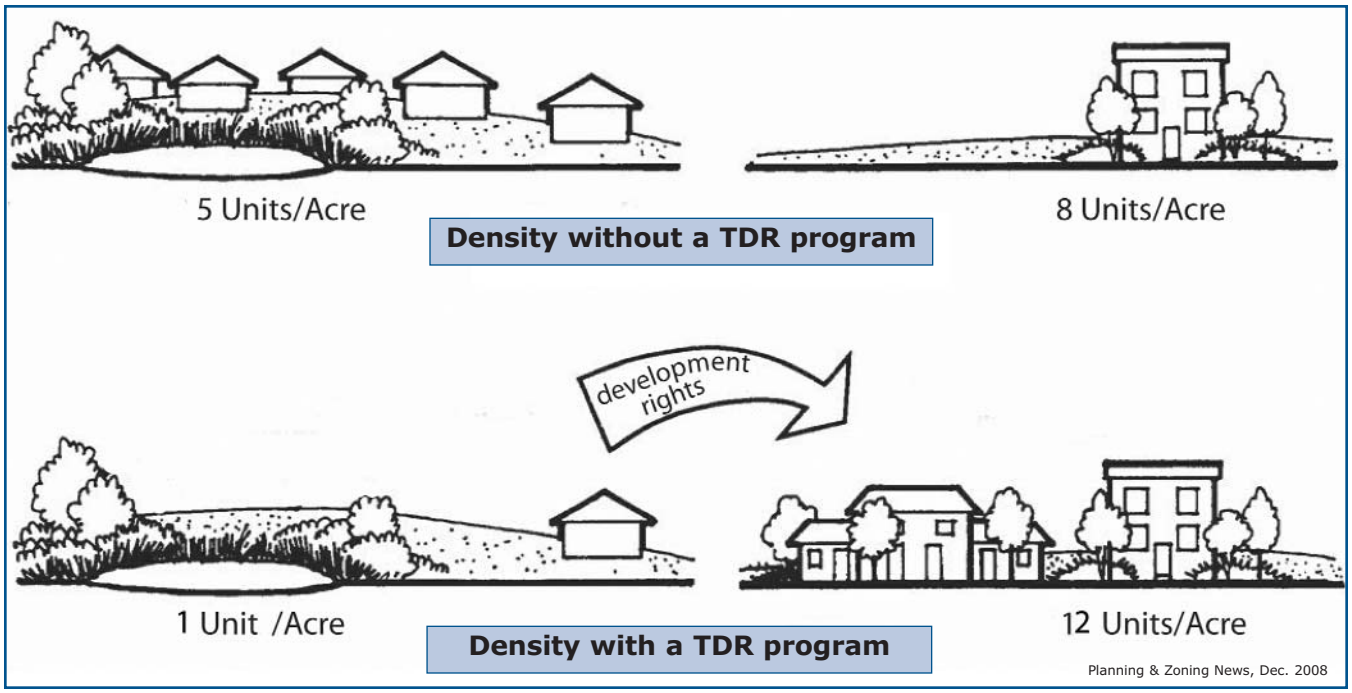


GIS and Water Monitoring

The use of geo-referenced maps, data and information has helped Mill Valley StreamKeepers with ongoing water sampling, watershed assessment and restoration planning efforts since the mid-1990s. The geo-reference maps were created using a GIS program and were a part of an initial water quality sampling project.

Mill Valley StreamKeepers has been relatively successful in securing modest grants to continue watershed restoration efforts. With the State's new emphasis on integrated regional water management planning, the Mill Valley StreamKeepers have positioned themselves as key partners due to their extensive GIS data collection and knowledge of the watershed.

source: GIS map created by Andy Peri for Mill Valley StreamKeepers and Marin County Stormwater Pollution Prevention Program



sending area is land having high conservation value where development rights could be transferred or sold, and a receiving area is land where development rights could be applied or purchased. For example, property within a riparian corridor that is recognized as having high conservation value could be designated as a sending area while property within existing communities, such as a vacant lot, that is more appropriate for development can be designated as a receiving area.

In a TDR program, landowners who have land worthy of protection are able to sell the development rights associated with their property. Depending on the program, landowners have the option of selling development rights either directly to another landowner or to a local government that manages a TDR bank.

The landowner still retains ownership of the land but is compensated for not developing the property. 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 allowed by its general plan or zoning designation.

For example, a developer who owns five acres of land in a receiving are that is zoned at one residential unit per acre could buy five development rights from a landowner in a sending area, and increase the development rights of the receiving property to two units per acre.

Determining sending and receiving areas is based on specific community goals and community input. For example, historic preservation, farmland protection, habitat conservation, growth management and watershed health protection are examples of goals of many TDR programs. Based on these goals, land is identified and evaluated for inclusion as a sending or

TDR Twist in Boulder

The City of Boulder, CO, adds an extra twist to its TDR program by integrating it with city and county open space acquisition funds. After a landowner has sold development rights to another landowner, the city will purchase the land from a willing seller at a price that reflects the agricultural value of the property. The city or county will then manage the lots or sell them to other farmers. The county grosses around $350,000 a year from leases.[2]

Land having high ecological value and worthy of protection can be designated as a sending area for development rights.

As the county develops, the development value of in-town sites like this one will grow. Such sites could become viable recieving areas for a TDR program.

receiving area using agreed-upon criteria (e.g., proximity to existing development, meets requirements of TDR goals, existing lot sizes and minimum lot sizes allowed based on current zoning).

Traditionally, once land is designated as a sending or receiving area it is rezoned to give the landowner the choice of participating in the TDR program or to develop the land according to the baseline zoning.

Landowners in sending areas who voluntarily participate in the TDR program will have their property's deed adjusted to restrict future development or reflect a reduced amount of development that is permitted. Signing the deed restriction on a sending site allows development right(s) to become separate from the parcel of land, thus allowing the landholder to market them as a commodity to developers.

Developers who purchase these rights must have property within a designated receiving area and use these rights to increase the density of their project.

Conservation and preservation of open space are most often the goals for jurisdictions using TDR programs, but urban growth management goals can be pursued in tandem.

Designating receiving sites in areas that are best prepared to accept growth can help communities develop underutilized areas within or near existing communities, therefore, placing more people closer to schools, jobs, transportation and shopping. These areas also can take advantage of already existing infrastructure, making it easier for residents to connect to urban services such as municipal water and wastewater systems.

Creating incentives for development such as density bonuses in these areas can complement community or regional conservation goals by directing growth away from valuable open space and into or near existing communities.

TDR programs are great in theory but successful implementation is difficult. The timeframe of when a landowner is interested in selling development rights is hard to predict, making it difficult to plan for the availability of development rights from sending areas. Also, once a landowner's deed is adjusted to restrict future development it cannot be reversed. Trading development rights is permanent. Lastly, there are limited players in the development trading market. Common challenges resulting from a thin market are unpredictable land purchases and high transaction costs.

Many current TDR programs do not have active markets because they were not set up with much "market knowledge" in mind. Therefore, it is recommended that communities considering a TDR program conduct an economic feasibility study. An economic feasibility study examines the potential market for buying and selling development rights by determining developer

Tahoe Conservancy's Land Coverage Bank

Protecting the water quality in the Tahoe Basin has taken collaboration from state and federal agencies. The Tahoe Conservancy, an independent California state agency, is doing its part by identifying parcels that pose or could potentially create water quality problems and then working to acquire these parcels.

Once parcels are acquired, the site is restored, revegetated and erosion control measures are installed. Along with the purchase of the land, the Conservancy acquires development rights and other "activity rights" associated with the property.

These rights are stored in a "land bank" and can be sold to the private sector to increase density or other activities on property. Money generated from selling acquired rights is used to fund future acquisitions. Between 1985 and 1997, over 5,950 acres were acquired.

For more information: California Tahoe Conservancy, (530) 542-5580

and landowner interest, studying trends in the local real estate market, comparing options for allocating development rights, and evaluating the viability of sending and receiving sites within the initial study area. (See Appendix C for a fuller discussion of conducting a feasibility study for a TDR program.)

The distance between sending and receiving areas will affect the available supply. TDR programs tend to be supported both politically and publicly when sending and receiving areas are within an acceptable range, which will vary from region to region. For instance, it is easier for residents to accept density in their neighborhood when they can benefit from preserved open space nearby. Often land located at the boundary of urban areas is targeted for protection because these lands are usually in the direct path of development. With this approach, less land is protected from development because these lands usually have a higher price than more remote areas. The lesson here is that distance between sending and receiving lands must both satisfy financial limitations as well as public perception of TDR benefits.

Model Polices and Programs

The following policy language is taken from city and county General Plans.

City of Truckee 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."

"Work with the applicable special districts to develop a program allowing transfer or sale of rights to service from areas designated Resource Conservation/Open Space or Open Space Recreation to areas designated Residential, High Density Residential, Commercial, Industrial, or Planned Community."

"Establish clear guidelines and procedures for working with property owners to ensure that land transfers or other agreements are willingly supported and equitable."

Butte County General Plan

"In the Orchard and Field Crops area, encourage parcel consolidation and site-sensitive planning by allowing for Transfer of Development Credits (TDC) and other land use concepts."

"In the Grazing and Open Lands area, encourage the voluntary retention of ranch lands in large acreages through site-sensitive planning, Transfer of Development Credits (TDC), density bonuses, and other land use concepts."

"Use proactive incentives including but not limited to density bonuses, clustered development, Transfer of Development Credits (TDC), Purchase of Development Credits (PDC), innovative land

Payments for Ecosystem Services Can Be Profitable

Quantifying ecosystem services can also help landowners receive full compensation for their land when they choose to sell. In 2002, Allegheny Group hired GreenVest, an environmental planning firm, to analyze the ecological assets of a 12,000-acre parcel in the Canaan Valley in West Virginia.

They sold the property for $16 million to the U.S. Fish and Wildlife Services but reported a price tag of $32 million to the IRS, based on the land's "ecological assets." Therefore, Allegheny was able to claim a charitable contribution of around $16 million, which saved millions of dollars in taxes.

GreenVest quantified the property's value based on its potential to serve as a mitigation bank, potential to sequester carbon, and as public open space.

For carbon sequestration, GreenVest included $15 per ton of stored carbon in its analysis, which added an additional $7 million to the property's value.

This example has encouraged other energy companies to consider applying eco-asset valuations to turn "ecologically significant land from tax burdens into profitable and functioning habitats".[3]

use planning, and land trusts to retain and/or protect agricultural lands."

"Establish a voluntary transfer of development credits program to be administered by the County. Programs shall establish requirements and procedures for transfer of development credits from certain agricultural areas to specified receiving areas. Receiving areas may be in the County and/or may be jointly identified by a city through a joint powers agreement."

Other Market-Based Conservation Strategies

Currently, benefits provided by natural infrastructure are considered to be "free" services, meaning community beneficiaries do not pay for services provided by undeveloped land, such as filtering, purifying, storing and conveying water. However, the conversion of natural lands coupled with burgeoning development has negated these free services, causing water managers and local governments to reconsider the value and importance of open space as a water supply and management strategy.

By investing in open space, water agencies are realizing they can save thousands and sometimes millions of dollars by avoiding the need to build, maintain, and retrofit existing infrastructure to convey, filter, store, and supply water.

In this new era of water and land use planning, hydrologic services that open space provides can no longer be considered "free" but just a "less expensive" alternative for ensuring a high quality water supply.

Outright Purchase

Placing a monetary value on services provided by a healthy watershed and open space has inspired innovative market-based conservation strategies. Local governments and water agencies are investing to protect water supply and quality by outright purchase of open space and/or acquisition of conservation easements on land within the watershed.

For example, Lee County, FL, has recognized the economic savings of investing in natural infrastructure with a recent plan to protect open space as a flood control measure and to ensure high quality drinking water. By purchasing open space in the flood plain, the County can avoid the cost of pumping water out of flood-prone residential areas and increase the ability of water to infiltrate and replenish its ground water drinking supply. In addition, the

River terracing in Napa County (left) to allow for restored wetlands, which in turn provide flood protection.

newly acquired public open space will provide recreational opportunities to the community.

Conservation Easements and Leasing

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 retained by the landowner 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 also 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 and private groups as funding partners to integrate easements into local planning efforts.

For example, in Maryland, the Conservation Fund, Forestland Group LLC and the Glatfelter Corporation formed a partnership to protect 25,000 acres of ecologically significant land, which includes 23,000 acres of forestland, 26 major river systems and 89 watersheds. A large portion will be retained as a working landscape but protected under a conservation easement. The conservation easement outlines sustainable forestry practices, excludes development, and protects vital water resources. The remaining land will be purchased by the Conservation Fund and transferred to the State of Maryland once public funding becomes available.

Payment for Ecosystem Services

Paying for ecological services is a way to recognize the value of open space to the larger community, and ensure land is managed and protected for future generations. Developing a payment agreement with landowners to compensate them for ecological services their property provides is a relatively new conservation strategy.

A big hurdle for this type of approach is agreeing upon the monetary value of different types of ecosystem services. For example, wetlands and riparian habitats both store, filter and absorb water but to varying degrees.

The criteria for how each ecosystem service will be evaluated and applied, as well as how landowners will be compensated, are current challenges for this strategy.

Napa County's "Living River:" Watershed Strategy Uses Natural Infrastructure for Flood Management

Plagued with periodic flooding, communities in Napa County needed relief. The U.S. Army Corps of Engineers proposed a conventional plan for flood control: higher floodwalls and straightening the waterway. The community fought for a different strategy. Instead of relying on grey infrastructure to hold back floodwaters, the community partnered with the Corps to design what they call "the Living River" approach. This approach relies on green infrastructure as a flood management strategy by reconnecting the river with adjacent floodplains, creating wetlands throughout the area, enhancing riparian habitat, and allowing for natural river dynamics to occur.

The project's goals are to recreate the natural processes of the river by retaining the natural slope, width and depth of the river; maintaining and/or restoring the connection of the river to its flood plain; allowing the river to meander as much as possible; maintaining channel features such as mudflats, shallows, sandbars and a naturally uneven bottom; and maintaining a continuous fish and riparian corridor along the river.

To accomplish these goals, features will include dike removal, channel modifications, biotechnical bank stabilization, a dry bypass channel, limited set-back levees and floodwalls, and recreation trails. Over 300 parcels of land will be purchased along a 6.9-mile stretch of the river. Buildings, utilities and train tracks within the floodplain will be demolished or relocated.

To accomplish such a feat has required the cooperation and contribution of multiple agencies and relied heavily on community support. The planning process itself included a coalition of 27 local community organizations, the Corps, the U.S. EPA and 25 other federal, state and regional environmental agencies. Funding comes from a mix of federal, state and local dollars, with $43 million from state and federal grants and $175 million shared equally by the Corps and the County. To come up with the local share, Napa County voters passed a half-cent sales tax increase, which is projected to generate over $120 million over 20 years and will go towards paying back bonds and a low-interest Clean Water State Revolving Fund loan.

Much has been accomplished since the initial groundbreaking in 2000. Over 650 acres of historic wetlands have been restored, four bridges have been replaced, three detention basins have been constructed, and 11 acres of contaminated riverbank have been cleaned up. More than 50 mobile homes, 16 residences and 28 commercial buildings have also been acquired and removed from flood-prone areas. As of 2008, the project is more than half-completed.

The Corps seems committed to this new strategy and has partnered with other organizations to implement green infrastructure techniques. In South Florida, the Corps is dismantling dikes and dams to help restore the Everglades. The Truckee River Flood Project is another example of collaboration between regional governments, local communities and the Corps to use community-based planning and a "Living River" approach.

Flooding costs exceed $5 billion annually nationwide. Incorporating green infrastructure into flood management offers a new solution that combines the best of both ecology and engineering with the overarching goal of protecting communities from flooding.

For more information: Napa River Flood Management Plan (Napa Flood and Water Conservation District), www.co.napa.ca.us/Gov/Departments/DeptDefault.asp?DID=6

Truckee River Flood Project , http://truckeeflood.us

There are several pilot programs exploring Payment for Ecosystem Services (PES) ideas in the U.S. and other countries. A basic approach to a PES program can be broken down into three stages:

1. Assess the property's range of ecosystem services and who benefits from these services.
2. Estimate the economic value of these services from the standpoint of the beneficiaries.
3. Develop policies, subsidies, or market-based incentives to compensate landowners for retaining these systems on their land.

Recommendation 4: City-County Coordination

A key policy question facing communities in the region, particularly Amador County, is whether more growth should occur within city boundaries or within unincorporated county lands. Leaving the question unanswered makes it difficult to manage growth, preserve rural lands or develop strategically. Coordinated planning between cities and counties provides the opportunity to promote efficient land use and service delivery, and preserve rural lands. Tools that can be applied through coordinated city-county planning include:

Revenue Sharing – California tax structure, primarily Proposition 13, limits the ability of local governments to generate a consistent revenue stream from anything other than sales tax. In many areas, this fuels competition between local governments vying for development, especially commercial projects, that can generate sales tax revenues. As a result, local planning decisions are often based largely on their revenue implications. This is widely recognized as a driver of dispersed land use patterns as "lower value" uses such as agriculture are developed to build a larger tax base.

Proposition 11, passed in 1998, authorizes revenue sharing between jurisdictions upon approval by their governing bodies. Prior to Proposition 11, voter approval was required for local entities to engage in these agreements. Local revenue sharing can reduce fiscal competition between neighboring jurisdictions so that municipalities are less likely to base development decisions solely on generating revenue. The intended effect is to enable more efficient land use, service provision and development patterns.

Institutional Arrangements – Some cities and counties develop institutional arrangements that ensure most future development will take place within cities, allowing undeveloped parts of the county to remain so.

Ventura County's Guidelines for Orderly Development is a prime example. The guidelines established a formal policy between Ventura County and the cities within it, 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."

This arrangement has helped to distinguish urban and rural areas and to maintain green buffers separating 10 distinct cities within the county. Several communities also established greenbelt agreements designed to create contiguous corridors of agricultural land as buffers between adjacent communities.

Greenbelts – Greenbelts are a specific example of an institutional arrangement that can support conservation goals. They are community buffers intended to separate and maintain distinctiveness of individual cities and/or unincorporated communities. Typically, greenbelts are created through nonbinding agreements among two or more government entities, establishing areas where cities agree not to annex land or extend urban services, and the county agrees to prohibit urban land uses.

STRATEGY 2: NATURAL INFRASTRUCTURE IN THE BUILT ENVIRONMENT

The way a site is developed is fundamentally important to the volume and pattern of runoff

California Design Criteria and Performance Measures

Low Impact Development (LID) techniques need to be sized appropriately to store and/or convey runoff on-site and allow for pollutant removal. Pollutant removal rates vary with the type of the pollutant, the composition of the soil, the rate of infiltration and temperature.

The amount of rainfall a project site will need to handle depends on local rainfall averages, type of disturbance being made to the site (e.g., grading), and if the runoff will be stored on site or conveyed off site. Most of the LID techniques presented in this guidebook are volume-based, which are used for storing and infiltrating water on-site. Flow-based designs, such as bio-swales, are meant to convey runoff with the intentions of slowing it down and allowing for infiltration and sediment removal.

For safety purposes, the California Stormwater BMP Handbook recommends planning for twice the volume of water generated hourly by the 85th percentile-size storm (a storm that has an 85% chance of happening in any given year). For Amador and Calaveras counties, that would be 0.10 inches per hour; therefore, the rate that should be used in calculations is 0.20 inches per hour.

The next step to sizing LID features is selecting an appropriate infiltration rate. The specific pollutant being targeted for removal as well as the soil's permeability influences the infiltration rate. Most jurisdictions in California use a minimum infiltration rate of 1.5 to 5 inches per hour. Generally, the slower the infiltration rate, the greater the potential for pollutant removal. For soil based treatment systems, a minimum holding reservoir of 4 to 6 inches is recommended. Standing water within a treatment facility should be limited to no more than 72 hours as a vector-control measure.

The combination of rainfall volume and infiltration rate will determine the appropriate size of the LID treatment facility. Some jurisdictions have chosen to size LID features by dividing rainfall volume draining to treatment area by the infiltration rate. Others use calculators similar to those found at the UC Davis Center for Water and Land Use website (http://pepi.ucdavis.edu/mapinfo/mapserv/biosize.html) for sizing treatment facilities.

For more information: California Stormwater Construction BMP Handbook, www.cabmphandbooks.com

it creates and the pollutants it carries. Stormwater management has conventionally relied on a matrix of storm drains, underground pipes, concrete conveyance ditches and large detention systems designed primarily for rapidly conveying runoff away from developed areas. Consequently, rapid delivery of stormwater to local water bodies has severely impacted stream health by increasing peak flows, erosion, sedimentation and pollution.

More advanced infrastructure and site designs are being used today that not only attenuate runoff, but can also remove pollutants, encourage infiltration, and/or drain in a more controlled manner.

Often referred to as "Low Impact Development" or LID, these design strategies are intended to mimic a site's predevelopment hydrology by protecting existing drainage and incorporating naturalistic features designed to infiltrate, filter, store, evaporate, and detain runoff from impervious areas.

LID techniques fit into a range of development settings and conditions: urban and rural, commercial and residential, and in various soil types, topographies and climate conditions. The

techniques can be applied at site, neighborhood or regional scales to create a reliable "green" infrastructure to address drainage and reduce water related impacts from development related land conversion.

Local Policy Approach in Amador and Calaveras Counties

Both Amador County and Calaveras County mention the use of LID in their General Plan updates but neither county has developed implementation policies or design guidelines. Initial investment will be needed to educate planning staff, developers and the general public about LID techniques as well as to promote collaboration to create a strong foundation for a LID program that fits the unique circumstances and environmental conditions found in Amador and Calaveras counties.

Amador County: The Amador County General Plan update process included four land use alternatives containing varying degrees of LID. A new Watershed Overlay land use designation was included in three of the four alternatives. Within the overlay boundaries, all new development would have to implement County-defined LID techniques. The fourth land use alternative didn't include a Watershed Overlay, but required new development, regardless of location, to use LID techniques. The watershed overlay idea has not survived in the current process.

Calaveras County: Calaveras County has shown strong support for developing a comprehensive program outlining best management practices "designed to protect water quality and reduce the discharge of pollutants into the county's storm drain systems to the maximum extent practicable." On-site measures would be pursued to reduce and control soil erosion and sediment discharges from construction sites as well as reworking land use guidelines and design standards to promote water quality.

Institutional Issues

Counties and cities have direct authority for permitting development on a plan, project and site basis. However, because every site and project is unique and presents different drainage and runoff challenges, it is difficult to identify one-size-fits-all best management practices. Therefore, counties (and cities) need to balance providing clear requirements to developments while allowing flexibility with respect to the design solutions used. A "toolbox" of available options is highlighted in this section.

Finally, county and city public works departments and utilities also create urban runoff and water quality issues through road construction and other public facility and infrastructure projects. It is important to consider appropriate LID solutions and best management practices when planning, designing and constructing public works projects, as well as regulating private development.

Recommendation: Use natural infrastructure and LID techniques to manage stormwater.

The term "low impact development" (LID) describes a set of alternative stormwater management systems that minimize the water quality impacts of development. An LID approach tries to mimic the natural hydrologic system as much as possible, using vegetation to slow down and treat stormwater, and soils to absorb and percolate stormwater.

An LID approach can be applied at multiple scales from a constructed wetland that seeks to treat runoff from an entire community to a small rain garden designed to capture runoff from a single part of one rooftop.

From this perspective, a set of design strategies can be linked together to create a "treatment train" of LID practices from the point where rain falls to the point of discharge into the creek, stream or lake. It is important to get in early with an LID approach; it is far easier and less costly to plan these features and design concepts at the initial concept plan stage and then follow through with detailed design.

There are typically five elements to an LID approach:

1. ***Conserve natural infrastructure:*** First "do no harm," by conserving natural features

already on the site that provide stormwater benefit and natural treatment of pollutants. Wetlands, buffer strips, riparian corridors, trees and open spaces all can contribute. By mapping these features, understanding their role in providing "free" stormwater services, and designing development to avoid impact, a developer can save money; retain aesthetic, recreational and ecological value; and still have economic development value.

2. ***Minimize impacts to the site:*** Minimize impacts to resources useful to stormwater functions by limiting site grading and clearing, retaining permeable soils on site, limiting disturbance of vegetated areas, reducing soil compaction and using soil amendments, and planting trees and other landscape features. In design, it is also wise to reduce curbs, gutters, pipes and impervious surfaces, and try using "green" surfaces where possible like green roofs and pervious pavements.
3. ***Retain natural time of runoff concentration:*** Once impervious areas like parking lots or rooftops have been created, maintain the natural runoff hydrology on site as much as possible. This involves using dispersed, open drainage systems, with longer, slower flow paths than a typical, concrete engineered system. This often involves carefully designed soil and vegetation in swales, bio-retention systems and similar features that allow storm runoff to stay on site for all but the largest storm events.
4. ***Store, detain and filter runoff:*** Store, detain and filter urban runoff through soil and plants as much as possible to reduce pollutants and allow for percolation and recharge of water. Different soil types, engineering designs and plant mixes can provide very different results in terms of pollutant removal. Well-designed systems can be very effective for many common urban pollutants. These systems use rain gardens, bio-swales, green roofs, engineered soils under pervious pavement and other means to hold the runoff, and filter it slowly through permeable materials. It is critical that the water does not stand too long (creating nuisance conditions and mosquito habitat) and does not flow too fast (reducing the filtering benefits).
5. ***Prevent pollution in the urban environment:*** Strive to reduce pollutants in urban stormwater in the first place. This can apply at many scales from reduced solid waste production to less use of fertilizers and pesticides on landscaping. Although source pollutants are typically addressed by different institutions and organizations than those permitting stormwater projects, the concepts of source reduction are critical to long-term water quality benefits.

Factors to Consider

When considering an LID approach for a project and what techniques to employ, there are a series of factors to consider.

Natural Factors

- Soils: Well-drained, permeable soils are ideal for storing and filtering runoff, while impermeable soils with high clay content or highly erosive soils may require additional design considerations such as soil amendments. In addition, the soil depth and nutrient content will determine how much water can be retained on site as well as the ability of the soil to support appropriate plant mixes.
- Water: Does the site drainage go into a natural water body? Is that water body listed as "impaired" for water quality? Does that water body serve as a habitat for listed species? Does the water body have an adequate buffer around it to absorb and filter urban runoff? Is the ground water table very close to the surface or does it contain pollutants?
- Topography: Many LID systems are designed for relatively level terrain. In sloping areas and hillsides, additional grading, terracing and structural elements such as retaining walls may be necessary.

Development Factors

- Type: Is the project commercial, industrial or residential? How important are aesthetics to the project? Will the project result in large

expanses of surface parking or large flat rooftops? Will the project be so dense that little green space is left over for stormwater management? What kinds and concentrations of pollutants will be present in the runoff from the site? How can the amount of impervious surfacing be minimized?

- Size and Scale: For smaller sites, how can the various functions of the site be combined to maximize space? For a larger site, is a systematic approach to stormwater management feasible, and can it be combined with existing features to maximize environmental protection? How can the amount of land disturbed on site be minimized?
- Location: Is it redevelopment and infill or is it in a "greenfield" location? Will the project have substantial amounts of landscape areas around it to use for bio-retention? Are there developed areas around the site that might be valuable for stormwater management like park sites or buffer lands? What pre-existing issues on site and in the general vicinity will need to be mitigated? Do existing municipal facilities extend into the site?

Local Perspective: LID Design from a Developer's Perspective

By Krista Clem, Project Manager, Mokelumne Bluffs Nature Estates and Golden Vale Subdivisions

The Mokelumne Bluffs Nature Estates project is located on Highway 88 above Pine Grove and is a 138-acre site with mixed conifers and oaks, two large wetland areas and a diverse population of plant and animal life. Instead of the typical "curb and gutter" design, this project utilizes existing natural amenities (green infrastructure) and Low Impact Development (LID) techniques to create a site sensitive plan that preserves open space and treats stormwater runoff on-site.

I was fortunately asked to be the project manager for this development and was involved in all aspects of the project from design to implementation. This has been an exciting opportunity to incorporate water planning and watershed related ideas into a development while still being cost effective. Through this experience, I have learned key points to consider when using site-sensitive planning and a LID approach:

1. Use your site. The original incarnation of the Mokelumne Bluffs Nature Estates would have required a community septic field, underground storm drainage with curb and gutter design, and tons of concrete. The community septic field would have entailed clear cutting approximately 40 acres of trees and mass grading of the site. Destruction of the on-site wetland areas and natural infrastructure would cause irreparable harm to the watershed so we decided to scrap the original plan and start over. We wanted a cost-effective plan that respected the existing character, topography and features of the land.

2. Get professional assistance and start early. In addition to attending countless seminars, workshops and forums about site sensitive planning and development, we enlisted the professional help of Terry Strange, a well-respected local biologist with knowledge of watershed issues, woodlands, wetlands, wildlife habitat and sensitive species. This proved to be a cost-effective decision. Using LID principles and protecting existing natural infrastructure at the early stages of planning allowed us to make use of the natural topography and drastically reduce costly grading.

3. Keep an open mind. We considered many alternatives with regard to preserving open space that would be in step with this area's rural setting. We finally decided upon the idea of implementing 10,000 square-foot building envelopes on each lot, outside of which exist deed restricted "no disturbance" areas. As a result, the new design will maintain at least 70% of the

All of these development-related issues impact the type, layout and nature of stormwater solutions. Since every site and project is unique and presents different drainage and runoff challenges, it is difficult to identify one-size-fits-all best management practices. Therefore, a "toolbox" of available LID options can be created to help projects meet stormwater management standards. Examples of LID techniques appropriate for Amador and Calaveras counties are bioretention, porous pavement, flow through bio-swale, cisterns and rain barrels, infiltration units and constructed wetlands.

Further explanation of these techniques can be found in Appendix D.

Transitioning to a landscape-based or LID stormwater management strategy will require initial investment for educating planning staff, developers and the general public about LID techniques as well as to promote collaboration to create a strong foundation for a LID program. Counties and cities have direct authority of permitting development on a plan, project and site basis and will have to balance providing clear requirements to developments while allowing flexibility with respect to the design solutions

site as privately owned open space in perpetuity. Protected open space coupled with LID techniques helped to accomplish other project goals, such as: insure privacy for homebuilder, retain wildlife corridors and heritage oaks, and provide cost effective solutions for stormwater management. The natural beauty and attractiveness of the site was a "natural byproduct" of making smart, resource efficient decisions.

4. Compare costs. A developer always has to keep costs in mind. We were surprised that costs decreased as we implemented more LID techniques. The new design conforms to the natural topography, eliminating the need for mass grading and underground storm drainage, which are extremely expensive to build. The conventional "curb and gutter" design was replaced with bio-swales, rock-lined culverts, crushed granite walking trails alongside each road within the subdivision, and utilization of existing natural flora. Developers will be surprised to know that in addition to being cost-effective, using LID techniques and preserving natural infrastructure is highly marketable. Today's homeowners and builders are increasingly looking for sustainable housing options.

Many of the design elements we incorporated are also financially sustainable, in that they will ultimately cost the county and homeowners less money to maintain. For instance, all the project engineers agreed that eliminating the standard "curb and gutter" design will reduce maintenance costs over the lifetime of the subdivision. In addition, the LID design also combats the effects of global warming by preserving trees that sequester carbon and by decreasing impervious surfaces, which will keep ambient temperatures cooler.

5. Use education as a maintenance strategy. Since we are not building the homes but selling lots, we put together a Homeowner Education Packet containing concept drawings of rain gardens, grassy driveways and other LID techniques. The Homeowner Education Packet is constantly expanding and now includes information on fuel maintenance, wildlife habitat and a few pages about local businesses.

We are mentioning the packet in the conditions, covenants and restrictions (CC&Rs) for the project and will be filing a copy of the final version with the County so it will be accessible to the public and subsequent purchasers. The response to the Homeowner Education Packet has been overwhelmingly enthusiastic and has become a very helpful marketing tool.

For more information: Krista Clem, Project Manager, kristaclem999@hotmail.com
Mokelumne Bluffs Nature Estates and Golden Vale Subdivisions, "Live in Harmony with Nature"

used. Beyond regulating private development, LID solutions and best management practices should be considered when planning, designing and constructing public works projects.

Model Policies and Programs

The following policy language is taken from city and county general plans.

Yolo County General Plan

"Adopt design standards that use low-impact development techniques that emulate the natural hydrologic regime and reduce the amount of runoff and associated pollutants. Examples include vegetated swales, landscaped detention basins, permeable paving, and green roofs."

"Construct on-site stormwater detention facilities that are designed so that runoff from the 100-year storm event does not: (1) result in an increase in peak release rate; (2) result in a time decrease associated with the time of concentration; (3) contribute to adjacent flood problems; and/or (4) significantly alter the direction of runoff."

"Design new stormwater facilities to enhance recreational, habitat, and/or aesthetic benefits, as well as to integrate with existing parks and open space features."

"Minimize pollution of stormwater, receiving water bodies and groundwater, and maximize groundwater recharge potential by:

- Implementing planning and engineering design standards that use low-impact development techniques and approaches to maintain and mimic the natural hydrologic regime.
- Using 'infiltration' style low-impact development technologies.
- Following stormwater Best Management Practices during and after construction."

Cities and counties have worked around the lag time associated with updating a General Plan by pointing to separate documents or organizations that set stormwater management guidelines.

The following examples of language are pulled from city and county general plans that refer to outside sources for stormwater regulations.

City of South Lake Tahoe General Plan

"Provide assistance to the reasonable implementation of the Tahoe Regional Planning Agency (TRPA) Water Quality Plan (section 208) as well as meeting the Lahontan Water Quality Control Plan (section 303 d) on public and private property."

"In addition to the land coverage requirement, the implementation of best management practices (BMPs) is also a requirement intended to protect water quality in the Basin. TRPA requires property owners to install infiltration facilities designed to protect water quality by ensuring that runoff from up to 20-year, one-hour storm is contained on-site for all development in the Lake Tahoe Basin. To help address water quality issues, the City's rehabilitation loan program also funds implementation of BMPs."

For more information on Tahoe Regional Planning Agency Water Quality Management Plan: www.trpa.org/default.aspx?tabid=168

Alameda County General Plan

"The County shall regulate new development on a case-by-case basis to ensure that, when appropriate, project storm drainage facilities shall be designed so that peak rate flow of storm water from new development will not exceed the rate of runoff from the site in its undeveloped state."

"The County shall conform with Alameda County Flood Control and Water Conservation District's (Zone 7) Wastewater Management Plan and the Regional Water Quality Control Board's San Francisco Bay Basin Plan."

For more information on the Regional Water Quality Control Board's San Francisco Bay Basin Plan: www.swrcb.ca.gov/rwqcb2/basin_planning.shtml#2004basinplan

5. Community Planning and Design

Few decisions are more important to water resources than where and how development occurs. The strategies in the previous section addressed "where not to grow" and policy options for preserving those areas that are deemed worthy of protection. Those strategies only work if they are made in concert with strategies that steer growth to appropriate locations and shape sustainable communities and land use patterns.

Land use patterns are critical to water quality, reliability and watershed health. The location and form of development affects water quality, demand and reliability, infrastructure costs and needs, and the health of the watershed as a whole. This makes community design an essential, but often-overlooked component of watershed planning and water management.

This section recommends town-centered development with a greater mix of land uses and housing types, connected by safe and walkable streets. The strategies and recommendations in this section address the threats that sprawling development patterns pose to water quality, reliability and watershed health. The strategies include:

1. Strategic Location – Encourage infill development that is within or directly connected to existing communities. Support the "recycling" of developed land through revitalization efforts.
2. Compact Design – Support compact community form in the design of buildings, neighborhoods and the community as a whole.
3. Mixed Use Development – Mix appropriate land uses and development types to support compact community form and reduced travel distances and automobile dependency.
4. Transportation Network and Street Design – Support an interconnected transportation network with complete streets design that encourages all types of mobility, supports the needs of all types of users, and incorporates natural drainage practices.

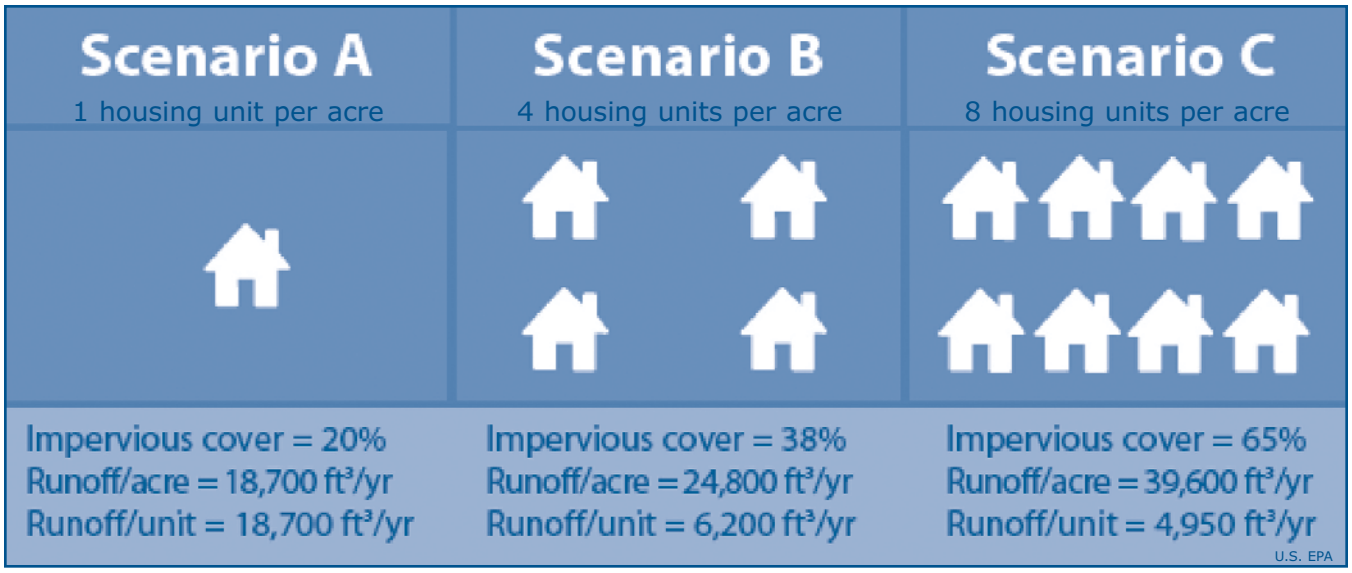
These strategies are interdependent and mutually reinforcing. In combination, they shape land use patterns and community forms that support water management and watershed health while preserving rural character and open landscapes.

The specific watershed benefits include:

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

Effects of Land Use Patterns on Watershed Disturbance and Stormwater Runoff

Development comes with certain impacts to watersheds and the services they provide. Development that occurs in ecologically valuable areas has a greater impact than development that occurs in areas that are already



disturbed or are less sensitive. Development that is more spread out has greater impacts because more of the watershed is fragmented with the introduction of new roads, buildings and other structures, infrastructure systems, and other activities that come with development.

The amount of impervious cover added and the amount of raw land disturbed or converted to impervious area are key factors affecting watershed health and stormwater runoff. Different types of development impact these factors in very different ways.

On a per-capita basis, compact development patterns reduce the overall development footprint, minimizing land disturbance and impervious cover in the watershed. More land is also left undeveloped or reserved for lower impact uses.

Low-density patterns of development require more land for a given amount of growth. This results in greater land disturbance and more impervious cover in a watershed.

A 2002 U.S. EPA study examined the stormwater impacts of new development at densities of one, four and eight residential units per acre. The study illustrated that lower-density development patterns generate more impervious cover and runoff per unit than higher-density development for the same number of units. In Scenario A (see chart above), 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 (Scenario C) 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 (A) was 18,700 square feet annually. The average runoff per unit at eight units per acre (C) was 4,950 square feet annually.

The study reveals that while higher-density development will have a greater percentage of impervious area per acre of development, the total impervious area per residence actually will be less. Overall imperviousness at the watershed level also will be less.[1]

The EPA study corroborates other research on the effects of density on water, land conversion and patterns of growth. At 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 low-density development on the urban fringe would produce 10 times more runoff than a higher-density development in the already developed area.[2]

The link between land use patterns and transportation has further implications for imperviousness and stormwater runoff. Highways, streets and parking lots account for a substantial

portion of the overall imperviousness of the built environment. Development patterns greatly influence how much transportation infrastructure is needed to serve an area.

Where land uses are highly separated, there is a greater need for roads and parking because people need cars to travel between homes, jobs, schools, shops and services. When housing is located far from employment, commercial, recreational and institutional centers, more roadway is required to serve those residences.

Effects of Land Use Patterns on Water Supply, Demand and Infrastructure

Dispersed development is spread out across a wider area, and requires more extensive conveyance infrastructure to serve a given number of homes and businesses. This means higher costs for water service and more water lost through leakage.

A system can lose from 6% to 25% of its water to leaks and breaks.[3] How much water is lost depends on the condition of the system, its length (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. For this reason, connecting dispersed, outlying development to water service is often cost-prohibitive.

The traditional way around this is to develop low-density residential parcels with private wells, but this alternative has its own water problems – namely, decreased water reliability from unmonitored groundwater usage and water-quality issues from overlying septic tanks and naturally occurring contaminants, such as arsenic, radon, iron, manganese, sulfides and salinity.

Large-lot, single-family homes are characteristic of typical low-density development outside of town centers and require more land and water than more compact neighborhoods. Residential landscaping accounts for around 50% of household water demand, and larger lots tend to have more lawns and landscaping than smaller lots. Studies in Utah 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.[4]

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. This means more houses are served per block of transmission main, which reduces the amount of transmission main needed per household, providing better economy of scale for infrastructure construction, operation and maintenance.

Increased development within the wildland fire interface in the Amador and Calaveras region also aggravates water supply challenges by increasing the potential of catastrophic wildfires, and thus the need to secure adequate water supplies for protecting property. Under-sized distribution facilities or private wells in the area are unable to meet flow standards set by the State Fire Code, leaving communities without proper protection, and vulnerable to catastrophic fire.

Institutional Issues

In advisory committee meetings and interviews, people identified public discontent with the character of recent growth in Amador and Calaveras counties. In many cases, this has fueled "no growth" sentiments and ongoing debates about development. Yet, growth trends suggest that demand for considerable new development is likely to continue in the years to come. While significant differences of opinion persist, there are also growing levels of agreement about the character and form of development that people want and do not want to see.

Advisory committee members, including planners, environmentalists, developers and community activists, voiced the need for education

to help the public and decision-makers understand the tradeoffs between different development futures. They said local resistance to development made it difficult for planning agencies to advance programs or policies supportive of infill, redevelopment, mixing land uses and increased density in appropriate locations, such as town and community centers, even if these programs are needed to protect the open lands and rural character that residents cherish.

The CommunityViz workshop held in Mokelumne Hill was a response to this challenge. It was intended to help residents and stakeholders understand tradeoffs between alternative patterns of future growth, and strengthen understanding of the water implications of those choices. The project also helped convene a two-day public design workshop in Valley Springs to inform the development of a community plan, and help residents visualize and prioritize design strategies for future development.

STRATEGY 1: STRATEGIC LOCATION

Determining where to grow and where not to grow are among the most important yet contentious decisions facing any community, including those within Amador and Calaveras counties. Numerous considerations come into play when considering alternatives for locating future development, from the sentiment of existing residents and businesses to interests regarding property rights or concerns about land preservation.

From a water management and watershed protection perspective, it is best to avoid disturbance of natural functioning parts of the watershed and to grow in areas that have water supplies and are served by existing infrastructure. Infill and redevelopment are town-centered approaches to development that support both of these goals. Both strategies make more efficient use of existing infrastructure by locating growth in areas that are already served by road, water and sewer systems. Economically, this serves to focus investment into the community rather than away from it.

A study in Florida found that an infill housing development consumed 73% less open space per housing unit than a greenfield site. A comparison in Montgomery County, MD, found that on a per unit basis, the cost of providing infrastructure to a unit of infill development was 92% less than providing the same infrastructure to one unit of greenfield development.[5] This is because existing infrastructure can be used, any extension of newer services is shorter in distance than it would be otherwise, and more people can make use of a smaller over all allotment of infrastructure.

Like infill, redevelopment can reduce pressure to grow into outlying natural areas and prevent the spread of impervious cover. Redeveloping areas that are already paved (greyfield sites) or that require clean-up and restoration (brownfield sites) reuses land. New development demand is accommodated on a paved or otherwise already disturbed site, so no new impervious cover is added to the watershed and growth is avoided in ecologically valuable areas.

Infill and redevelopment projects face substantial barriers when compared to greenfield projects. Sites are often constrained by surrounding development, outmoded infrastructure and irregular parcel shapes and complex property boundaries. Local development regulations create additional barriers when inflexible requirements related to parking, setbacks and density controls that fit uniform suburban subdivisions and large format commercial centers are applied to infill and redevelopment sites.

Recognizing the pitfalls of conventional zoning, many communities are updating their codes to introduce greater flexibility (e.g., lowering parking ratios, allowing mixed uses, or allowing greater lot coverage) for certain areas. Planners and developers are using specific plans, form-based codes (an alternative to traditional zoning practices that emphasizes regulation of the visual character of development over the type of use) and other emerging tools to over come these barriers.

Local resistance is another common barrier, which often comes down to whether residents

would prefer to have growth within town or in the countryside. In most areas, the notion of "no growth" is increasingly untenable and tends to lead to the latter option – growth in the countryside. The answer to the challenge is increasingly centered on design, the degree to which new projects can be developed in keeping with the scale and character of existing development.

Costs are another challenge. The barriers to developing in existing communities, coupled with incentives for developing at community edges, make greenfield development comparatively attractive to developers. The combination of political, spatial and policy barriers increase the costs of infill and redevelopment projects.

In formally designated redevelopment areas under state law, tax increment financing can be a source to help fund redevelopment projects. Additional incentives such as density bonuses are also part of a growing toolbox communities are using to level the playing field for infill and redevelopment projects.

Local Policy Approach in Amador and Calaveras Counties

Several jurisdictions are updating their General Plans or have recently done so. Others, notably the City of Jackson, have been updating local codes as well. In so doing, some jurisdictions are making headway in addressing shortcomings in conventional zoning and are applying innovative planning tools that encourage better development in targeted locations. This includes an increasing emphasis on infill and, to a lesser extent redevelopment, as components of enabling town-centered development and protecting the character of local communities.

Amador County

Much of the language in the draft general plan goals and policies document supports town-centered growth though infill development. The policies related to infill or "town-centered" development address several important themes: identifying "target areas" for future development, coordinating growth with infra-

Water Benefits of Infill and Redevelopment

1. Infill focuses growth into already developed areas, which prevents conversion of ecologically valuable land, enables a more compact development footprint, and reduces per capita imperviousness.
2. Infill and redevelopment relieve development pressure on undeveloped or "greenfield" sites that offer ecological services.
3. Redevelopment is land efficient – it allows "recycling" of paved-over areas, which avoids new impervious cover and reduces the overall development footprint.
4. Infill and redevelopment tend to occur within areas already served by infrastructure.
5. Infill and redevelopment enhance the local tax base, which increases funding for infrastructure repairs and upgrades, including water quality and supply retrofits.
6. Infill and redevelopment reduce the overall development footprint within a watershed.
7. When infill and redevelopment enable compact neighborhood design, the added density can support walking and potentially reduce automobile trips. In addition to reducing transportation-related impervious cover, air deposition of exhaust components are reduced, as are metals deposited by brakes and tire wear.

structure availability, preserving agricultural land and open space, and shaping land use patterns that enable alternative modes of transportation (walking, biking and transit) for air quality and energy efficiency goals.

Language from the most recent draft that addresses land use patterns and the strategic location of development includes:

- Goal LU-2: Enhance and maintain separate and distinct communities within the county.
- Policy LU-2.1: Direct development to areas with existing urban services, or to areas where extension of urban services is feasible given distance from developed areas and topographic, capacity, or land capability considerations.
- Policy LU-2.2: Establish target areas for future commercial, industrial, and residential growth.
- Policy LU-2.3: Direct higher density or intensity development to infill areas, or areas adjacent to existing communities or activity centers.

New Land Use Classifications

Three new land use classifications have emerged from the General Plan Update that could have a significant influence on the location of future growth and resulting land use patterns. The "Town Center" (TC, also known as the Local Service Center or LSC) and "Regional Service Center" (RSC) classifications would steer some portion of future growth into existing unincorporated communities. The Special Planning Area-Residential (SPA-R), intended to meet affordable housing needs, may also encourage infill, depending on what areas are designated.

Each of these classifications could serve to establish "target areas" for future development and support a greater mix of land uses than are allowed under current zoning. They would be applied in varying degrees and locations in each of the County's proposed land use alternatives. Each is discussed in turn below.

Town Center

The Town Center (TC) classification builds on the Local Service Center (LSC) classification in the current General Plan. In fact, the two are used interchangeably in the current versions of the goals and policies document and land use alternatives workbook. According to the alternatives workbook, the new classification will include:

- A minimum-density requirement for residential development.
- A maximum Floor Area Ratio (FAR) lot coverage and building height for commercial development.
- A mix of residential, commercial, public and industrial uses to provide access to commercial and industrial uses which draw users from the community and immediately surrounding communities.

The following language in the draft goals and policies document provides the basis for the County's Town Center and Regional Service Center classifications: "Amador County is a livable community comprised of cities and small, distinct unincorporated towns. The General Plan supports the continued viability of the County's existing communities by focusing commercial, public facility, and residential growth into these areas."

The new classifications also introduce a planning tool called a form-based code. The form-based approach would be applied within the TC and RSC to establish design guidelines and development standards that focus less on defining uses and more on the form and character of development.

Form-based codes emphasize the desired physical and visual result for the built environment, while conventional codes focus on allowable uses and micromanagement of development intensity through numeric and often arbitrary parameters. Since they are predicated on the desired physical result instead of the strict control of uses and numeric densities, form-based codes have the potential to provide more predictable outcomes than conventional codes.

Form-based codes can provide both the precision and flexibility needed to match future development with historic patterns as the region grows and its built environments evolve.

The new designations and form-based codes are also intended to address challenges with "commercial-strip" development, a common feature in the foothills and larger Sierra region. Commercial strip development is usually associated with sprawl, and clearly lacks a center. The policies document tackles the issue head on: "The guidelines and boundaries of these Town Centers will be clearly established to avoid strip-style commercial development along SR 88." (Policy LU-15.4)

Regional Service Center

The Regional Service Center incorporates some of the same programs as the LSC classification, but at a larger scale and density, including mixing land uses, form-based coding and varying degrees of infill depending on the land use alternative. Martel is the area most likely to be designated a RSC, but other areas may also be designated as RSCs, depending on the land use alternative selected.

The RSC classification has the potential to help promote compact mixed-use development in strategic locations, including Martel. However, it is important to consider the type of commercial development that it will support and the impact of that development on neighboring communities. If geared towards larger, big box-format commercial centers, then the classification may not be as effective at delivering on the stated intent of promoting traditional development patterns in the area.

On the other hand, the proposed form-based code approach offers an opportunity to establish criteria that will help align future development of the area with local character, and to help existing commercial strips evolve over time into more vibrant and pedestrian friendly areas.

If the RSC is really intended to accommodate large-format, "big-box" development, this should be made clear. In this sense, the RSC may still serve to support the Town Center classification by capturing the demand for large format retail development in one area, preventing its wider proliferation and impact on local businesses sought for the Town Center areas.

Special Planning Area – Residential

The SPA-R classification is designed to support affordable housing goals by identifying specific areas in which to locate affordable projects as well as minimum levels of density for those projects. The SPA-R would include a mix of mostly residential uses in "specific areas with utility service" that would range in density from 9-25 units per acre (9–18 units per acre for moderate and above-moderate income units, and 12.5-25 units per acre for low- and very-low-income units). The designation would establish a minimum density of 9 to 12.5 units per acre for SPA-R areas.

The big questions about the SPA-R are how much and where it will be applied. The adopted Housing Element identifies about 64 acres of SPA-R land, but the County will need to designate at least 50 additional acres. Areas inside city spheres of influence and located near available water and sewer services would receive the highest priority for SPA-R designation. As noted in the General Plan land use alternatives workbook, this "would require agreements between the city and the County to keep the land zoned for high-density residential use, irrespective of future annexation."

The success of this classification depends on how it is implemented and what areas are designated. Often, higher density affordable housing is pushed to the exterior of communities and not well integrated with other housing types. Increasing housing density within the framework of conventional single, separated uses zoning, particularly with overly restrictive height limits can lead to failure. The result is "dense sprawl."

If adopted and implemented, each of the new classifications has the potential to shape more efficient development patterns. The Town Center and Regional Service Center classifications would promote infill, revitalization, and diverse

land uses to achieve development patterns that meet economic, historic preservation and resource conservation goals.

With respect to water, these classifications, and the form-based coding that would be used within them, are among the most important programs or policies being considered in the General Plan update. The ultimate question is the degree to which they will be applied in the final land use alternative. From a water perspective, greater emphasis on these town-center approaches, and less on single-use, rural residential development, is warranted.

Calaveras County

On October 23, 2007, the Board of Supervisors voted unanimously to include goals, policies and implementation measures in the pending General Plan Update that "would limit the use of groundwater and onsite septic systems to serve that development and should instead encourage high-density development served by public surface water and public sewer with preservation of on-site open space as well as other associated infrastructure."

At the same time, the Board resolved to put an interim development policy (Resolution #07-242, November 2007) in place that encourages development in areas already served by water and sewer infrastructure for any projects with parcel sizes smaller than 40 acres per unit (with the exception of creating one single parcel). The policy also encourages protection of on-site open space and habitat and alignment with measures in the current Housing Element.

Infill is discussed directly in the General Plan Update Issues and Opportunities Report. The report notes that the General Plan Update can create policies and implementation programs that "encourage new development to locate in well-defined community centers." The report recognizes the challenge of coordinating new "town-centered" development with desires to maintain rural character. The report asks this central policy question: "how can Calaveras County support infill development that offers a small-town, rural atmosphere and lifestyle in existing community centers?"

While it appears that the General Plan update will yield policies supportive of infill development, the County code is currently silent on the matter. It does include some provisions that could be used to support strategic location goals, including the Planned Development (PD) land use classification, which provides greater flexibility to areas where it applies. However, updating local codes will be a critical step to enabling infill and redevelopment.

Cities in Amador and Calaveras Counties

The City of Plymouth's draft General Plan includes language that makes clear connections between the location of growth, land use patterns and the city's economic, social and environmental goals. The following policy coordinates the location of development with local infrastructure and public services: "The City's land use pattern should focus new development and significant redevelopment where adequate public services and utility capacity are already in place or projected for improvement, including streets, water, wastewater, and drainage infrastructure."

The City of Jackson's Municipal Code includes provisions that can support infill. The planning commission can approve a density bonus of up to 25% for projects according to the proportional benefit provided including consideration of lands dedicated to open space, recreation and enhanced public facilities. Bulk regulations for the Historic Commercial (HC) use district also do not require front or side setbacks, and allow for 100% site coverage and four story buildings. This flexibility is a critical ingredient for successful infill or revitalization efforts.

Along with efforts to remove potential code barriers, the City recently established a revitalization committee to advance economic development and revitalization while preserving Jackson's historic character. The committee has a strategic plan for 2008-09 that includes several projects that can help stimulate business in the downtown and encourage appropriate infill and redevelopment.

The City of Angels Camp General Plan has several policies that support infill and redevelopment. For infill, the City has a policy to monitor and map land availability, including vacant parcels, and to ensure that the data is made available to developers and on the County's website. The policy calls for updating the data at least every three years.

Angels Camp also establishes a policy to consider a redevelopment agency to "Assist in the Provision of Affordable Housing, to Fund Infrastructure Improvements, and to Achieve Other City Goals." The policy lists areas that redevelopment efforts would contribute to, which include several water-related goals, including funding water and wastewater infrastructure, affordable housing, parks, drainage facilities and street improvements.

Angels Camp has a policy that aims to addresses code barriers to infill and revitalization by updating development standards in the downtown historic district: "Revise existing development standards in the historic district as necessary to achieve compatibility with the character, scale and architectural style of the district. Revisions should include, but not be limited to, a review of dimensional limitations (e.g., building height)."

Recommendation 1: Reform codes to enable flexibility in areas poised for infill and redevelopment.

Assessing and updating local codes to include more flexible requirements in neighborhoods and districts targeted for infill and redevelopment can remove barriers. Excessive parking and setback requirements and over-restrictive height and site coverage requirements are common barriers to infill and redevelopment. Changes can be applied to infill and redevelopment ares through overlay zoning, adding new use districts or by changing requirements for existing use districts.

Recommendation 2: Initiate a vacant land study program.

Amador and Calaveras counties should consider developing and sustaining a long-term vacant land study, which is dedicated to identifying and assessing undeveloped parcels that are poised for infill and redevelopment.

Recommendation 3: Provide targeted density bonuses.

Density bonuses allocate additional development rights to a parcel so a project can be built above zoned densities. By state law, housing projects that dedicate a minimum portion of units to affordable housing are entitled to a density bonus, but the tool can be applied to other planning objectives as well. For example, some communities provide density bonuses for projects that set aside a certain amount of open space. Applied to targeted infill and redevelopment areas, density bonuses serve to accomplish whatever goal is being promoted through the incentive (housing affordability), as well as the goal of enabling development within target areas.

Recommendation 4: Study the feasibility of a Transfer of Development Rights (TDR) Program.

Pursuing a TDR program was recommended in the previous section, but is reintroduced here because infill and redevelopment sites can be ideal receiving areas. In this way, TDR programs can support open space goals while helping stimulate development in strategic areas.

Recommendation 5: Develop regional partnerships to guide and balance growth into existing communities.

Interagency agreements are sometimes used to establish various types of growth boundaries to balance development needs and challenges. Such arrangements have been used successfully in other areas, including Ventura County, where the County and ten cities therein established the Guidelines for Orderly Development to steer the majority of future development into existing cities. When the guidelines were developed in the late 1960s, Ventura County was a sparsely developed and largely agricultural county facing strong development pressure due to its proximity to a fast growing metropolitan region and "quality of life" appeal.

Recommendation 6: Tier development fees and infrastructure investment to direct growth to target areas.

Jurisdictions can reduce development fees based on location and project type to help steer growth into target areas. They can also reduce costs by streamlining approval for infill and redevelopment projects. Finally, jurisdictions should pursue "fix it first" policies or establish "priority funding areas" to direct funding to maintain and upgrade public infrastructure to accommodate and stimulate growth in areas sought for infill and redevelopment.

Model Policies and Programs

The following policy language is taken from city and county General Plans.

Butte County General Plan

"Encourage urban infill development within city limits and within existing unincorporated communities where development can more easily and readily be served by public infrastructure facilities."

City of Sonora General Plan

"Consider using redevelopment as a tool for enhancing the appearance and/or economic values of new annexation areas subject to redevelopment law restrictions and requirements."

"Encourage adaptive renovation and reuse of existing shopping centers as anchor grocery stores recycle, consolidate, or leave."

"Facilitate economic development within the city by working in cooperation with the Economic Development Company of Tuolumne County to maintain a list of vacant commercial land to be made available to the public upon request."

"Provide a flexible framework for the development of properties that have unique or unusual characteristics and do not fit into the conventional zoning pattern including vacant land requiring unusually environmentally and aesthetically sensitive development."

"Develop a Special Planning Zoning District consistent with the Special Planning (SP) general plan land use designation promoting development which includes some or all of the principles of Traditional Design. The Special Planning Zoning District may consider discerning between principles applicable to those developments which are primarily commercial in nature and those which are primarily residential in nature. Examples of Special Planning development principles may include, but are not limited to:

i. Walkability – most things within a 10-minute walk of home and work; pedestrian-friendly street design.
ii. Connectivity – interconnected streets; high- quality pedestrian network.
iii. Diversity – diversity of complementary uses.
iv. Quality Architecture and Urban Design – integrated appearance consistent with the character of the city and design recognizing the physical characteristics of the parcel vs. traditional neighborhood structure (for residential development).
vi. Increased Density – more buildings, residences, shops and services located closer together for ease of walking (increased density would be inapplicable to development which does not promote walkability).
vii. Smart Transportation – pedestrian-friendly design encouraging a greater use of bicycles and walking as daily transportation
viii. Sustainability – minimal environmental impact of development and its operations.
ix. Quality of Life – taken together, the application of the design principles in the Special Planning district should produce a high quality of life.

Development in this zone should require the preparation of a Specific Plan (as defined in Government Code Section 65450 et seq), or an equivalent plan for developments in excess of 10 acres. The SP Zoning District shall establish the required contents as necessary to fully illustrate the project's design concepts."

Before and after: Streetscape improvements and infill development transform a barren commercial strip into a small town main street.

STRATEGY 2: COMPACT DESIGN

A growing number of communities are seeking ways to build more compactly as a means of protecting undeveloped areas, enabling pedestrian activity, and creating more vibrant town centers. Compact community design reduces the watershed impacts of development, and enables more efficient use of water, land, and infrastructure. The term compact design is wide ranging, applying to different types of development across multiple scales from individual buildings or lots to neighborhoods, districts, and entire communities. Regardless of scale or development context, compact design is a central strategy for reducing watershed-scale imperviousness, and conserving open space and ecologically valuable areas.

General Policy Approach

The overall form, or "compactness," of a community is the result of many factors, including:

- The diversity of land uses and development types.
- The design and layout of streets and parking.
- The design and layout of public and private open space.
- The design of lots and buildings.

The way these factors are organized and addressed in conventional zoning codes and land development regulations tend to expand the overall development footprint through use separation; minimum parking, street width, lot width, setback and height requirements; limits on lot coverage; and minimum lot sizes.

Conversely, enabling a greater use mix, more efficient distribution of parking, properly sized streets, compact building types, and incorporating public open space all relate to a broader goal of achieving a more compact community form. Likewise, compact form is considered fundamental to making many of those objectives, such as land use and housing diversity, actually function within a community.

The most common issue people think about in relation to community design is density, a sensitive if not dreaded word in most growing areas. However, community form is a combination of elements, not just density. Compact design calls for a return to the form and character of traditional buildings, neighborhoods and communities as an alternative to sprawling subdivision and commercial-strip development.

Zoning and subdivision codes contain key land use controls that govern development intensity. Bulk regulations establish the allowable location and size of structures on a given parcel. They typically include the following parameters:

- **Setback requirements** establish an amount of space between buildings and edges of the property line. A front setback for example, is the distance between the building and the street, which for residential areas is usually the front yard.
- **Height requirements** specify the allowable height of buildings or other structures,

Compact, traditional neighborhood design comes with a variety of housing types and sizes in Chico (left); a duplex with a single-family home appearance (right) blends into neighborhood in Davis, CA.

expressed as gross height or number of floors.

- **Site coverage or building footprint requirements** are typically limited by a cap on the size of the building footprint (e.g., 45%) relative to the lot size.

Density and intensity are concepts people are most familiar with. Most codes will prescribe a minimum lot size and maximum number of units per acre for residential areas. For commercial areas, density is referred to as "intensity" and is usually established as cap on building size by floor-area ratios (FAR) or by the building footprint limit listed above.

As applied in most conventional zoning and subdivision codes, bulk regulations can greatly inflate the overall development footprint and create barriers to compact design. Common barriers include:

- **Inflexible Setbacks** – Codes typically prescribe a minimum distance for setbacks, such as 20 feet. Such minimums, when combined with other bulk regulations, underlie the uniform yard-size characteristic of modern subdivisions. Two problems arise from modern setback requirements. First, they are often oversized, pushing homes away from the street and making less appealing streetscapes and neighborhoods. Inflexible setbacks lead to "cookie-cutter" projects as developers will maximize the building footprint based on uniform setbacks.

  Second, inflexible setbacks 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.

- **Height Limitations** – Height limits can be a sensitive topic when discussing neighborhood design. From a watershed 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 rural downtowns have three- and four-story buildings, which are highly compatible with local character. Computer visualization programs can help community members see what greater height allowances would look like in their community.

Multi-story buildings in Jackson and Windsor are in keeping with the small-town, rural character.

- **Minimum Lot Sizes** – Minimum lot-size requirements are common in many development codes, to the detriment of water resources. Large lot requirements can increase distance between development, put pressure on infrastructure, and lead to inefficient land use. Inflexible lot requirements undermine efforts to design development around sensitive features, which makes environmental site design difficult.

Combined, these 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 use of land and more homogenous development.

Local Policy Approach in Amador and Calaveras Counties

Amador County

The SPA-R designation is required to maximize the property's residential development potential by prohibiting development projects with densities below 50% of the maximum allowable density of 18 units per acre for housing for moderate and above-moderate income households, and 25 units per acre for low- and very low-income households.

Calaveras County

Under current zoning, a large amount of remaining land within Calaveras County is subject to dispersed, low-density development patterns. More than 190,000 acres are slated for low-density (5-acre to 20-acre parcels) residential development based on current County zoning. Currently, existing residential land use only represents 2.3% of the land base in the Planning Area, equivalent to 15,307 acres with 396 acres designated as medium and high-density residential.

To further aggravate the situation, Calaveras County has 224,821 acres of private land within its Planning Area zoned as "Unclassified," which leaves room for an interpretation of adding more low-density development to the mix.

The loss of open land to development sharply contrasts with the vision of Calaveras County. In recent community workshops for the General Plan update, citizens voted natural resources, recreation, rural atmosphere and open space as the top most valuable assets in the county. To remediate impending open land conversion, the General Plan Draft of Issues and Opportunities suggests several possibly strategies with an emphasis on revamping land use classifications and development regulations to encourage higher densities.

Santa Cruz Accessory Dwelling Unit Ordinance

Santa Cruz's award winning Accessory Dwelling Unit (ADU) Development Program was designed to provide quality affordable housing opportunities in one of the nation's least affordable cities in terms of housing.

The program encourages development of small-scale neighborhood compatible housing and discourages the proliferation of poorly-constructed illegal ADUs.

At the same time, construction of ADUs promotes infill development and sustainable land use patterns, resulting in transportation patterns. which in turn reduce pollution.

The ordinance regulates the development of ADUs, which are allowed only on residentially zoned lots of 5,000 square feet or greater. In some cases, the ordinance allows for a simpler and shorter permitting process as well as some ADU development incentives. Two-story ADUs located within a rear-yard setback or any ADU that does not meet applicable zoning standards require a public hearing and Administrative Use permit.

For more information: www.ci.santa-cruz.ca.us/pl/hcd/ADU/adu.html

Cities in Amador and Calaveras Counties

The City of Jackson has taken steps to enable compact form in its Historic District (HC) by creating flexible setbacks and parking standards.

The City of Angels Camp's General Plan includes a policy to support higher density in and around the downtown core: "Establish and maintain the High Density Residential (HDR) and Medium Density Residential (MDR) General Plan Land Use Designations and their compatible zoning districts on vacant land within walking distance (i.e., ± mile) of the City's commercial centers so development is readily accessible to pedestrians, low-speed vehicles (LSVs), bicycles and similar low-impact modes of transportation."

Recommendation 1: Allow accessory dwelling units (ADUs) in new and existing development.

Jurisdictions should develop policies, standards and programs to enable additional living units on properties to add density in a manner that is consistent with rural and small town neighborhood patterns. Often called an in-law unit or granny flat, in most cases accessory units are built as backyard cottages, guest houses, units above garages and garage conversions. Providing second units will increase affordable rental opportunities in both counties while providing homeowners with a chance to supplement mortgage payments.

Recommendation 2: Review and update policies and regulations to enable more compact development.

Jurisdictions should review and revise development standards to enable more compact neighborhoods and town centers in desired locations. Factors to consider when developing standards include:

- Consider establishing a maximum lot size for areas serviced by municipal sewer and water.
- Consider minimum density requirements as opposed to maximum requirements.
- Reduce height restrictions for building types that are compatible with surrounding buildings to increase density and reduce building footprints.
- Permit an increase in lot coverage.
- Reduce front setbacks to bring residences and commercial buildings closer to the street.
- Reduce side setbacks and consider use of zero lot line development to allow buildings to be built to the side property line.
- Reduce lot width requirements.

- Encourage a mix of single-family and attached housing types, mix of commercial and residential uses on single lots, and mixed-use buildings with residences, offices and workspaces above retail.
- Develop standards for sidewalks and streetscapes that include trees, lighting, street furniture and other features to ensure a safe, attractive and accessible pedestrian realm.
- Develop standards for building fronts.
- Reduce parking requirements through shared parking, maximize on-street parking and consider maximum parking requirements to reduce excess land devoted to surface lots.
- Encourage the use of alleys and detached garages to reduce the visual impact of garages in higher density residential neighborhoods.
- Require parking in the rear and to the side of buildings in commercial and mixed-use districts.

Recommendation 3: Consider lot size averaging in new residential subdivisions.

Lot size averaging is an adjustment to the rule that all lots in a subdivision should be the same size. It can serve as the underlying basis for implementing cluster or conservation subdivision design in which a large portion of a parcel or multiple parcel planning area remains as open space while homes are located on the remaining portion of the site.

Typical zoning requires each lot to be equal to or greater than a prescribed minimum size. In contrast, lot size averaging allows the average size of all of the lots together in a subdivision to be equal to or greater than a specified minimum. Conservation subdivisions are one of the best-known approaches to residential development that uses lot size averaging. Developed lots are typically smaller than the prescribed minimum lot size and grouped together in one portion of the lot while the cumulative reductions are compiled in one large lot reserved for open space uses. Some communities have required conservation subdivisions to conserve

Accessory units can encourage development compatible with small-scale neighborhood design.

important farmlands, forests, riparian corridors and habitat areas.

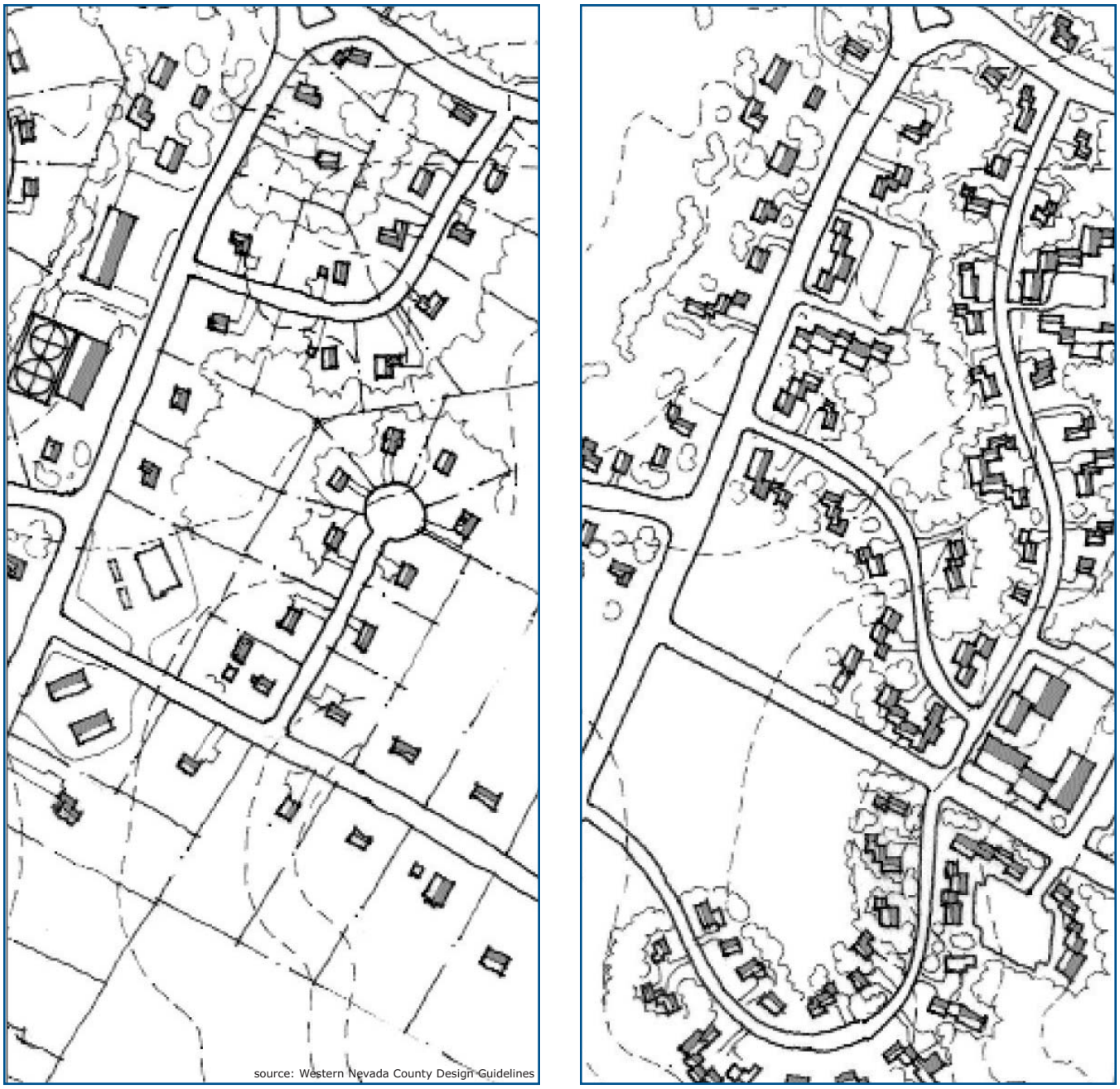
Lot size averaging is especially appropriate in circumstances where the current minimum lot size is based more on the overall resulting density desired in the area than on requirements relating to the size of individual lots such as the minimum needed for the provision of on-site water supply and septic systems.

Model Policies and Programs

The following policy language is taken from city and county General Plans.

City of Livermore General Plan

"The City shall encourage the clustering of development in order to minimize its overall



Conventional vs. cluster development: Housing is organized into clusters of small development in a manner that preserves large areas of open space.

footprint in areas of ecological sensitivity, such as hillsides, alkali springs, creek corridors, and watersheds." (Land Use Element)

Riverside County General Plan

"Re-plan existing urban cores and specific plans for higher density, compact development as appropriate to achieve the Riverside County Integrated Project Vision."

"Concentrate growth near community centers that provide a mixture of commercial, employment, entertainment, recreation, civic and cultural uses to the greatest extent possible.'"

"Concentrate growth near or within existing urban and suburban areas to maintain Riverside County's rural and open space character to the greatest extent possible."'

"'Site development to capitalize upon multi-modal transportation opportunities and promote compatible land use arrangements that reduce reliance on cars."

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."

STRATEGY 3: MIXING LAND USES AND DEVELOPMENT TYPES

Mixing uses integrates two or more different activities into a single structure or grouping of buildings on a single property or a larger planning area. Conventional zoning practices segregate different uses into different areas. This creates the separation of land uses that predominates most post-World War II development. While the separation of some uses is necessary (e.g., an industrial plant separated from a housing complex), it has also forced apart the places where people live, work and access services.

Historic town centers in Amador and Calaveras counties developed prior to application of post-war zoning practices. Walking along a traditional main street, it is still possible to observe two story buildings accommodating retail on the ground floor with housing above. Encouraging mixed use development places a variety of

Mixed-use building in Downtown Jackson

destinations within close proximity, which promotes walking and biking, minimizes the overall transportation footprint, and reduces car generated pollutants found in stormwater runoff.

Separated Uses, Dispersed Development and Vehicle Miles Traveled

Highly separated lands uses disperse growth and contribute to excess impervious cover and auto-related pollution by increasing automobile dependency. To meet daily needs, people must take more trips (e.g., between home, work, store and school) and drive farther between activities.

This explains why increasing vehicle miles traveled (VMT) is correlated with use separation. In turn, this feeds into formulas that determine the size and expanse of roads, parking lots and other car-related infrastructure.

All of this translates into more impervious cover that may not appear in project-site runoff analyses, but is directly linked to the cumulative development pattern produced by multiple single-use projects. Conversely, mixing uses links and combines complementary functions and building types to reduce "trip making" and support more compact form and efficient land development.

VMT has been rising rapidly and outpacing growth in Amador and Calaveras counties and the Sierra region as a whole. Between 1990 and 2000, VMT increased by 30% in the Sierra

region. This VMT increase is nearly double the area's growth in population, indicating that current development patterns are leading to longer commutes and more driving. In Amador County, VMT increased 23% between 1999 and 2006, while Calaveras County saw a 16.2% increase over the same period.[6] This correlates with the region's dispersed exurban growth, resulting in "extreme commuting."

A 2000 Seattle area study compared VMT in mixed-use areas and single, separated use suburban areas. The study recorded trips for 1,563 households in the communities of Queen Anne, Wallingford and Kirkland in Kings County. The mixed-use area residents traveled 28% fewer miles than adjacent neighborhood residents and 120% fewer miles than suburban ones.[7] Additional analysis showed that mixed-use areas also led to reductions in average work trip length and daily auto mileage, and increased the number of walking trips. The daily automobile mileage was 16 miles less in the mixed-use neighborhood than in the single use subdivision.

General Policy Approaches

Communities are seeking ways to integrate a greater mix of land uses into appropriate areas to support economic development goals, achieve a better job/housing balance, support pedestrian orientation and walkability, create more vibrant downtowns and business districts, provide more housing options, curb sprawling growth patterns, and enable more compact community form. The water benefits are only now being recognized.

Since use separation is a result of conventional zoning practices, efforts to enable a greater mix of uses start with fixing local codes. In general, the two ways to obtain a use mix within the zoning codes are through:

1. The list of allowable uses within the list of conventional residential, commercial and industrial categories.
2. A new code category that expressly calls for mixed use.

Applying these options is typically accomplished through the use of overlay zones, specific plans, or the development of designated mixed-use districts. The most common tactic for Amador and Calaveras communities has been to list residential uses within designated commercial districts.

Local Policy Approach in Amador and Calaveras Counties

Amador County

The draft policies document for Amador County's General Plan Update includes a subsection on "Diverse Land Uses," which promotes housing diversity and creating a greater mix of land uses within the county. Goals within this section focus on ensuring an "integrated mix of residential, commercial, agricultural, industrial, recreational, public, and open space land uses" because "a diverse and desirable balance of land uses can help ensure the county's fiscal viability and promote a desirable community in which people can work, shop, live, visit, and recreate." A policy within this section recognizes the water benefits of mixed-use development that result from more efficient land use patterns. There is also emphasis on ensuring compatibility between various land uses.

A limited mix of uses was previously allowed in the Special Planning Area (SPA) designation. The new Regional Service Center (RSC) and Town Center (TC) land use designations, jointly called "mixed use activity centers," are specifically designed to implement mixed-use development within existing community areas.

The new Special Planning Area Residential (SPA-R) designation is intended to provide housing diversity in select areas to meet affordable housing needs, and appears to allow a limited mix of commercial uses into affordable residential projects. The following language from the land use alternatives explains the intent: "help reinforce the traditional development pattern of small communities to facilitate bicycles and pedestrians and reduce the length of vehicle trips to meet basic needs."

Three of the four proposed land use alternatives include these designations in varying degrees. The County is considering additional modeling of the alternatives to understand tradeoffs and the implications of each on key issues in order to develop a preferred alternative.

Calaveras County

According to the Draft Baseline Report by the County's General Plan consultant, only 1.2% of existing property in Calaveras was classified Commercial/Mix Used in 2007. Land use alternatives and draft policies are under development and are likely to incorporate greater emphasis on mixed-use development, which receives notable attention in the Issues and Opportunities Report.

Cities in Amador and Calaveras Counties

The **City of Jackson**'s new Land Use Element incorporates a use mix by allowing residential land uses by right in three of the five Commercial land use designations – Historic Commercial (HC), Light Commercial (LC) and Professional Office (PO). The other two designations, Commercial (C) and Industrial (I) can include residential dwelling units with a conditional use permit. According to the City, most mixed use will occur (and currently exists) in the historic downtown commercial area where residential use is allowed without a conditional use permit. Even now, most of the two-story commercial buildings on Main Street have residential units on the upper floor.

Similarly, the **City of Sutter Creek**'s code allows limited residential within two of three commercial classifications. Commercial (C-2) zone allows multi-family residential and the Downtown Commercial (DTC) zone allows "first and second story residential units, including studio apartments." However, the Light Commercial (C-1) zone does not.

Several cities in the area have taken steps to enable mixed-use development, primarily by allowing residential development "by right" (as opposed to the more cumbersome conditional use) in commercial districts.

The Arbors' Mixed-Use Infill in Gold Rush Town

Calaveras County is home to one of the most popular examples of new mixed-use development in the Sierra region. The Arbors is a 1.5-acre mixed-use, infill project built on Main Street in downtown Murphys, a historic Gold Rush town.

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 public engagement in the design process, and the County's willingness to work with developers to provide flexibility in meeting local development standards, investments in street upgrades, and surveying assistance to help developers incorporate street trees into the project.

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

New mixed-use buildings in Davis (left) and at the Arbors in Murphys (right).

The **City of Angels Camp** allows mixed use by right in each of its commercial zones. It also has policies that support a mix of housing types throughout the community. For example: "High Density Residential developments generally will be located close to commercial or other services and near major streets and thoroughfares for convenient access. High Density Residential developments typically will be located throughout the city and not concentrated in a single location."

Recommendation 1: Develop and implement a mixed-use zoning ordinance.

Implicit in the previous sections on strategic location and compact design is that these strategies would introduce and require more flexibility in land uses and incorporate a greater diversity of housing types. An explicit and comprehensive tool that could be used to foster mixed use would be a stand-alone mixed-use code. It could be applied to new residential development to allow for a mix of housing combined with neighborhood-oriented commercial development. It could also be applied to new and existing areas to allow for live/work development, where residents can have a workshop or studio on the premises for craftwork or other small enterprises such as fruit stands or electronics repair.

Mixed-use codes could also be applied to preserve a mix of uses in the region's historic town centers and to single-use zones in transitional areas to increase the vitality and convenience to residents by adding complimentary uses (for example, restaurants or dry cleaners to a residential area or apartments to a main street area).

There are numerous examples of zoning ordinances to permit and encourage a mix of uses in a planning area. The American Planning Association has a model ordinance available at www.planning.org/research/smartgrowth.

Recommendation 2: Explore the use of form-based codes.

Since the dawn of zoning, conventional codes were built around the concept of separating uses. They seldom allow uses from a different category such as retail, single-family, multi-family and offices within the same zoning district.

In contrast, form-based codes outline a specific town form rather than zoning by use. They 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. By focusing on the shape and scale (and therefore character) of the total built environment, the form-based approach can more readily organize and calibrate land use regulations and development standards to implement a mix of uses and housing types on a single property, neighborhood or district level.

Character by Design: Elements of a Form-based Code

Form-based codes commonly include the following elements:

- Regulating Plan. A plan or map of the regulated area designating the locations where different building form standards apply, based on clear community intentions about the physical character of the area being coded.
- Public Space Standards. Specifications for the elements within the public realm, including sidewalks, travel lanes, on-street parking, street trees and street furniture.
- 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.
- Definitions. A glossary to ensure the precise use of technical terms.

Form-based codes also sometimes include:

- Architectural Standards. Regulations controlling external architectural materials and quality.
- Landscaping Standards. Regulations controlling landscape design and plant materials on private property as they impact public spaces (e.g., regulations about parking lot screening and shading, maintaining sight lines, and ensuring unobstructed pedestrian movements).
- Signage Standards. Regulations controlling allowable signage sizes, materials, illumination and placement.
- Environmental Resource Standards. Regulations controlling issues such as stormwater drainage and infiltration, development on slopes, tree protection and solar access.
- Annotation. Text and illustrations explaining the intentions of specific code provisions.

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

For more information: www.formbasedcodes.org

Bringing the form and character of development forward in the standards removes guess-work about community expectations that can hold up proposed projects in public hearings and other discretionary review processes. The increased clarity in intent can lead to a shift in approval review from a hearing-heavy process to one that is more administrative and potentially less staff-intensive. Simplified and streamlined proposal reviews provide a built-in incentive for desired types of new development.

Model Policies and Programs

The following policy language is taken from city and county General Plans.

City of Truckee 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."

"Encourage a mix of land uses in the Town to promote a vibrant community and to reduce traffic, while addressing the need to minimize land use conflicts."

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

Mariposa County General Plan

"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."

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

STRATEGY 4: TRANSPORTATION NETWORK AND STREET DESIGN

Automobile-related hardscapes generally account for more than 60% of the total imperviousness in suburban areas. Streets account for the lion's share of this – about 40% to 50% in residential areas alone. Parking lots take up around 10% of the land in U.S. cities, and can occupy as much as 20% to 30% of downtown core areas.

There has been increasing attention placed on strategies that produce alternatives to an automobile-dependent transportation system. Key strategies include:

Create connected street network.

Land use and development that are based on a network of well-connected streets and paths, are prerequisite for reducing impervious surface and the overall transportation-related footprint. Attention to the size and spacing of blocks, streets and intersections can increase connectivity within and between neighborhoods and reduce congestion on individual streets by creating more route choices for daily trips. A connected street pattern provides more direct links between destinations, making trips shorter and some trips short enough to be made on foot or bicycle, further reducing car dependency and the need for large asphalt roads and parking lots.

Direct and multiple connections to destinations also improve emergency access and response time, a necessary requirement for narrower streets.

Design "complete streets" that serve all users.

Complete street design considerations include sidewalks and bike lanes, on-street parking, transit stop areas, and narrower travel lanes to slow vehicle speeds. These streets encourage public activity and allow for easy access to destinations and multiple travel options for users. There is not one design model for complete streets, but the concept can be adapted to different contexts and settings. For instance, roadways in outlying rural areas may not include sidewalks, but can use narrow lanes with highly visibility shoulders to provide area for bicyclists and pedestrians, and extra road width for larger vehicles and emergency passing.

Incorporate "green infrastructure" into street design.

Green infrastructure can be used to manage stormwater on-site as well as to provide a more comfortable and aesthetically rich environment for all users. Planting areas between the curb and sidewalk as well as street medians can be designed to manage stormwater by allowing water to be captured, retained, and even filtered on site. These areas serve double duty by also providing opportunity for reduced imperviousness, maximizing tree canopy, and improving traffic flow and safety.

Narrow, tree-lined streets also slow traffic speeds, enhance pedestrian comfort, and provide more area for open space or additional development on the same amount of land. Well-shaded streets also require resurfacing less often since they are less prone to deterioration from the sun.

Excess pavement is retrofitted with landscaping, sidewalks, bike lanes, parking, small outdoor gathering areas and other features for traffic calming and walkability.

Local Policy Approach for Amador and Calaveras counties

Amador County

The Amador County Transportation Commission developed the Amador County Pedestrian and Bicycle Transportation Plan that identifies a regional bikeway system that links major population centers and destinations within them. The plan currently serves as each local agency's pedestrian and bicycle master plan, allowing them to be eligible to compete for state Bicycle Transportation Account (BTA) funds.

Also, policies included in the draft Goals and Policies Workbook to mix land uses are related to transportation planning and street policies. Mixing land uses has been shown to reduce vehicle miles traveled and increase walking. Below is a review of policies that link development patterns with transportation issues.

Land Use Policy 1.6 calls for land use patterns that "support water quality objectives; enable viable transit, bicycle and pedestrian transportation; and contribute to reductions in greenhouse gas emissions." This policy makes an important connection between development patterns and design for pedestrian access and mobility.

Land Use Policy 2.3 directs higher density or intensity development to infill areas, or areas adjacent to existing communities or activity centers. This facilitates compact development patterns, which have been shown to reduce vehicle miles traveled and the need for related transportation infrastructure.

Circulation and Mobility Policy 1.3 calls for greater connectivity on local roads, improved connections between the County's communities, and multiple routes between communities wherever possible.

The draft goals and policies workbook also includes an entire "Alternative Transportation" section with a set of goals and policies to promote development patterns and forms, and transportation routes and facilities that support public transit, pedestrian and bicycle mobility. Policy language is included to work on establishing a pedestrian and bicycle trail system in public rights of way, and through easements on public and private lands to connect residents to communities and activity centers, and offer an alternative to automobile transportation.

Circulation and Mobility Policy 3.5 calls for promotion of smart growth land use patterns in new development that place residents near activity centers and essential services to reduce the need for frequent automobile travel. Policy 3.9 encourages provision of bicycle and pedestrian facilities in new development projects.

Policies 3.6-3.8 focus on public transportation, including coordination with the Amador Regional Transit System (ARTS) and other agencies to improve availability of public transit connecting residents to services; continued provision of public transportation from Amador County to

regional job and activity centers located outside the county; and development of facilities, which support carpooling and public transportation within the county.

SR-49 and portions of SR-88 are eligible for designation as Scenic Highways by the state and federal government. Together, Amador County's eligible and designated scenic highways and byways are referred to as scenic corridors. Required protection of these corridors provides an opportunity to coordinate with green infrastructure design to reduce the watershed and water quality impacts of these major transportation corridors.

Calaveras County

The Calaveras County roadway network includes 867.5 miles of developed paved public roads. Travel in the county is primarily by automobile due to its rural nature. Long distances between towns and a lack of other pedestrian and bicycle facilities have limited opportunities for non-motorized travel. The network is built around four state highways, including State Routes 4, 12, 26 and 49. These routes are classified as minor arterials and connect with a system of collector and local streets.

This network has enormous influence over the type and patterns of development taking place in the county. It drives an auto-centric planning cycle that prohibits pedestrian access and modal options, while extending development over wider areas. These patterns feed back into lot layouts, parking provision and building types that are geared towards serving cars above all else.

Along with several other issues related to transportation planning, the need for transit services and more bike and pedestrian facilities were identified as priorities at public workshops for the General Plan update. Currently, Calaveras County has limited public transit services available for travel between existing communities, within the county or to surrounding destinations.

According to the 2000 Census, 5.3% of Californians travel to work on public transit, while only 0.3% of the population in Calaveras County (approximately 42 people) used public transit to get to work.

There is no public transit connection to regional transit such as Amtrak and only one park-and-ride facility in the county. Numerous locations throughout the county serve as informal park-and-ride lots, demonstrating the need for additional facilities.

The draft Calaveras County Bikeway Master Plan (2007) states that there is great potential to increase the number of people who bike to work or school because of the small size of communities, moderate density surrounding downtowns, a favorable climate for year-round cycling, and a culture that values fitness, outdoors and nature. Existing Calaveras County bikeway facilities consist of an incomplete system of just over 4.1 miles that are not continuous and do not provide direct access to most major destinations.

The Calaveras Council of Governments (CCOG) developed a Bikeway Master Plan that promotes access to popular destinations countywide and sets consistent design standards, but will require funding to implement. The plan is updated every five years to enable the County to compete for bikeway grants through the Caltrans Bicycle Transportation Account.

These are all common challenges, not unique to Calaveras County. Communities within the County and the County itself are already taking steps to correct these deficiencies and place greater emphasis on multi-modal street design and transportation planning.

For example, the Arnold Rural Livable Community-Based Mobility Plan was completed in June 2008 and produced design concepts for pedestrian and bicycle facilities, connections to transit and possible in-fill development options for the downtown area of Arnold. The goal of the plan is to increase resident and visitor ability to walk, bike, access transit and drive through the SR-4 corridor.

The City of San Andreas is also tackling transportation and connectivity issues. Using a

Narrowed lanes with colorized shoulders to reduce traffic speeds and provide an area for bicyclists, pedestrians and emergency passing.

Caltrans grant awarded to the CCOG, the City has created the Rural Mobility Plan Project, which will address the current mobility challenges of State Route 49 (St. Charles Street).

The Calaveras County Master Bicycle Plan and Calaveras County Pedestrian Master Plan are also potential tools that can be used to guide development of a master street, path and trail network with "complete streets" design.

RECOMMENDATIONS

There are many agencies involved in the design of streets and transportation planning and funding, including County public works departments, County planning departments, Amador Transportation Commission, Calaveras Council of Governments, Caltrans, and public works and planning staff or contract consultants for each of the incorporated cities. These agencies need to work together to coordinate local land use decisions, road construction and maintenance projects, and public works and development standards that direct construction and improvement of roads.

Recommendation 1: Revise subdivision and road standards for streets and highways.

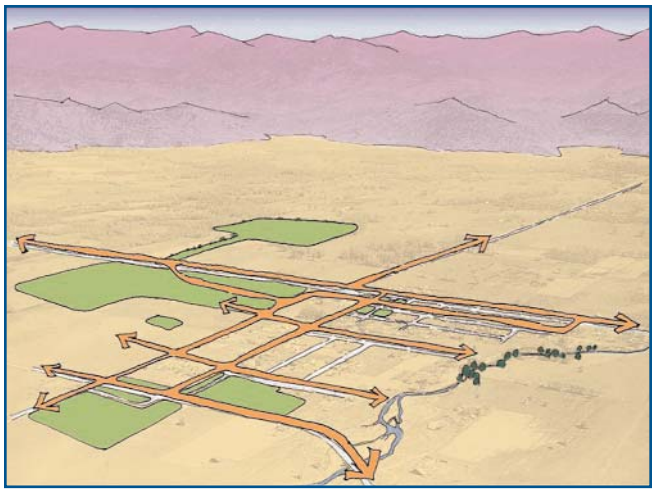
Transportation, public works and planning agencies should review and revise public works standards for the construction and operation of a range of street types that incorporate complete streets, context sensitivity and green infrastructure design considerations. Street design standards and outmoded level of service formulas often lead to excess number of lanes, excess lane widths and inefficient intersection designs that produce unnecessarily wide roadways and accompanying imperviousness.

Recommendation 2: Maintain street connectivity in existing communities and require connectivity in new development.

New development should have street connections to adjacent development. Dead-end streets and cul-de-sacs should generally not be permitted unless there are special topographic (such as hilly terrain) considerations or other unavoidable site constraints. Development with low street connectivity can be mitigated with a viable trail network for pedestrian and bicyclists providing direct connections between streets within the neighborhood and to surrounding destinations, such as schools, parks and commercial areas.

Recommendation 3: Develop pedestrian and bicycle master plans.

In rural low-density areas, there are often discontinuities in public rights of way, and challenges to establishing and coordinating alignments across public and private lands to produce connected road and trail networks.



A non-motorized mobility network continues along primary transportation routes and through off-street trails.

Transportation, public works and planning agencies, and staff and commissions involved in parks and recreation management should work to develop regional and local comprehensive plans and prioritize projects to develop sidewalks and on-street bike routes and lanes in more developed areas. In less developed areas where there are fewer roads, planning needs to include pedestrian and bicycle connections through a trail network.

Existing and proposed new recreational trails should be considered for opportunities to provide direct connections between homes, schools and other gathering places. Separated paths should be considered along rural highways or shoulder improvements to allow for pedestrian and bicycle transportation.

Model Policies and Programs

The following policy language is taken from city and county General Plans.

City of San Jose General Plan

"In order to preserve and enhance the scenic and aesthetic qualities of rural areas located within the City's Sphere of Influence, the design and construction of public and private right-of-way improvements should conform to the following guidelines:

- Streets should be designed in consideration of the natural topography and the landscape. Divided streets and grade separations may be used.
- Concrete sidewalks, curbs, and gutters should be constructed only when required by the topography. Crushed gravel walks and vegetation lined swales are encouraged."

Overall Community Design Recommendation: Develop form-based codes as an alternative to conventional zoning regulations.

A challenge facing communities in Calaveras and Amador counties is to balance new development with desires to preserve rural landscapes and the small-town feel of their historic communities. Infill, mixed-use development and compact design are central to preventing rural sprawl and loss of open lands, but they require steering some future development into existing communities, as well as increasing densities in some areas.

There is not a simple solution to this challenge; however, the design of new development can have a great impact on whether it conforms to or detracts from the character of existing communities.

Form-based codes are a relatively new method to regulate the development of buildings and streets to be more consistent with what the community desires.

Conventional zoning overlooks the form and character of development and focuses instead on its use and intensity. Also, it is subject to interpretation, sometimes leading to differences between community vision and physical development. The result can be seen in most any subdivision built under conventional zoning codes – generic buildings and landscaping within homogeneous neighborhoods. Form-based codes emphasize building form and its relation to the street, adjacent buildings and public spaces, allowing a return to pedestrian scaled design.

There are many advantages of a form-based code. The key points are adapted from the Form-Based Codes Institute:

- Prescriptive vs. Proscriptive: They state what you want (prescriptive) rather than what you don't want (proscriptive), fostering a more predictable results in built projects.
- Focus on Key Elements: The design elements controlled by conventional regulations are often arbitrary. The elements controlled by form-based codes are those that are most important to the shaping of a high quality built environment.
- Built from a Community Vision: All form-based codes are developed out of participatory design processes. Because they include visual depictions, form-based codes also allow citizens to see what the outcome will look like, leading to greater comfort regarding location, height, density and other factors.
- Development Diversity: By working at the scale of the individual building or lot, form-based codes promote independent development by multiple property owners. By contrast, conventional zoning can encourage large land assemblies and mega-projects by single builders.
- Architectural Diversity: Form-based codes encourage a diversity of architecture, materials, uses and ownership.
- Design for Compatibility: Form-based codes work well in established communities because they effectively define and codify a neighborhood's existing "DNA." Vernacular building types can be easily replicated, promoting infill that is compatible with surrounding structures.
- User-friendly: Form-based codes are organized to be readable and accessible. They include graphics to illustrate design concepts and are shorter, more precise and less repetitive than conventional codes. This helps all involved in the development process.
- Combine Regulatory and Design Guidance: Form-based codes combine the best elements of design guidelines, which can be difficult to apply and enforce consistently and which require significant discretionary oversight, into a regulating framework for new and redevelopment. According to the Form-Based Code Institute, this results in "less politicized planning process that could deliver huge savings in time and money and reduce the risk of takings challenges."

Form-based codes may prove to be more enforceable than design guidelines. The stated purpose of form-based codes is the shaping of a high-quality public realm, a presumed public good that promotes healthy civic interaction. For this reason, compliance with the codes can be enforced, not on the basis of aesthetics, but because a failure to comply would diminish the good that is sought.

While enforceability of development regulations has not been a problem in new growth areas controlled by private covenants, such matters can be problematic in already urbanized areas due to legal conflicts with First Amendment rights.

6. Sustainable Water and Watershed Management

While our population is growing rapidly, our water supplies are limited. Like most of the Sierra Nevada region, the majority of developed water resources in Amador and Calaveras counties are derived from surface water sources.

While groundwater is an important resource as well, it is more challenging to use due to the Sierra's fractured bedrock geology, which results in relatively small and intermittent pockets of groundwater. While surface waters in the region are relatively abundant, they are also the primary water supply for large population centers further west.

Unfortunately, we cannot make more water – we can only manage the supply and demand of the water we have. It is not that new water sources cannot be developed – California has been finding innovative, albeit expensive, ways to develop and move water for ages.

Since the 1930s, we have built an enormous and intricate system of dams, aqueducts, pumps and canals to move water from the mountains to the coasts and from the north to the south. Local watersheds like the Upper Mokelumne are integral to this system. However, the cost of updating and maintaining conventional water supply systems, which depend on aging infrastructure, are increasing even as those systems become less reliable.

Similarly, the environmental impacts of conventional systems have become apparent, further increasing financial costs and legal hurdles. The recent court decision to reduce the amount of water that can be pumped from the Sacramento-San Joaquin Delta to southern California is a prime example.

Conventional systems that deliver stormwater and associated pollutants directly into waterbodies, compromise the quality of local water supplies as well as environmental health.

Climate change will also influence the future of water planning. California depends on the Sierra snowpack as a massive natural storage system. Climate change experts warn that shorter winters and higher temperatures will decrease the Sierra snowpack, effectively shrinking California's largest water storage system.

With these water management challenges in mind, it is clear that more efficient and sustainable water management solutions, with less economic and environmental costs, are need. In part this shift will rely on expanded use of efficiency measures including conservation practices, recycling and reuse, and water capture systems; these combine to increase water supplies.

For communities to realize the full potential of water conservation and efficiency measures, development patterns must also be addressed. Dispersed development patterns and large lot homes (common to the region) place high demand on water supplies and increase strain on water and wastewater infrastructure.

This is especially important in Amador and Calaveras counties because most of the region is served by small, independent and isolated municipal water and sewer agencies, which individually lack the technical or financial capacity to upgrade and/or expand their treatment facilities and infrastructure. Water and wastewater agencies in the area are often not able to (or choose not to) consolidate to take financial advantage of a larger customer base that could enable needed repairs and expansion.

Dispersed development patterns that cannot be served by centralized water and wastewater systems must rely on "on-site" septic systems to manage and treat wastewater. Septic systems have land area requirements that result in larger lots, thus driving lower density development. Septic systems can also create water quality problems due to systems leaking into local waterways and groundwater supplies, leading to public health and safety concerns.

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 and suggested that extending wastewater collection and treatment systems may be the best option to reduce the volume of pollutants from failing septic systems entering local water bodies.[1] But this is likely cost-prohibitive, and may induce growth in outlying areas. As a solution, more compact communities and strategically located development can make homes easier and less costly to serve by a centralized wastewater facility thus saving ratepayers and water agencies money and reducing environmental impacts.

On-site systems are not the only contributors to water quality impairment. Effluent from centralized wastewater treatment plants is also of concern given that so many facilities in Amador and Calaveras are nearing or beyond capacity. Looking at Amador County, there are around 25 community-based sewer treatment plants. Average daily wastewater flow for Amador County is expected to increase from 1.5 million gallons per day to 9.0 million gallons per day in 2025. However, several treatment facilities are at or near capacity, or are otherwise in need of repair or upgrade. The cities of Jackson and Sutter Creek, in particular, have wastewater treatment plants (WWTP) that are approaching capacity.

In light of these challenges, water efficiency and smart planning are increasingly important, and will require a more integrated and coordinated management approach. The state's Integrated Regional Water Management (IRWM) program, which ties funding to more coordinated and collaborative planning processes, seeks to support a more coordinated management framework. The IRWM program was always intended to ensure that various water interests are working together, and now state water officials are seeking increased linkage to local land use planning and development decisions as well. Despite early challenges, this program is changing the way water is managed in California, including in Amador and Calaveras counties, which can improve water and land use efficiency by continuing and increasing their involvement in the program.

This chapter focuses on strategies that local governments and water agencies can use to make the most of current water supplies by

Why Do Septic Systems Fail?

Old systems have a higher rate of failure compared to new ones. The U.S. EPA reports that generally "tanks and pipes buried in the ground begin to deteriorate after 20 or more years of use and may require repair or replacement." Another area of concern with older systems is the tendency of soil filtration systems to become clogged with contaminates and to no longer function as designed. In addition to age, there are three primary reasons that on-site wastewater treatment systems fail:

1. **Improper Installation (including design and site selection):** The reliability of conventional (septic) systems is based largely on local conditions including soil permeability, geological formation and ground water levels. For example, areas with higher clay content in soils tend to have lower soil permeability and therefore are less suitable for standard septic systems. Similarly, constrained or restrictive geologic formations and perched water tables can prevent a system from functioning properly.
2. **Improper Operation:** Residents are not always aware of how their septic systems work, that they need regular inspection and maintenance. If improper materials or trash are put into the system, a failure can result. With increasing numbers of second home owners and residents moving into the foothills and Sierra from other regions, a number of residents accustomed to centralized sewer systems who may be unaware of how on-site wastewater systems work. Education programs are an effective means of increasing the public's awareness about how to operate septic systems.
3. **Inadequate Maintenance:** For on-site wastewater treatment systems to function properly, solids must be removed from the tank on a periodic basis. More detailed inspections should be conducted on all systems at the time of pumping. In some areas of the country, local jurisdictions are considering contractual maintenance requirements for all on-site wastewater treatment systems, which will ensure that systems are regularly inspected and pumped by a third party service provider.

   Given the large influx of residents to Amador and Calaveras counties from areas serviced by centralized sewer systems, such a requirement may avoid environmental and human health concerns from systems owned by individuals who may not be aware of the pumping and maintenance requirements of on-site wastewater treatment systems.

reducing demand, managing a more diverse portfolio of water resources, and protecting water quality through improved development patterns and coordinated planning. The strategies are broken into three areas:

1. Water Conservation and Efficiency
2. Water Reuse (wastewater and greywater recycling)
3. Coordinated Water Resource and Land Use Planning

These strategies support solutions that do not rely on the investment of high finance water projects, such as redirecting water away from streams and rivers, building new reservoirs, or enlarging or draining existing reservoirs, to create a reliable and high quality water source. Instead these strategies can be used to take advantage of water supplies by increasing water use efficiency through conservation, reuse, and collaboration.

Strategy 1: Water Conservation and Efficiency

Water conservation is the cheapest and most readily available option of increasing California's water supplies, according to the Pacific Institute. The Institute's 2005 report, *Waste Not Want Not*, highlights the potential for water efficiency to cost-effectively increase water supplies by decreasing demand. More than half of urban water conservation strategies can be achieved at $200 per acre-foot or less.[2]

The report estimated that urban water conservation could contribute 2.0 to 2.3 million-acre feet a year to California's water supplies – enough to supply the current demands of more than two million households.[3]

In addition to supporting water supply needs, water efficiency provides environmental benefits by protecting flows in local rivers and streams to support recreation, fisheries and habitat. It also reduces the amount of chemicals needed to treat water and wastewater, and the amount of energy used to treat, pump and transport it. This translates to financial savings as well – approximately 33% of the energy budget of city governments in California is used for pumping water and 23% is used for treating wastewater.[4]

Despite these and other benefits of water efficiency, California's "use it or lose it" legal framework creates perverse incentives that dissuade conservation in many rural areas for fear that by not using "enough" water, they will lose the rights to that water in the future.

While this does not prevent conservation initiatives altogether, it requires increased levels of coordination between water agencies and land use agencies to plan for future needs, and identify beneficial uses for "saved" water that results from conservation and efficiency measures.

Pricing and rate structures also do not always send the right signals to consumers. Many rate structures charge a flat rate for water use even though costs increase as more water is needed. More and more water agencies are looking to creative pricing to send appropriate market signals to consumers, by charging more as demand increases, or to pump water farther distances.

General Policy Approaches

For urban uses, water conservation approaches are usually divided between outdoor and indoor uses. Over half of water used by a typical single-family home is applied outdoors. To reduce landscape demands, local governments can offer rebates and incentives for using new water-saving irrigation technologies, encourage "water-wise" landscape designs, and provide irrigation audits to commercial and residential customers.

Cities and counties can work with water agencies to incorporate water-saving devices into new and existing development. 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. For existing development, simple upgrades can be required so that homes are retrofitted with more efficient appliances and plumbing at the time of sale.

Local governments can work with water suppliers to provide incentives, system audits, rebates and outreach programs to help residents, property managers and developers incorporate efficiency measures.

The rates charged for water service can have a big impact on water usage and development patterns. Utilities are under pressure to keep rates low and affordable for their customers, but when rates do not reflect true costs, they can promote inefficient water use and development practices, and penalize certain customers for the less-efficient choices and practices of others. Water rates need to reflect the monthly costs of operations and maintenance as well as long-term needs of existing water systems, such as for upgrading and retrofitting aging and failing infrastructure.

State Laws on Water Conservation in the Landscape

California Urban Water Conservation Council (AB 2717), 2004

Upon the passage of AB 2717, the California Urban Water Conservation Council created a task force to develop recommendations for improving the efficiency of water use in irrigated landscapes in California. From this process, the council adopted a set of 43 recommendations. The Department of Water Resources was then charged with updating its existing Model Efficient Landscape Ordinance using these recommendations and to upgrade the California Irrigation Management Information System.

Water Efficient Landscape Ordinance (AB 1881), 2006

Building upon the momentum of AB 2717, the Water Efficient Landscape Ordinance (AB 1881) enacts many of the recommendations of the council's task force. The Department of Water Resources must update the Model Efficient Landscape Ordinance no later than January 1, 2009. Local agencies are required to adopt the updated model ordinance or the equivalent by January 10, 2010, or the model ordinance will automatically by adopted by statue. AB 1881 also charges the California Energy Commission to adopt standards and labeling requirements for landscape irrigation equipment to reduce the unnecessary consumption of excess energy or water.[5]

Local Policy Approach in Amador and Calaveras Counties

Amador County

As part of the General Plan update, Amador County released a General Plan Advisory Committee Workbook which included draft policies addressing water conservation. The County aims to encourage water conservation measures in new development and to develop BMPs for water conservation. The County also suggests specific water conservation efforts, including the reuse of greywater, water-conserving plumbing fixtures and low-water use landscapes. The County also recognizes the need to coordinate with the Amador Water Agency (AWA) and other organizations to develop water use standards and regulations to curb demand during water supply emergencies and drought.

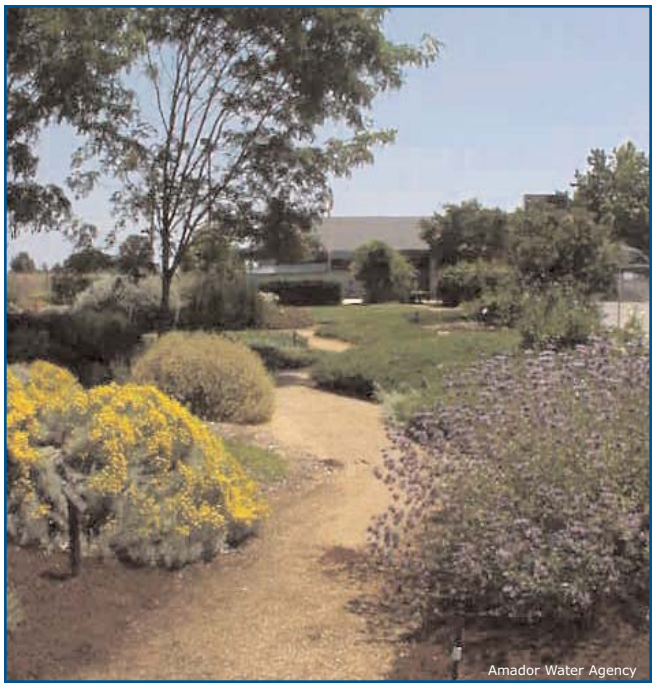
The AWA's efforts to increase efficiency include updating infrastructure, public outreach and participation in regional planning efforts (though the AWA chose not to participate in this project). Recently, the AWA completed the 8-mile Amador Transmission Pipeline, which replaced a 23-mile ditch that had served as the AWA's main supply line. The pipeline creates efficiency by reducing water loss from leakage and evaporation.

Drinking water entering the Ione treatment plant is also now significantly cleaner and requires less water (50,000 gallons a day) to operate.

Further savings result from reduced flow into the wastewater system, which reduces maintenance needs and overall strain on the system.

The AWA offers educational material, planted a demonstration drought-tolerant garden at its main office, and provides water conservation tips and resources on its website. Upon request, customers can receive a free water-saving kit with showerhead replacements and a device for reducing toilet flush water for regular toilets.

The AWA participated in the Mokelumne/Amador/Calaveras IRWMP, and as part of the Upper Mokelumne River Watershed Association (UMRWSA) is working with Calaveras County Water District and East Bay Municipal Utility District on a conservation plan for the Mokelumne River to be implemented in 2009.



The Amador Water Agency created this model drought-tolerant garden at its Sutter Creek office, constructed in partnership with Mule Creek State Prison inmates and faculty as well as the Amador County Cooperative Extension Master Gardeners.

Calaveras County

As part of the General Plan update, community meetings were held to receive input from residents on the guiding principles for the County. The community identified the need for increased water efficiency and balance of water demand across watershed boundaries. More specifically, the community believed the County should develop water conservation regulations, enforce greywater reuse for irrigation in all new development, and promote efficient patterns of development that require less water.

In its 2005 Urban Water Management Plan Update, the Calaveras County Water District (CCWD) emphasized water conservation as a main component of its commitment to responsible management of water resources, offering such programs as water surveys for single- and multi-family homes, commercial and industrial facilities, residential plumbing retrofits, leak detection and repair, large landscape conservation programs and incentives, high-efficiency washing machine rebates, public and school outreach, and wholesale agency assistance.

To reflect the true cost of water, the CCWD uses commodity rates for all new connections and retrofits, and recently implemented a three-tier rate structure. It also enforces the responsible use of water, and if it notices negligent or wasteful use of water, it holds the right to discontinue service if conditions are not corrected within five days of written notice to the customer. The District has hired a conservation coordinator to oversee and implement its many water conservation programs.

Recommendation 1: Support water-smart landscaping and irrigation practices.

On average, more than half the water consumed in residential development goes to landscape irrigation. Californians use about 977 billion gallons of water for landscape irrigation each year.[6]

In the Sierra, dry summers require significant water to keep lawns and gardens green. One of the most ubiquitous examples of a typical front yard is a conventional "turf" lawn. Turf lawns are not indigenous to the state and are adapted to live in a cool weather climate. For lawns to survive in drier and more variable climates, they require an enormous amount of water as well as chemical fertilizers and pesticides.

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%.[7] Drought tolerant and native plants that are accustomed to local conditions are lawn alternatives that tend to require fewer or no pesticides and fertilizers (significant contributors to water contamination), and require little or no irrigation or mowing.

Changing the common lawn culture will not be easy, and will require investment by both local governments and water agencies to educate residents on the water impacts of different types of landscaping and provide them with the

Water Efficiency and Calaveras County's Water Element

Several agencies and water stakeholders in Calaveras County met in fall 2008 to develop a Water Element as part of the County's General Plan update. A majority of county supervisors supported the idea and local water leaders spearheaded a fast-paced process to develop goals and policies.

The inclusion of water conservation policies in the Calaveras General Plan will help implement best practices and reinforce conservation efforts of local water utilities.

The California Urban Water Conservation Council established a Memorandum of Understanding Regarding Urban Water Conservation in California (MOU), which outlines 14 Best Management Practices to reduce consumption of California's water resources. These BMPs are considered the standard for water conservation practices. Currently, 384 water agencies and environmental groups have signed the MOU confirming their commitment to implement the 14 BMPs, including the Calveras County Water District. The BMP list is regularly updated and available at www.cuwcc.org/ bmps.aspx.

vision, skills and literature to create water-wise landscapes.

Programs used by other local governments and water agencies include creating demonstration gardens, providing water conservation fact sheets and guidebooks about landscaping, and creating incentive and rebate programs. Many water agencies offer irrigation audits to customers and provide assistance to planning departments when reviewing large-scale landscape plans.

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

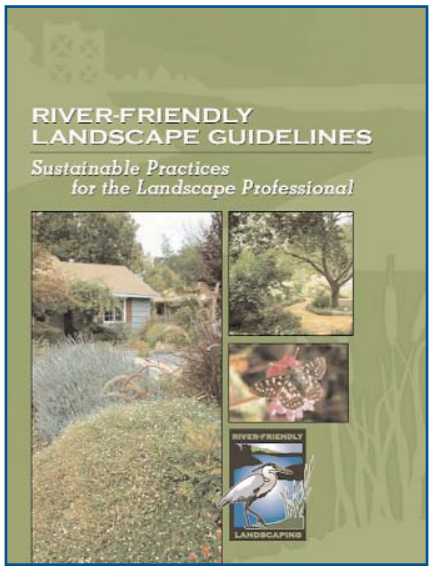
Examples of landscape guidebooks include:

- "Sierra Nevada Yard & Garden: A homeowner's guide to landscaping in the Sierra" Sierra Nevada Alliance (www.sierranevadaalliance.org/ publications/SNLG).
- "River Friendly Landscape Guidelines: Sustainable Practices for the Landscape Professional," Sacramento Stormwater Quality Partnership (www.sacramentostormwater.org/SQP/riverfriendly/default.asp).

Irrigation systems play a significant role in how much water is used for outdoor watering.

Irrigation practices also affect water quality; runoff from over-watered lawns can carry high concentrations of chemical treatments, such as fertilizers and pesticides, into local waterways. Several factors affect how water-smart an irrigation system is, including:

- Timing – Watering should occur early in the morning or in the evening (to reduce evaporative loss) and only when needed. New smart-controller irrigation systems are able to read soil moisture and apply water accordingly.



"Turf Buy Back Program" in South Lake Tahoe

Lawns are widely believed to be the largest crop grown in the state, and they are certainly the thirstiest option for residential landscaping. From a water management perspective, lawns present two problems: they tend to be over-watered, and they require lots of chemical treatments. Increasingly, residents are looking to different landscaping options that are more water-efficient, easier to maintain, and that can be more aesthetically appealing.

The South Tahoe Public Utility District's "Turf Buy Back Program" provides a cash rebate to residential customers for reducing the amount of lawn area in their yards. The District has used two state funded water conservation grants to provide voluntary lawn buy-backs at $2 per square foot for customers who wish to replace their lawns with less water-intensive, landscaping options. The incentive for lawns larger than 1,500 square feet is $1.50 per square foot.

Eligibility requirements include a minimum of 400 square feet of irrigated, maintained lawn (pre-conversion). The converted landscape must employ water-efficient irrigation systems and planting materials such as mulch, a 50% living plant cover at maturity, and selection of native/adapted plants.

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

- Quantity – Irrigation should apply only the amount of water needed to satisfy the needs of the plants. The amount changes seasonally and with differences in weather. Newer irrigation systems are able to sense climate conditions to determine when and how much water is needed.
- Plant Selection – A well-planned, water-efficient garden will group plants according to their water needs (a technique called hydro-zoning). This practice can also take advantage of planting materials that keep soils and roots moist. Shading and windbreaks can further reduce evaporation and retain soil moisture.
- Precision and Leaks – Many sprinklers do not get water where it is needed, wasting a valuable resource. Ensuring that the system directs water to where it is needed (instead of on the sidewalk), and that excess water is not lost to leaks, are essential for water-efficient landscaping.

Though many people are aware of the need to irrigate lawns more efficiently, earlier sprinkler systems made it hard to do. New automatic irrigation technologies do much of the thinking for us. 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 overwatering, and makes landscape maintenance easier for residents.

Recommendation 2: Support indoor water-efficiency.

Water conservation can also be applied indoors. Converting to water-efficient toilets, showers and clothes washers results in household water savings of about 30% compared to conventional fixtures.[8] 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.[9] Switching from an older top loading clothes washer can generate up to 14,000 gallons of used water per year which could be used to irrigate around 800 square feet non-turf plants (trees, shrubs and flowers) in most climates.[10]

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.

Recommendation 3: Apply water-efficient rates and pricing (i.e., charge the true cost of water).

Water rate structures play a critical role in conveying the value of water to consumers, as well as the often hidden costs of developing and providing water to a growing population. The costs of providing water depend on several factors, including the cost of developing new water sources, operation and maintenance costs, the amount of water used, and the type and location of development being served. On top of these are the opportunity costs that can be lost when water is diverted from other uses.

These costs affect consumer choices and can have an important impact on water use as well as land use patterns. When the price of water does not reflect the true costs of providing that water, consumers receive mixed signals that can create inefficiency.

Rate structures can be designed to incentivize efficient water use and efficient land use patterns by accounting for the variation in cost of service that result from different development locations and consumer behaviors.

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. When everyone pays the same rate, there is no incentive to locate in an area that is easier or less expensive to serve.

Conservation Pricing: Volume water rates can be configured to encourage less water consumption, and more accurately reflect the value of water and the 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 practicing conservation (e.g., turning 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.

Watering the road is not water-wise.

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 (for example, at 2,500 gallon increments) of water used. Block rates can be a highly effective way to encourage conservation while covering costs of providing service. 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.

According to a study by Western Resource Advocates, a properly designed block rate structure can:

- Provide water at low prices for basic and essential needs, so all customers can afford it.

Conservation Pricing

EBMUD Reacts to Drought with New Conservation Rates

Drought conditions in 2008 prompted the East Bay Municipal Utility District (EBMUD) to adopt new conservation rates to encourage customers to reduce water use.

EBUMD increased volume charges by 10% and added a drought surcharge for high water use. The rate change is expected to reduce overall water use by 10% and generate $21 million.

The rate increase will help fund EBMUD's drought management program and offset revenue loss from reduced water sales. Customers who use less than 100 gallons a day will be exempt from the rate increase and surcharge.

New Fee Structure Has Rewards for the Irvine Ranch Water District

When rapid population growth led to dwindling supplies and increased wholesale water charges, the Irvine Ranch Water District implemented a new fee structure that rewards water efficiency and identifies waste when it occurs.

The long-term goal was to develop a water-wise conservation ethic within the community while maintaining stable utility revenues.

Within a year, water use declined by 19%. Over the next six years, the district saved an estimated $33 million in water purchases.

For more information: Irvine Water District Conservation Office, (949) 453-5325 or www.irwd.com/Conservation

- Reward conserving customers with lower unit rates for water.
- Encourage efficient use by sending a strong conservation price signal.
- Assign water supply and development costs proportionately to the customers who place the highest burden on the supply system.
- Do all of the above while still maintaining a stable flow of revenue to the utility.[11]

Zone Pricing: While conservation pricing can reward customers who use less water, it is also important to account for the cost of water delivery, particularly since the location of development affects both water demand (more water is needed for more spread out development), energy costs (more power is needed to move water farther distances) and infrastructure costs (longer lines needed for delivery).

Zone pricing sets rates 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 more distant development pays incrementally more than development that is centrally located.

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 per capita than higher density areas. Thus, pricing can be linked to zoning districts.

Model Policies

The following policy language is taken from city and county General Plans.

City of Truckee General Plan

"Coordinate with the Truckee Donner Public Utility District (TDPUD) to develop a list of feasible water conservation programs and incentives that might be offered to the District's customers, and develop related strategies for how the Town might support the District's efforts in implementing these programs."

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."

City of San Diego General Plan

"Maximize the implementation of water conservation measures as a cost-effective way to manage water demands and reduce the dependence on imported water.

a. Implement conservation incentive programs that increase water-use efficiency and reduce urban runoff.

b. Develop a response plan to assist citizens in reducing water use during periods of water shortages and emergencies.

c. Encourage local water agencies to use state-mandated powers to enforce conservation measures that eliminate or penalize wasteful uses of water.

d. Explore alternative conservation measures and technology as they become available.

e. Develop and expand water-efficient landscaping to include urban forestry, urban vegetation, and demonstration projects."

Sonoma County Draft General Plan

"Require low flow fixtures, leak repair, and drought tolerant landscaping (native species if possible), plus emerging water conservation techniques, such as reclamation, as they become available.

Use water effectively and reduce water demand by:

1. Requiring water conserving design and equipment in new construction.
2. Encouraging water conserving landscaping and other conservation measures.
3. Encouraging retrofitting with water conserving devices.
4. Designing wastewater systems to minimize inflow and infiltration to the extent economically feasible.
5. Limiting impervious surfaces to minimize runoff."

Ventura County General Plan

"Demonstrate low water use techniques at community gardens and city-owned facilities."

City of Livermore General Plan

"The City shall adopt a series of Best Management Practices for water conservation measures that will be mandatory in new development and strongly encouraged in existing developments.

Require compliance with the State and City's mandatory water efficient landscape ordinance.

Tucson "Beat the Peak"

Faced with the need to secure additional water supplies, Tucson's Water Department instead decided to decrease demand by creating a highly visible "Beat the Peak" campaign. The campaign encourages residents to do outdoor watering at off-peak periods. The agency increased water rates across the board and created a new, tiered rate structure that increases the cost of water as consumption increases.

Started in 1977, the campaign has proven to be highly effective. According to a 2006 report by Western Resource Advocates, the average person in a single-family residence in Tucson uses 114 gallons of water per day, one of the lowest usage rates in the Southwest.

Even by the 1980s, residents had noticeably changed their water habits to reflect the fact that they live in a desert environment. As an added bonus, outdoor conservation has led to indoor water conservation.

Develop and provide incentives for existing and future customers to reduce water consumption.

Develop and institute a City-sponsored program of mandatory water conservation measures for new development. Develop a program for existing developments that is based on a voluntary participation with incentives to achieve specific targets for water conservation. Examples include:

(a) Ultra-low flush toilets

(b) Plumbing retrofits

(c) Leak detection

(d) Efficiency standards for water-using appliances and irrigation devices, and industrial and commercial processes

(e) Greywater use

(f) Swimming pool and spa conservation measures such as covers to reduce evaporation

(g) Xeriscape landscape design standards."

City of Santa Cruz General Plan

"Efficient water use:

A. Landscaping:

1) Choose plants that are suitable for the climate and their intended function, with an emphasis on native and drought-tolerant plants.

2) Prepare soils for water penetration and retention.

3) Design and operate suitable and efficient irrigation systems.

4) The City will encourage drought-tolerant landscaping, vegetable gardens and fruit trees in lieu of large expanses of lawn or other more water-demanding plantings.

B. Landscape maintenance: Landscaped areas will be properly designed for efficient water use, and shall be properly installed and maintained, including the upkeep and replacement of low-flow irrigation fixtures and equipment."

Strategy 2: Water Reuse

Water is a vital amenity in all households and businesses and is used for common activities, such as rinsing dishes, taking a shower, irrigating the lawn, and washing a car. When performing these activities, water is commonly used just for that one purpose and is then conveyed to a wastewater treatment plant, where it is treated and released back into the environment.

Water reuse, on the other hand, allows water to perform more tasks between its first used and when it is released back into the environment. This makes better use of current water supplies and helps to diversify a community's water portfolio.

Communities can stretch their current water supplies by creating opportunities for water to perform double duty. For instance, instead of letting soapy water leftover from washing dishes go down the drain to be carried away to a treatment facility, it can be redirected and reused onsite in the garden or to irrigate outdoor landscaping.

This type of arrangement is a part of a greywater system. Greywater represents water that has already been used (such as water used in showers, dishwashers and sinks) but has not come into contact with sewage, while wastewater is water used for plumbing (toilets) that does contain sewage. Greywater is more appropriate for reuse onsite for irrigation or other appropriate uses, while wastewater must be first highly treated by a central wastewater facility before it can be reused for other applications, such as irrigation (such as golf courses, landscaping and agriculture).

Creating programs that encourage the reuse of both greywater and wastewater can help communities diversify their water portfolios with a water source that is locally controlled and dependable.

Communities can also become less dependent on both groundwater and surface water, which allows more water to be used by the environment and by sensitive ecosystems.

Treated or recycled water can also be used to replenish groundwater supplies and be stored for future use. Wastewater recycling and grey-water reuse are described separately below.

Water Recycling

Recycled water is the fastest-growing water supply in California.[12] California has more than 300 water recycling plants in operation. Currently 500,000 acre-feet of recycled water are being used around the state. (An acre-foot is roughly enough to cover a football field with one foot of water or the amount needed by one 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, enough water to satisfy the needs of 1.5 million homes annually.[13]

Water recycling is an umbrella term that encompasses the treatment, storage, distribution and reuse of municipal and/or industrial wastewater. Recycling wastewater provides communities with the opportunity to develop and diversify their water portfolios with a reliable source of water to meet a range of needs.

Recycled water has been used by California communities since 1929 without any reported health problems. California's regulations governing the production, distribution and use of recycled water are some of the most stringent in the world. The California State Department of Health Services sanctions the use of recycled water for a variety of uses. These include, but are not limited to, landscape irrigation, agricultural irrigation, construction water, water for industrial purposes, fountains and indoor toilet and urinal flushing. Recycled water may also be used in cooling systems for buildings.

Recycled water, although highly treated, is considered non-potable. A dual-plumbing system is used, with the recycled water carried in purple-colored pipes to prevent the unintentional misuse of recycled water or cross-connection with the potable water system.

Recycled water systems also require regular preventative maintenance, including inspections,

Purple pipe system

making certain that pipe markings remain level, monitoring of spray patterns and runoff from irrigation, and accurate recordkeeping of maintenance.

While the economics of recycled water depend upon place and use, it can be less expensive than purchasing new supplies. Matching water quality to end-use saves money for both the buyer and water agency. For example, the quality needed for landscaping is not as high as that needed for drinking water. Already large quantities of recycled water are used in California for agricultural purposes. The required quality of that water varies based on the degree to which the water may come in contact with food crops or dairy cows.

Recycled water supplies can also be used as a part of groundwater storage projects, where treated wastewater is stored in aquifers. Recycled water can be used to enhance or restore wetlands that provide wildlife habitat, flood protection, improved water quality and recreational amenities.

It can also reduce the volume of potable water that must be withdrawn from rivers, lakes and groundwater, thus helping to maintain the natural ecology of those bodies of water.

General Policy Approaches

State law indirectly requires the use of recycled water. California Water Code Section 13550-56 states that if recycled water is available, then

Recycled water is carried in purple pipes to ensure it remains separate from potable water sources.

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.

California regulates the use of recycled water under Title 22 in the California Code of Regulations. 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.

The local authority is usually the retailer of recycled water to the site. Permit requirements typically include construction, inspection, cross-connection certification, site-supervisor training and a schedule of the hours that recycled water can be used. These local authorities can specify what sites and/or uses of recycled water are to be used in their service area, as long as they comply with state requirements.

The Regional Water Quality Control Boards require that recycled water customers conduct an inspection at least once a year while the recycled water system is in use. The results of this inspection must be documented and submitted in a written report.

According to Department of Health Services regulations, at dual-plumbed sites, the customer is responsible for conducting a periodic cross-connection test every four years, unless visual inspections reveal a requirement for more frequent testing.

The agency operating the recycled water program also promulgates rules and regulations determining the way recycled water systems are implemented and operated, and how records are to be kept.

Local Policy Approach in Amador and Calaveras Counties

Amador County

The stage is set for Amador County to begin using and distributing recycled wastewater. Both Amador County and the Amador Water Agency (AWA) have shown commitment to create a regional facility, and have outlined specific goals for the development of a recycled wastewater program in their planning documents. The General Plan Advisory Committee Workbook for the Amador County General Plan update includes draft policies in direct support of recycled wastewater, such as:

- Increase wastewater treatment capacity to serve the county's population.
- Work with Amador Water Agency to identify a desired location for a regional wastewater treatment plant, and restrict the development of incompatible uses in the vicinity of the site.
- Encourage the use of reclaimed water for irrigation wherever possible to reduce the loading of the wastewater system.

The AWA announced its Purple Pipe Plan in September 2008. The plan outlines how the agency will move forward in creating a water system that will convey recycled water. By including recycled wastewater in its water portfolio, the AWA can potentially claim additional water rights if it is able to prove that recycled water is replacing significant quantities of treated water.

The program's goal is to produce approximately 3 million gallons per day of recycled water, which in turn will conserve 3,000 acre-feet of untreated water. The AWA's goal for the county

Regulatory Setting for Wastewater

If untreated, wastewater poses numerous threats to public health and the environment. Thus, wastewater treatment is one of the most common forms of pollution control in the country and is regulated at the local, state and federal level to ensure sufficient treatment.

Federal Regulations

As the primary water quality protection policy in the United States, the Clean Water Act employs a variety of regulatory and non-regulatory tools to reduce or prevent the discharge of pollutants into the nation's waterways, and to improve water quality. Two of the programs that most directly affect local governments and wastewater agencies are the National Pollutant Discharge Elimination System (NPDES) and the Total Maximum Daily Load (TMDL) program.

The EPA Office of Wastewater Management administers the National Pollutant Discharge Elimination System permit, pretreatment and municipal bio-solids management (including beneficial use) programs under the Federal Clean Water Act. The Office of Wastewater Management is also responsible for the Clean Water State Revolving Fund, which is currently the largest funding source for water-quality projects with a focus on wastewater treatment systems, non-point source projects and estuary protection.

State Regulations

The Water Boards: Within California, the State Water Resources Control Board (SWRCB), in coordination with the nine Regional Water Quality Control Boards (RWQCB), perform the primary regulatory functions related to water quality, including issuance of wastewater discharge permits and 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 that will require system inspections at least once every five years.

Title 22 Standards for Wastewater Treatment: Title 22 is a section of the California State Water Code requiring filtration of any reclaimed effluent used for full-body contact recreation or fresh food crop irrigation. Title 22 requires lesser levels of treatment for other uses of reclaimed effluent.

Local Government

In Amador County and Calaveras County, the Environmental Health Department is responsible for protecting the public and the environment from potential health and environmental impacts associated with on-site and community sewage disposal.

The Cortese-Knox-Hertzberg Governmental Reorganization Act of 2000 requires Local Agency Formation Commissions (LAFCOs) to conduct municipal service reviews for specified public agencies under their jurisdiction. A municipal service review is intended to evaluate an agency's ability to provide public services to its service area. A municipal service review is required before an agency can update its sphere of influence.

is to have recycled water be 20% of its water supply by 2020.

Although there is support from both the County and the AWA, there is still much to do before recycle water is a reality in Amador County. Deciding on a central location for a regional facility and generating buy-in from elected officials, the general public and other water agencies for the $20-$40 million-dollar facility are current challenges.

Coupled with the hefty price tag are underlying misconceptions and questions surrounding the quality of treated wastewater. To surmount community doubt, education and outreach will be integral in implementing a recycled wastewater program in Amador County.

Calaveras County

Localized problems with water quality and supply are a current challenge identified in the Issues and Opportunities Report for the Calaveras County General Plan Update. The report lists several guiding principles to ensure protection of water quality – recycling water is one of them.

Developing wastewater recycling will help areas within the county balance water portfolios. Groundwater overdraft has been a recurring problem in some areas and the State has encouraged water purveyors who rely solely on groundwater sources to explore additional options.

Interest in developing a system for recycling water has been expressed by local water agencies. A portion of the Calaveras County Water District's (CCWD) updated Urban Water Management Plan explores recycled wastewater capacities and future projections. The CCWD is working closely with Calaveras County, the Calaveras County Farm Bureau Federation, UC Cooperative Extension and Calaveras Grown to coordinate efforts, identify potential demand, and conduct public outreach. Currently, golf course irrigation is the main use of recycled water in the county, but the CCWD is looking to expanding service to agriculture customers and for other landscape purposes.

Many of the CCWD's facilities are too small to reasonably and economically develop recycled water systems. The CCWD will continue to evaluate the potential for recycled wastewater, and believes there is an opportunity to work with the County to incorporate recycled water use in parks and public landscaping. Currently, CCWD uses recycled water for landscape irrigation at its largest facility.

Greywater Reuse

Any water that has been used in the home – except water from toilets – is called "greywater." Shower, sink and laundry water comprise 50% to 80% of residential waste water, which may be reused for other purposes, especially landscape irrigation.[14]

Using greywater instead of drinking-quality water for landscape irrigation can keep lawns and gardens green – even in times of drought – and alleviate water demand in areas prone to water shortages.

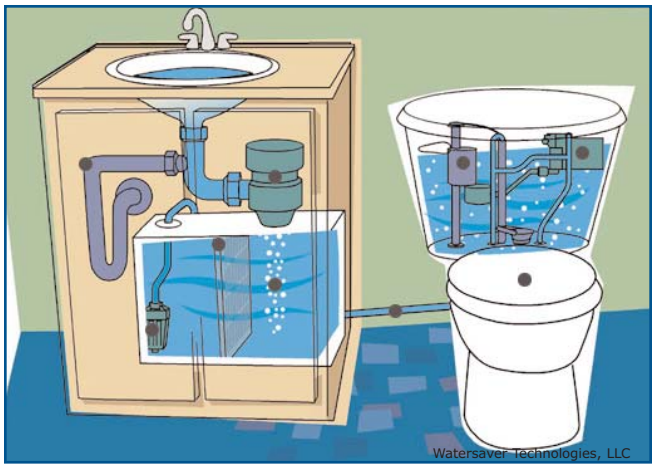
Wastewater treatment facilities will also have less volume to treat, and can delay expansion of those facilities.

Greywater can also be better for a garden than using treated drinking water. Soap and other products in wastewater are rich in compounds that can pollute waterways, wear out septic systems, and overburden wastewater facilities. However, these same materials – phosphorous, nitrogen, potassium and proteins – are sources of nutrients for fruit trees, landscaping and gardens.[15]

Greywater systems can be affordable to install if done at the time of construction. A workable, code-compliant, greywater irrigation system sends water from showers, sinks and other greywater sources away from blackwater before they mix and go to a sewage system. Individual customers can save money on their metered water bills when water is used more than once.

General Policy Approach

Greywater use is not common practice in most areas. Implementing and promoting the use of



This AWUS® toilet system disinfects and redirects water used in the bathroom sink to be reused as water for toilet flushing.

greywater systems requires support from local government. Cities and counties can require that dual drains be installed in new construction for the purpose of reusing water. As an incentive, the water saved can be counted as a source of water to meet the requirements of new state "show me the water" laws that require developers to prove that enough water is available to serve proposed new housing.

Cities and counties can develop a greywater ordinance, which regulates permitted uses and system requirements. Permit requirements for greywater systems can be further divided based on project size and flow.

For instance, a simple residential greywater system handling a flow of less than 400 gallons per day may be granted a permit without inspection or fees but a larger multi-home project may need technical and environmental review before a permit is awarded. Therefore, local governments can develop different greywater permit levels or tiers tailored for project size and greywater flow.

Local Policy Approach in Amador and Calaveras Counties

Amador County

Greywater reuse is encouraged in the Amador County Preliminary General Plan Goals and Policies, GPAC Workbook. A proposed policy looks to "encourage recycling and water-saving features in new development, including greywater irrigation, to limit the water flows to septic systems and leach fields."

Calaveras County

The reuse of greywater is also supported by the Calaveras community and was brought up at community workshops as a strategy for balancing water supply and demand. The community voiced support for requiring greywater reuse as irrigation for new housing developments.

Recommendation 1: Support water reuse by ensuring development and infrastructure are equipped for using recycled water.

Local governments and water agencies are the key players in the recycled water arena. Water agencies provide the commodity, and local governments provide the political will and regulatory framework. Both entities depend on each other's support to implement a successful program. They need to work closely to ensure the inclusion of recycled water in each of their planning documents, and consider sharing resources for a joint public-private venture, which may include the development of necessary reclamation and treatment facilities.

In Amador and Calaveras counties, local governments can amend building codes to require the installation of dual-purpose pipes (purple pipes) in new construction and remodels so that they are set up for safe use of recycled water supplies. Where recycled water is available, this step will implement state law. Where it is not, communities will be building the infrastructure for the future when recycled water is available.

Local governments can also work with developers to create incentives or otherwise streamline the deployment of dual-plumbing systems and initiate public discussion through outreach and education. Creating forums to share the benefits of using recycled water and address public concerns and questions will help build public understanding and support a recycled water program.

Tucson Greywater Policy

The City of Tucson has passed a greywater policy that calls for the installation of greywater systems in new development. The policy was passed by the City Council in recognition of the need to manage a finite supply of water despite rapid growth in coming years.

http://watershedmg.org/images/stories/docs/graywaterord_20080923.pdf

At the same time, the City Council passed a rainwater harvesting ordinance that requires all new development to provide a rainwater harvesting plan and to meet 50% of all outdoor irrigation needs with harvested water by 2010.

http://watershedmg.org/images/stories/docs/rainwaterord_20081014.pdf

Cities and counties can also adopt a water recycling ordinance. The California section of the WateReuse Association web site provides a model water recycling ordinance (www.watereuse.org/ca/modelwrord.htm). The ordinance's intent is to maximize resource conservation and streamline implementation of water recycling projects in conformance with state law. The ordinance can also be tailored to conform with local rules and regulations.

Some model wastewater recycling policies and programs taken from city and county General Plans include:

City of Chino General Plan

"It is the policy of the City that recycled water be used for any purposes approved for recycled water use, when it is economically, technically and institutionally feasible. Recycled water shall be the primary source of supply for commercial and industrial uses, whenever available and/or feasible. Use of potable water for commercial and industrial uses shall be contrary to city policy; shall not be considered the most beneficial use of a natural resource; and shall be avoided to the maximum extent possible."

City of Santa Clara General Plan

"Maximize the use of reclaimed water for construction, maintenance and irrigation, and encourage its use elsewhere, as appropriate."

City of Livermore General Plan

"Require all new industrial, commercial and office development within pressure Zone 1 to use reclaimed water for landscape irrigation, where available."

City of Palm Desert General Plan

"Coordinate with the Coachella Valley Water District on the continued use and future expansion of tertiary-treated wastewater treatment and distribution facilities to serve existing and new development projects in the city."

County of Los Angeles General Plan

"Encourage the production and use of reclaimed water and stormwater runoff to provide water for irrigation, groundwater recharge, saltwater intrusion barriers or other beneficial uses."

City of San Luis Obispo General Plan

"Facilitate use of tertiary-treated water and seek to legalize use of greywater for non-potable household purposes."

Recommendation 2: Support greywater reuse.

Reusing greywater for outdoor or non-potable uses like landscaping can be a promising approach to limiting the demand for potable water. However, there are several limitations and drawbacks to greywater use. For example, if the house or commercial building is in an urban area and served by traditional sewer service and wastewater treatment facilities, then it is far more cost effective, safe, efficient and easier to look toward a broader solution that reuses treated wastewater from the "plant" on an area-wide, citywide or neighborhood scale.

Greywater does make sense in low-density environments that are served by septic systems and leach fields or in situations where

treated wastewater is not available (or cost effective) on a municipal or institutional scale. Here the issues become the cost of providing a dual plumbing system to the house or business, the design of the system, and ensuring that you can get regulatory approval from the local County Health Department or agency. Many jurisdictions in California do not encourage (or even allow) greywater reuse because of residual health concerns. State law allows for greywater on a case-by-case basis; leaving the decision up to the local jurisdiction.

Land use agencies and public health departments in Amador and Calaveras counties should investigate the feasibility of using greywater systems, and consider phasing in requirements or incentives for the incorporation of greywater systems in new development in coming years. Such a policy could also provide for the use of rainwater capture systems to provide water for outdoor irrigation. In both cases, public health and building officials will need to evaluate design considerations for winter conditions.

Below are model policies and programs taken from city and county General Plans that can be used as references for creating greywater programs and ordinances.

Sonoma County General Plan

"Encourage greywater systems, roof catchment of rainwater and other methods of reusing water and minimizing the need to use groundwater."

City of Malibu General Plan

"New development shall include a separate greywater treatment system where feasible."

Malibu developed a "Greywater Handbook" to complement the City's policy. The handbook provides guidelines, resources and techniques to help homeowners and developers integrate greywater systems into their projects.

The handbook is available at www.ci.malibu.ca.us. For more information about Malibu's greywater law and permit process: Deputy Building Official Craig George, (310) 456-2489 x229

City of Santa Monica

The City of Santa Monica has an incentive-based program to encourage greywater projects. The City provides discounts on sewage bills for installing greywater systems and has implemented a grant program to provide partial funding for innovative landscaping projects that incorporate greywater systems and other innovative water-saving features. The City also provides fact sheets about greywater regulations and additional resources about constructing greywater systems, requesting rebates or receiving general assistance.

For more information: Kim O'Cain or Bob Galbreath, Santa Monica Water Resources Management Office, (310) 458-5408

Los Angeles County

The Los Angeles County Recycled Water Advisory Committee has developed an extensive 48-page "Recycled Water Manual" that provides information on goals, general provisions, design and construction, operations and maintenance, marking and equipment, agency contacts and resources for users and site providers. (www.watereuse.org/ca)

Los Angeles Air Force Base

The Los Angeles Air Force Base in El Segundo uses greywater in toilets and urinals in seven buildings and irrigates its five-acre landscape with grey water. The Los Angeles Air Force Base is serving as a template for bases throughout the world though its innovative use of recycled water.

For more information: Los Angeles Air Force Base Office of Public Affairs, (310) 653-1132

Strategy 3: Coordinated Water Resource Land Use Planning

Water agencies and local governments share the burden of ensuring the delivery and reliability of local water supplies, though land use planning and water planning are not always coordinated. 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

Arcata Wastewater Treatment Plant oxidation ponds

only then to comply with state legislation requiring verification of water supplies for certain development projects.

Lack of coordination between water and land planning can lead to the approval of developments that lack water to meet projected needs.

Another result is developments are approved that are located outside of current service boundaries and/or in areas where it is cost prohibitive for water agencies to extend water or wastewater services. Homeowners in areas not served by centralized systems rely on private wells and septic systems, which can compromise the quality and amount of regional water supplies.

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.

Many septic systems are not sited or maintained properly, which has lead to contamination of nearby waterbodies and created public health and safety concerns.

Land planners are often only peripherally involved in deciding where water will come from and how it will be provided as well as where and how wastewater will be treated or where utilities will make future infrastructure investments. As a result, water systems are built that may not conform to future development needs and vice-versa.

If there is inadequate capacity to serve growth within a wastewater agency's service area, new growth may be pushed into more remote areas, thereby encouraging low-density development patterns that threaten watershed health, water quality and water reliability.

Similarly, the amount of growth expected is often not well coordinated with the amount of water needed so an accurate and accountable water budget is often not developed. This can have detrimental effects on water use and land use patterns and challenge the efforts of water and land use agencies. For example, it is more difficult for a water agency to plan for future needs without an accurate assessment of the amount, type and location of future development. And, it is difficult for land use agencies to plan for future growth without a clear sense of current and future water and infrastructure capacity.

General Policy Approaches

In California, coordination is increasingly vital to day-to-day operation as cities and counties seek to address a growing number of issues and integrate various planning and management activities. Still, coordination is hard to achieve in practice. The State is trying to support coordination and collaboration at the local level, its Integrated Regional Water Management program links state funding to projects and programs that demonstrate regional collaboration.

Regulatory programs, such as the "show me the water" laws and SB 375, are also pushing more coordination at the local level to link issues like water, transportation, and public health to local land use decisions.

Other agencies and organizations are key partners. Local Area Formation Commissions (LAFCOs), Councils of Government (COGs), Watershed Councils, Resource Conservation Districts (RCDs), Fire Safe Councils and Land Trusts all have a role to play in aligning water and land use, and are important partners for water agencies and local governments.

In growing rural areas, LAFCOs can be particularly important partners. A 1995 law added

California's "Show Me the Water" Laws

In 2001, California enacted related laws designed to improve coordination between water and land use agencies and ensure that water supplies are considered during local development 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 (500 units or more for residential projects). 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 contingent upon the documentation of such supplies. Complying with SB 221 is the responsibility of the city or county that is approving the proposed project; the water agency need only document 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 large enough to trigger the law and thus provides the administrative process for implementing SB 221.

Under these laws, local governments are responsible for proving that water supplies are adequate to meet the demands of new development before it is approved. In some areas, where larger projects are regularly built, this can 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. But at this time, the thresholds triggering the legislation (projects over 500 units) are too high for most of the projects built in Amador and Calaveras counties. However, with growing concern about future water supplies, future legislation may change the current provisions of the law and lower the thresholds.

The "show me the water laws" may also have created an incentive for designing water efficiency into new projects as the development industry seeks innovative ways to prove adequate supplies by reducing the demands of their project through various conservation strategies. Harlan Ranch, a project being built outside of Clovis, CA and Seranno, a master-planned project in Placer County are recent examples.

section 10910 to the California Water Code that permits LAFCOs to require cities, when applying to expand their sphere of influence, to provide information for determining whether existing and planned water supplies are sufficient to meet current and new demands. LAFCOs cannot demand conditions for their approval of a project, however, LAFCO boardmembers can base their decisions on the impact of the proposed expansion on the watershed.

Integrated Regional Water Management Plan (IRWMP) – An IRWMP is a comprehensive planning document that provides the venue for multiple agencies and stakeholder groups to work together to identify and prioritize regional water resource projects and programs. The IRWMP tackles issues such as water supply, flood management, water quality, environmental restoration, environmental justice, stakeholder involvement and community and statewide water issues.

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 grants for local projects if they are part of a collaborative regional planning effort.

Local Perspective: Land Use and Water Planning

By Nate Lishman, Planner, Amador County

Land use and water quality are intimately linked; every square foot of land is located within a watershed. Stemming from 150 plus years of contention relative to water and land use, and the fragmentation of these disciplines, is a divide among regulatory agencies charged with the oversight of this precious resource – water.

This is ironic when you think about it. Land use, public works and water agencies generally all have the same desire: protecting water supply and quality. It's in all of our best interest to do so. These entities charged with the oversight of water and land use need to better collaborate to maintain and protect the natural infrastructure necessary to maintain water quality and supply within our natural drainages and wetlands.

Land use, transportation and water agencies seem to operate in a vacuum, to the detriment of water quality and supply statewide. These agencies must come together with the common goal of protecting not only water quality, but also water supply.

At this point in the history of California, our decisionmakers must look long term into the future and give their staff the tools needed to preserve water quality for this and future generations.

Local Policy Approach in Amador and Calaveras Counties

Both Amador County and Calaveras County have worked together with other water agencies and stakeholder groups in regional water planning efforts. Examples include:

M/A/C IRWMP – The Mokelumne Amador Calaveras Integrated Regional Water Management Plan (M/A/C IRWMP) was completed in November 2006 with Prop 50 funds and encompasses the majority of the Mokelumne and Calaveras River watersheds, Amador County, and parts of Alpine, Calaveras and San Joaquin County.

The project was initiated through adoption of a Memorandum of Under-standing (MOU) with signatories including the Amador Water Agency, the East Bay Municipal Utility District, the Amador Regional Sanitation Authority, the Calaveras County Water District, Amador County and the Cities of Jackson, Plymouth and Sutter Creek.

Mokelumne River Forum – The Mokelumne River Forum was established to create a partnership among water agencies and stakeholders who rely on the Mokelumne River and are concerned about regional water supply issues. Planning decisions concerning water supply volume, infrastructure needs, consumptive uses, environmental issues, and recreational needs are made through a collaborative process that strives to develop mutually beneficial and regionally focused solutions. The Mokelumne River Forum provides a venue to discuss and develop solutions that resolve conflicts and balance the needs of all users.

Mokelumne Inter-Regional Conjunctive Use Project – IRCUP is a conceptual project linking the counties of Amador, Calaveras and San Joaquin with East Bay Municipal Utility District in an expandable water storage and exchange program that could provide water supply sustainability and reliability benefits to all participants.

Upper Mokelumne River Watershed Authority (Authority) – The Authority created the Upper Mokelumne Watershed Assessment and Management Plan, which focuses on water quality, identifies pollutant sources and activities that contribute to water contamination. The plan's assessment was used to develop a framework of recommended management measures and implementation activities. The Authority was formed under a joint powers agreement in 2000 to undertake watershed assessment and planning projects. Authority members include the Alpine County Water Agency, the Amador Water Agency, the Calaveras County Water District, Calaveras Public Utilities District, EBMUD, the Jackson Valley Irrigation District, and Alpine, Amador and Calaveras counties. (For a more in-depth discussion of the Authority, see Chapter 2.)

Amador County

The need for coordination is identified in the General Plan Advisory Committee workbook. Draft policies included in the workbook encourage coordination between the AWA and other organizations to plan for future water supply needs in emergencies and droughts as well as promote regional and interagency coordination.

The Amador County Regional Wastewater Report believes that optimal treatment and disposal options require regional coordination to solve the wastewater issues in the County and to plan for replacement, expansion, and reuse of the treated wastewater effluent. The report includes specific wastewater facility needs for several geographic areas. The Regional Wastewater Plan recommends construction of one new treatment plant near lower Ridge Road and Highway 88 to meet growing wastewater needs in the Highway 49 corridor.

The Housing Element in the current Amador County General Plan calls for identification of areas appropriate for community leach fields. It calls for the Amador Water Agency in coordination with the Amador County Environmental Health Department to prepare a map of county soils that may support community leach fields for small to moderate developments where public sewer may be unavailable.

Calaveras County

The Calaveras County Water District (CCWD) has been an active participant in many regional water planning efforts, such as the M/A/C IRWMP, the Upper Mokelumne River Watershed Authority, and the Mokelumne River Form. The District was part of other regional watershed based planning efforts, as well. In 1999 and 2002, the CCWD worked with the Stockton East Water District (SEWD), a technical advisory committee, and a group of public stakeholders to begin the process of developing a Calaveras River Watershed Management Plan (CRWMP). Phase I of the project was accepted by the SWRCB and included a field assessment, stakeholder/technical advisory group formation and completion of the plan. Phase II of the plan, reported on Baseline Water Quality Monitoring on the upper and lower Calaveras River and was completed in June 2005.

Throughout the process, the CCWD engaged the public and participated with other agencies and non-government organizations at informational meetings over the last six years. CCWD hopes to secure additional funds for continued water quality monitoring.

In its 2003 Strategic Plan, the CCWD recognized the need for water and land use planning to align. Specific objectives include becoming more cognizant of population growth and land use trends by educating staff and board members on current land use and population growth trends, as well as inviting the County Planning Director to present current planning information at CCWD meetings. A Project Evaluation and Review Committee is also suggested which would bring together County staff and coordinate CCWD planning with County initiatives. With current land use planning data, CCWD aims to incorporate this understanding more fully into CCWD planning and decisionmaking.

Currently, there is countywide interest among water agencies and local governments to create a Water Element to be included in the General

Local Perspective: Potential Benefits of Regionalizing Water Supply and Wastewater Infrastructure

By Ed Pattison, Calaveras County Water District

In the utility world, the cost of doing business is skyrocketing. Infrastructure, materials and ever increasing new regulations mean increasing costs are challenging even the best run utilities. At the same time, outside funding sources are experiencing a shrinking pool of dollars to help utilities make infrastructure upgrades. Water agencies will also need to plan for changing water supplies and demand affected by climate change, increasing environmental flows, and simply growth in the population. Adapting to these changes will undoubtedly add costs to utilities already straining under the costs of infrastructure replacement and regulatory programs. As a result, legislators and funding agencies tend to be more favorable to projects that have a regional approach.

The term "regionalization" is often met with confusion, misunderstanding and, at times, outright hostility. Let me first say what it is not: Regionalization is not competition; it is cooperation. Regionalization is about keeping rates at the least long-term costs to the ratepayer while ensuring the delivery of a high-quality water supply and protecting public health and the environment. As such, regionalization may not result in consolidated service areas, but instead may result in a cooperative shared vision that shares costs to build multi-purpose solutions as compared to a more costly single purpose end. It may mean merging two or more existing systems where it makes sense.

Advocates of regionalization state that this approach has many strong points, such as economies of scale (i.e., a larger pool of ratepayers); shared resources; fewer numbers of treatment processes installed; increased ability to treat wastewater to high level; increased access to capital and lower cost of capital; improved natural resource management and watershed protection; and improved competitiveness for funding at the state and federal level. Ultimately, if done properly, regionalization could lead to restructured systems better equipped to have the long-term technical, managerial and financial capacity to comply with increasing state and federal regulations and to compete in the ever-increasing competitive outside funding world.

Plan update. CCWD is spearheading the process and is coordinating meetings for stakeholders to discuss content for the document.

The Calaveras County Water District (CCWD) is the largest agency providing wastewater services within Calaveras County. Other agencies are Murphys Sanitary District, the City of Angels (providing wastewater services within its limits), the San Andreas Sanitary District, the Mokelumne Hill Sanitary District, the Valley Spring Public Utility District and the Wallace Community Services District.

Currently, CCWD's 12 wastewater service areas have widely varying degrees of future capacity. Several systems are currently at or beyond capacity, while others are at capacity "on paper" by being committed to future planned developments. CCWD is undertaking a master planning effort for individual wastewater facilities to assess infrastructure capacity and needs in light of current growth projections. Collection systems are installed to accommodate flows at build-out, whereas treatment and disposal facilities are constructed in phases as demand dictates.

Like Amador, agencies in Calaveras County are investigating the need to regionalize wastewater management efforts. Several agencies were recently funded by the Sierra Nevada Conservancy to complete a wastewater regionalization study along the Highway 4 corridor.

Regionalizing or eliminating systems just to regionalize may not be better than doing nothing at all. A clear and obvious overriding reason to consolidate utilities, infrastructure or processes must be identified and clearly articulated to a receptive community prior to regionalization. Simply merging or regionalizing under-performing or poorly performing systems may not necessarily derive a better system; it may only provide a larger "bad" system. Challenges to regionalization include:

- Small systems may want to continue to operate independently.
- Small systems may be so geographically isolated that regionalization is not economically feasible.
- If smaller systems decide to physically consolidate, there may be short-term costs associated with connecting systems difficult to overcome.
- Organizations operate in silos with usually single purpose visions, concepts, and solutions.
- Systems interested in regionalization may be located in different political boundaries contributing to an initial reluctance to share services.

These and other problems often arise in regionalization efforts. But despite these hurdles, a number of successful regionalization efforts can be pointed to nationwide.

Some regionalization efforts resulted in consolidation and mergers, while other utilities interconnected or pooled resources for the purpose of purchasing wholesale water, emergency water supply, or share in common offices, management, materials and operational personnel, but maintained separate boards.

For the benefits of regionalization to be realized, a policy statement that establishes clear guidance regarding the expectations on water and wastewater service rates, levels of service, economic development and environmental protection must be established. Strong leadership, combined with elected officials looking out for the overall good of the community, will help ensure an appropriate outcome. Considering whether or not to regionalization should involve public participation, transparent information, and a willingness to listen to all sides of the debate. With new regulatory emphasis on water and wastewater systems, diminishing water supplies, and increased competition for dollars, regionalization could be an appropriate answer.

Recommendation 1: Align water and land use data in local planning documents.

Communities in Amador and Calaveras counties can work with local water agencies to coordinate data create a water budget based on assessments of current and future demands. This process will support compliance with the state's "show me the water laws" (SB 610 and SB 221) and ensure that data in Urban Water Management Plans (developed by local water agencies) are consistent with land use data in General Plans.

Incorporating water data into land use decisions is best achieved during the initial development or with significant amendments of the land use map. In their book *Water and Land Use: Planning Wisely for California's Future*, Jeff Loux and Karen Johnson outline the following steps:

1. Establish existing water use patterns.
2. Determine water use factors for each land use.
3. Map the community's current and potential land uses, including both infill and intensification, and new "greenfield" development to be added.
4. Calculate total future water demands based on water use factors (building in water conservation assumptions).

5. Develop a basis for comparing future water needs against future supplies.

Current 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.

The same principles are important for water quality planning and monitoring as well, and are discussed further in Chapter 7.

Successful integration of water resource and land use planning must also be performed at a watershed-wide scale. A single community within a watershed can enact measures to protect water quality or prevent flooding but they won't be as effective as when neighboring communities enact similar measures. Coordination is needed because watersheds do not tend to follow jurisdictional boundaries. Mayors, city councilmembers and county supervisors are in an excellent position to bring together key players to discuss important land planning and water management strategies that will preserve the functionality, health and resources located within watershed boundaries.

Recommendation 2: Consider including a Water Element in the General Plan.

Water affects many aspects of community planning and development, therefore, references to water can be found throughout the General Plan. Water management, quality and supply are also affected by local stormwater ordinances, development regulations, zoning, and land planning decisions.

To create cohesion, some counties in California have created a separate Water Element to be included with the State-required General Plan Elements. A separate Water Element can focus attention on specific water issues that may not be addressed in other General Plan sections, such as:

- Water supply planning.
- Water use efficiency.
- Groundwater supplies and monitoring.
- Recycling and reuse of water supplies.
- Stormwater management.
- Policies and programs to support implementation.

A Water Element is not required but can provide the framework and vision for future water needs and management goals. Benefits of having a Water Element include providing the necessary linkage between land use planning, water supply and wastewater treatment planning, which will help align growth and development with the planning, financing and construction of water and wastewater infrastructure.

A separate Water Element also makes water resource information accessible to the general public, policy makers, and interested parties through a single high-level document. Data and information on local hydrologic cycles and processes as well as descriptions of wet and dry conditions can also be included in a Water Element.

Recommendation 3: Align land use decisions and development fees with water management goals.

For water management needs, local governments can align water management and community development goals through development fees (also known as exactions, impact fees, service development fees, or facility charges) to cover the costs associated with constructing, operating and maintaining water and sewer infrastructure. Though impact fees are common, they are not always designed to provide incentives that reward development that has reduced impacts on infrastructure.

Agencies in Amador and Calaveras counties should review fee structures to determine if correct incentives are in place to reward infill and redevelopment, and to evaluate the use of such fees to finance the protection of natural infrastructure.

Communities can consider full or partial waivers of fees for development that is located

in targeted growth areas to create market signals for strategically located development (infill and redevelopment). Some communities calculate fees for different zones so that fees increase incrementally with distance from community centers or water systems.

Recommendation 4: Coordinate wastewater infrastructure with efficient development patterns.

All new development requires a system for handling wastewater. If not properly managed, wastewater can pose a threat to public health and the environment, especially when it enters drinking water supplies, such as when individual septic tanks fail.

A centralized wastewater system allows for more control over the management of wastewater, including the collection, treatment, disposal and maintenance of associated infrastructure.

In contrast, a wastewater management strategy that relies on individual septic systems distributes the responsibility for maintaining and siting individual wastewater systems between numerous private homeowners who are currently not overseen by a regulating agency.

For homes and businesses to be served by a central wastewater supplier money to expand services as well as maintain existing infrastructure and facilities is required, but communities across the nation are facing grave infrastructure challenges.

The construction of water and wastewater systems that many communities rely on were heavily subsized in the 1960s and 1970s by federal money that has largely disappeared. This has left water agencies and small communities scrambling to find the resources to fix and upgrade outdated systems.

In 2001, the American Society of Civil Engineers (ASCE) reported an annual shortfall of $11 billion for drinking water and $12 billion for wastewater, due in part to the need for infrastructure replacement and compliance with existing and upcoming federal regulations.[16]

Local governments can craft a fix-it-first policy to help balance the needs to expand services, replace old infrastructure, and maintain the overall system, while providing water or sewer service at reasonable rates for their customers.

Fix-it-first policies can encourage replacement and maintenance of current infrastructure by directing funding towards updating, maintaining, and replacing current infrastructure as opposed to allowing new infrastructure to control the allocation of funds.

This is an important planning strategy because it takes advantage of areas that are already developed and invests in existing infrastructure, including water and wastewater infrastructure and roads. By investing in areas already built up, communities can make infill and redevelopment more attractive, especially if these systems are over capacity and in need of upgrading.

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 target of updating a certain percentage of existing infrastructure each year.

Another tactic local governments can use to promote the use of current infrastructure is 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.

Instead of water agencies incurring the cost of building new infrastructure, they 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.

A centralized wastewater system is not a catch-all solution and will not satisfy every project's needs. In instances when a decentralized wastewater system is needed, new technologies and designs can be explored to protect water quality and support good community form. For example, natural infrastructure, such as wetlands, has been successfully used as a part of a treatment train that cycles wastewater through multiple cleansing systems and ultimately back into the environment.

Other systems include clustered septic systems and package plants, which serve a group of homes or businesses, and treat their wastewater collectively.

Overall, wastewater treatment solutions need to be based on community goals for what is the best use of land, rather than allowing wastewater infrastructure to determine land use outcomes.

Model Policies

The following policy language is taken from city and county General Plans.

City of Woodland General Plan

"The City shall cooperate with other jurisdictions in jointly studying the potential for using surface water sources to balance the groundwater supply so as to protect against aquifer overdrafts and water quality degradation."

Inyo County General Plan

"To ensure planning decisions are done in a collaborative environment and to provide opportunities of early and consistent input by Inyo County and its citizens into the planning processes of other agencies, districts, and utilities."

City of Livermore General Plan

"Require coordination between land use planning and water facilities and service to ensure that adequate water supplies are available for proposed development."

City of Truckee General Plan

"Initiate a process with Nevada County and Placer County, either in conjunction with development of the Open Space Plan or as separate effort, to develop a coordinated open space protection strategy for the entire Planning Area.

Work with the Truckee River Watershed Council, TDRPD and other agencies to develop comprehensive, long term management plans for the Truckee River corridor... The plans should treat the Truckee River and Donner Lake and their associated riparian, wetland and meadow habitats as holistic systems, and should address the complete range of issues associated with the Truckee River and Donner Lake, including scenic and habitat values, opportunities for riparian restoration and enhancement, flood protection, water quality, and access and recreation opportunities.

Form a citizens advisory committee that will serve as an advisory body during the preparation of the stormwater and/or water quality management plan. Upon adoption of the plan, consider other roles the committee may assume.

Work with the Truckee Donner PUD to study ways in which the development review process can be strengthened to define more stringent requirements for documentation of a project's projected water needs and the availability of local water supplies to serve it."

City of Sonora General Plan

"Work in coordination with the Tuolumne County Resource Conservation District to assist in preparing, implementing and funding voluntary, stewardship-based, resource management programs, especially those which maintain and enhance water quality and quantity.

Consider facilitating an annual city/county staff meeting, luncheon or similar activity to facilitate coordinated land use planning between city and county staff members. Senior staff from the various city and county staffs should, at a minimum, be present at the coordination event."

7. Water Quality Monitoring Guidelines

This project does not implement a specific project, such as a stream restoration, but supports integration of water management and land use planning policies within Amador and Calaveras counties. While it is not possible to measure the direct benefits of any one policy, much less the range of policy recommendations included in this plan, it is increasingly important for local land use agencies to be able to assess the impacts of planning and development decisions on water quality and watershed health.

The purpose of this water quality monitoring plan is not to propose a new monitoring program but to offer guidelines for expanding and coordinating existing monitoring efforts and management programs, particularly those that have the potential to link watershed conditions with local planning and development decisions, and on going water/watershed planning efforts.

Background

Existing water quality/watershed monitoring programs in Amador and Calaveras counties range from small and low-tech to highly technical and intensive watershed modeling. Examples include small scale stream sampling conducted by local watershed groups, assessments of physical conditions and habitat related largely to fisheries management, regular sampling conducted by local water and wastewater agencies in accordance with federal and state laws, and the deployment of the highly sophisticated Watershed Analysis and Risk Management Framework (WARMF) model as part of the 2007 Upper Mokelumne River Watershed Plan. Members of the Upper Mokelumne River Watershed Authority, as well as other water management agencies in Amador and Calaveras counties are also beginning the process of updating the Mokelumne/Amador/Calaveras Integrated Regional Water Management Plan (M/A/C IRWMP). Finally, both counties are using land use modeling in current General Plan updates.

With these efforts and the purpose of this plan in mind, three interrelated programmatic opportunities are noteworthy:

1. Build on and expand the technical watershed assessment work completed by the Upper Mokelumne River Watershed Management Authority (UMRWA) for the Upper Mokelumne River Watershed Planning project to include additional watersheds in Amador and Calaveras counties, prioritizing areas expected to see the largest amount of growth.
2. Calibrate the existing WARMF model developed through the UMRWA effort to other watersheds in Amador and Calaveras to carry out Opportunity 1.
3. Integrate the work of updating and expanding the WARMF and related assessment tools into future Integrated Regional Watershed Management Plan work plans and General Plan efforts.

Opportunity 1. Build on the Upper Mokelumne River Watershed Management Authority's watershed planning efforts.

The Upper Mokelumne River Watershed Authority (Authority) is a joint powers authority formed to address "areas of mutual concern pertaining to drinking water quality, water supply, and the environment within the Upper Mokelumne River watershed."[1] With $950,000 in funds from Propositions 13 and 50, the

Authority undertook the Upper Mokelumne River Watershed Assessment and Planning Project to "advance a broader understanding of watershed water quality issues of concern and to develop a method and tools for the long-term evaluation of Upper Mokelumne River watershed water quality."

The project was conducted in two phases. The first phase focused on establishing stakeholder collaboration and data development. The second part documented existing baseline water quality and watershed conditions, identified existing and potential risks to beneficial uses, and established a program to evaluate long-term water quality.

An assessment tool was developed to provide a better understanding of watershed processes, particularly in areas of the watershed with limited data, identify potential responses to changing watershed conditions, and inform future decisionmaking in the watershed.

The project developed the following analytical tools:

- Baseline water quality
- Watershed simulation of water quality (WARMF)
- Water Quality Vulnerability Zones (WQVZ)
- Fire Models (FlamMap and FARSITE)

Of these, the baseline water quality, WARMF model and Water Quality Vulnerability Zones offer the best tools for linking water quality assessment and land use planning in Amador and Calaveras counties.

The project helps the Authority, its members and others to track changing water quality conditions throughout the watershed. The WARMF tool provides a method for tracking long-term, water quality conditions in the Upper Mokelumne River Watershed, and can be used to simulate source water quality conditions under various land use and land management scenarios.

Similarly, the Water Quality Vulnerability Zones were identified to help local planning agencies prioritize and protect sensitive watershed lands and could also be used to help identify areas most suited for development and/or the application of special management measures (e.g., Low Impact Development practices).

The watershed hydrologic simulation model (WARMF) was developed as a tool to analyze the entire watershed's existing hydrologic and water quality characteristics with the ability to analyze future potential water quality conditions based on changes to land uses and activities. This provides an ideal framework to build upon if it can be extended to other watersheds within Amador and Calaveras counties.

A related tool, Water Quality Vulnerability Zones, was developed to determine watershed lands most vulnerable to the transport of contaminants to waterbodies. Vulnerability zones were defined based on physical characteristics of the watershed – slope, soils, vegetation and proximity to water.

The tool identifies areas in the watershed that have high, moderate and low vulnerability or potential for increasing the concentration of a water-quality parameter of concern in receiving waterbodies.

Water Quality Vulnerability Zones can be used to identify lands that are suited to accommodate future development and those best suited for protection. Where development does occur, it helps identify areas that require greater management or protection measures, such as stormwater control measures or higher septic system standards to ensure water quality is protected.

Opportunity 2. Calibrate the existing WARMF model developed through the UMRWA effort to other watersheds in Amador and Calaveras.

The WARMF model was the primary tool used to carry out the watershed assessment. WARMF uses a dynamic watershed simulation model to analyze streamflow and water quality conditions within a watershed. Water quality concentrations can be simulated based on the interaction of hydrologic data with other watershed conditions such as land use or land cover, which are incorporated into the model.

The Authority and consultant team used the WARMF model to help assess baseline water quality conditions and then to show when the established water quality benchmarks for parameters of concern would be exceeded. Water quality and quantity data were processed to complete a baseline water quality analysis, calibrate the WARMF model, and provide input for establishing water quality benchmarks.

In addition to providing a very detailed watershed assessment based on available data, WARMF can be used to generate and evaluate alternative development scenarios and show the water quality impacts of future land uses and development activities within the watershed. This makes WARMF a highly valuable tool for linking local land use decisions with watershed and water quality outcomes.

This allows the WARMF model to not only serve as watershed assessment tool, but also a growth modeling tool. In combination, this would allow local agencies to keep track of water quality and watershed health as the area grows, as well as to evaluate policy alternatives ahead of time to prevent or lessen future impacts. However, there are barriers:

1. The model is limited to the geographic area of the Upper Mokelumne River Watershed east of Highway 49. It will need to be expanded and calibrated to other areas if it is to be used in broader panning and management efforts.
2. Updating the model in a consistent manner requires ongoing resources. The Authority noted this issue within the final report. The Authority recommended that land use data be updated annually and watershed/hydrology/water quality data be updated every two years. Expanding the model to new areas may make this more challenging, but it may also provide an economy of scale to balance the costs of updating the model.
3. Funding to recalibrate and extend the model will need to be acquired.
4. Public education and outreach are needed. If the model is extended, there will need to be considerable public education and outreach, particularly to local landowners, public officials and to local planning agencies.
5. Local expertise to run and update the model is limited. The model is complex and requires specific technical knowledge. The Authority outlined a short-term plan for housing data and the model itself with the East Bay Municipal Utility District (which has such expertise in-house), but this arrangement would need to be revisited if the model is extended to a broader area.
6. if it is to be useful, the model must be used. It is not clear to what degree the existing WARMF model is being used to aid General Plan updates, but it does not appear to be a central component of land use alternatives analysis.
7. The model needs a programmatic champion to carry it forward. The project that created it is complete, but other projects can and should advance the tool. The most immediate opportunity to do so is through the forthcoming effort to update the Mokelumne/Amador/Calaveras Integrated Regional Water Management Plan.

Opportunity 3. Integrate the work of updating and expanding the WARMF and related assessment tools into future Integrated Regional Watershed Management Plan work plans and General Plan efforts.

The Integrated Regional Water Management (IRWM) program is intended to promote integrated regional water management to ensure sustainable water uses, reliable water supplies, better water quality, environmental stewardship, efficient urban development, protection of agriculture, and a strong economy.

The Department of Water Resources (DWR) administers the program. Its IRWM Grant Program encourages development of integrated regional strategies for management of water resources by providing funding through competitive grants.

The Mokelumne/Amador/Calaveras Integrated Water Management Plan was developed in 2006. The plan established several regional goals that are relevant to linking water management and land use planning decisions as well as to water quality monitoring in the region. The plan's overall goals are:

1. Develop a comprehensive IRWM plan for the Mokelumne/Amador/Calaveras area that incorporates regional water supply, water quality, flood control and environmental protection and enhancement objectives.
2. Improve and maximize coordination of individual water district, agency and city plans, programs, and projects for mutual benefit and optimal regional gain.
3. Identify, develop and implement collaborative plans, programs and projects that may be beyond the scope or capability of a single entity, but which would be of mutual benefit if implemented among multiple parties.
4. Facilitate regional water management efforts that include multiple water supply, water quality, flood control and environmental protection and enhancement objectives.
5. Foster coordination, collaboration and communication between entities and interested stakeholders to achieve greater efficiencies, enhance public services, and build public support for vital projects.
6. Realize regional water management objectives at the least cost through mutual cooperation, elimination of redundancy and enhanced competitiveness for state and federal grant funding.

Several regional specific goals were also identified, including a water quality goal. Measurable objectives were established for each specific goal. The water quality goal is discussed below.

Water Quality Goal

The regional goal for water quality is to protect and improve water quality for beneficial uses consistent with regional community interests and the RWQCB Basin Plan through planning and implementation in cooperation with local and state agencies and regional stakeholders. Measurable objectives for this goal include:

1. Meeting or exceeding all applicable water quality regulatory standards.
2. Meeting or exceeding urban water quality targets established by stakeholders.
3. Delivering agricultural water to meet water quality guidelines established by stakeholders.
4. Meeting or exceeding recycled water quality targets established by stakeholders.
5. Aiding in meeting Total Maximum Daily Loads established, or to be established, for the Mokelumne and Calaveras River watersheds.
6. Protecting surface waters from contamination and threat of contamination, including through Sanitary Sewer Overflows (SSOs) and Sewer System Management Plans.
7. Protecting groundwater basins from contamination and threat of contamination.
8. Managing existing land uses while preserving or enhancing environmental habitats.
9. Developing environmental water to meet water quality guidelines established by stakeholders.
10. Minimizing impacts from stormwater through implementation of Best Management Practices or other detention projects.
11. Managing existing land uses for recycled water discharges and allowable water-based discharges.

The overall goals for the M/A/C IRWMP, and particularly the Water Quality Goal, appear to align with the need to establish a long-term, regional, water quality monitoring program. The WARMF model provides a sophisticated assessment tool to serve that purpose.

With respect to monitoring the long-term watershed impacts of development, the state is requiring closer ties with local land use agencies in the next round of IRWM funding. The WARMF model provides an ideal nexus for water agencies and land use agencies to reach

a greater level of coordination with respect to water quality.

Data development and consolidation is a key need that the IRWMP process can also advance.

With these opportunities and the previously noted barriers in mind, the following steps are recommended:

1. Local stakeholders involved in the M/A/C IRWMP, Upper Mokelumne River Watershed Authority and other agencies should seek to integrate the WARMF model into long-term water quality and water management efforts by extending the range of the model. This will include an evaluation of the costs of extending the model.
2. If the model cannot be extended to encompass all of the watersheds in Amador and Calaveras counties at the same time, then a phased approach could be used. This would require determination of priority sub-watershed areas to extend into. Areas projected for greater amounts of development, such as western portions of both counties, should receive priority.
3. An agreement to solidify and consolidate key data is a preliminary step that can expedite extension of the model while aiding other planning and management efforts.
4. An education and outreach effort should be undertaken for two purposes: educate the area's landowners about the model and initiate dialogue about its use for planning, particularly to clarify issues related to private property rights; and educate local staff within the region on the use of the model so that it can eventually be housed locally and updated by local agencies.

Endnotes

CHAPTER 1.

1 U.S. Environmental Protection Agency, Office of Water. 2005. "Making the Connection: Smart Growth and Water Resource Protection," WaterTrain Module. www.epa.gov/watertrain/smartgrowth.

2 Stein, Eric and Susan Zaleski. 2005. "Managing Runoff to Protect Natural Streams: The Latest Developments on Investigation and Management of Hydromodification in California." Southern California Coastal Water Research Project and USC Sea Grant.

CHAPTER 2.

1 Hickey, E., Clayburgh, J., Raborn, S. (2005) *Planning for the Future – A Sierra Nevada Land Use Index.* Sierra Nevada Alliance (population numbers based on California Department of Finance Projections).

2 Sierra Nevada Alliance. 2005 (June). *Planning for the Future, a Sierra Nevada Land Use Index*. Sierra Nevada Alliance. South Lake Tahoe.

3 State of California, Department of Finance, Population Projections for California and Its Counties 2000-2050, by Age, Gender and Race/Ethnicity, Sacramento, California, July 2007.

4 IBID.

5 Mintier and Associates (2007) *Calaveras County General Plan Baseline Report*: Chapter 2 Population and Demographics – Preliminary Draft, November 2007.

6 IBID.

7 EDAW (2006) Amador County General Plan Update: Demographics and Housing Working Paper. Mintier and Associates (2007) Calaveras County General Plan Baseline Report: Chapter 2 Population and Demographics – Preliminary Draft. November 2007.

8 *Sierra Nevada Wealth Index 2005-2006 Edition*, Sierra Business Council.

9 Sierra Nevada Alliance. 2005 (June). *Planning for the Future, a Sierra Nevada Land Use Index*. Sierra Nevada Alliance. South Lake Tahoe.

10 IBID.

11 *2002-2004 Farmland Conversion Data*, *Farmland Mapping and Monitoring Program*, California Department of Conservation.

12 IBID.

13 Bernstein, A. (2007) *Dangerous Development: Wildfire and Rural Sprawl in the Sierra Nevada.* Sierra Nevada Alliance.

14 Hickey, E., Clayburgh, J., Raborn, S. (2005) *Planning for the Future – A Sierra Nevada Land Use Index*. Sierra Nevada Alliance.

15 Bernstein, A. (2007) *Dangerous Development: Wildfire and Rural Sprawl in the Sierra Nevada*. Sierra Nevada Alliance.

16 Sierra Nevada Alliance. 2006 (March). *State of Sierra Waters, A Sierra Nevada Watersheds Index*. Sierra Nevada Alliance. South Lake Tahoe, CA.

17 Millar, C. I. 1996. *Sierra Nevada Ecosystem Project, Final Report to Congress, Vol. I, Assessment Summaries and Management Strategies, Centers for water and Wildland Resources, Report No. 36*, University of California, Davis, California Cooperative report of the PSW Research Station, PSW Region, USDA, for the Sierra Nevada Framework Project, Sacramento, CA.

18 *Cosumnes River Watershed Management Plan*, December 2007. Sloughhouse RCD.

19 IBID.

20 Amador Water Agency, *Urban Water Master Plan*.

21 California Department of Water Resources, 2008. *Water Plan Update 2009, Volume 3 – Regional Reports*, Chapter 13 Mountain Counties Area, Initial draft available at: www.waterplan.water.ca.gov/materials/index.cfm?subject=apr1108.

22 Upper Mokelumne River Watershed Project Authority, TM No.10 *Watershed Management Plan* (2007), Upper Mokelumne River Watershed Assessment and Planning Project, RMC.

23 IBID.

CHAPTER 4.

1 Ernst, C. (2008): *Protecting Land as a Smart Growth and Clean Water Tool 2008 NPSG conference presentation*. The Trust for Public Land.

2 Fulton, W., Mazurek, J., Pruetz, R., and Williamson, C. *TDRs and Other Market-Based Land Mechanisms: How They Work and Their Role in Shaping Metropolitan Growth.* The Brookings Institution Center on Urban and Metropolitan Policy, June 2004.

3 Smart Growth Network and the International City/County Management Association. 2003. *Getting to Smart Growth II: 100 More Policies for Implementation*. Washington, DC: ICMA.

CHAPTER 5.

1 U.S. Environmental Protection Agency, Office of Water. 2006. "Protecting Water Resources with Higher-Density Development," EPA 231-R-06-001. Washington, DC.

2 Harbor, J.B. Engel, et. Al.2000. "A Comparison of the Long-Term Hydrological Impacts of Urban Renewal Versus Urban Sprawl." West Lafayette, IN. Purdue University.

3 Levin, R.B., Epstien, P., Ford, T., Harrington, W., Olson, E., Reichard, E. 2000. U.S. Drinking Water Challenges in the Twenty-first Century. Environmental Health Perspectives. 110(s1):43-52.

4 U.S. Environmental Protection Agency, Office of Water. 2006. *Growing Toward More Efficient Water Use: Linking Development, Infrastructure, and Drinking Water Policies.* U.S. EPA. Washington, DC. EPA 230-R-06-001.

5 U.S. Environmental Protection Agency, Urban and Economic Development Division. 1999. *The Transportation and Environmental Impacts of Infill versus Greenfield Development: A Comparative Case Study Analysis.* U.S. EPA. Washington, DC. pp. 17. epa.gov/smartgrowth/pdf/infill_greenfield.pdf.

6 Sierra Nevada Alliance. June 2005. *Planning for the Future, a Sierra Nevada Land Use Index.* Sierra Nevada Alliance. South Lake Tahoe, CA.

7 Ed McCormack, G. Scott Rutherford, Martina G. Wilkinson (2001) The Travel Impacts of Mixed Land Use Neighborhoods in Seattle, *Transportation Research Record*.

CHAPTER 6.

1 Upper Mokelumne River Watershed Project Authority. 2007. TM No.10 Watershed Management Plan. Upper Mokelumne River Watershed Assessment and Planning Project, RMC.

2 Gleick, Peter H. et al. 2003. "Waste Not, Want Not: The Potential for Urban Water Conservation in California." The Pacific Institute.

3 IBID.

4 California Energy Commission. 1993. "Energy Aware Planning Guide," Local Government Commission.

5 California Department of Water Resources. Updated Model Water Efficient Landscape Ordinance AB 1881. www.owue.water.ca.gov/landscape/ord/updatedOrd.cfm.

6 California Urban Water Conservation Council. 2005. "Water Smart Landscapes for

California: AB 2717 Landscaping Task Force Findings, Recommendations, and Actions."

7 IBID.

8 U.S. Environmental Protection Agency, Office of Water. 2000. Wastewater Technology Fact Sheet: High Efficiency Toilets. U.S. EPA. Washington, DC. EPA 832-F-00-047.

9 IBID.

10 "Graywater Introduction." Alliance for Water Efficiency. Retrieved Dec. 8, 2008. www.allianceforwaterefficiency.org/graywater_introduction.aspx?terms=greywater

11 Western Resource Advocates. 2006. Water Rate Structures in New Mexico: How New Mexico Cities Compare Using This Important Water Use Efficiency Tool.

12 California Recycled Water Task Force. 2003. "Water Recycling 2030 Recommendations of California's Recycled Water Task Force."

13 Ibid.

14 Department of Water Resources. 1995. "Graywater Guide: Using Graywater in Your Home Landscape."

15 Department of Water Resources. 1995. "Graywater Guide: Using Graywater in Your Home Landscape."

16 Levin, R.B., P. Epstien, T. Ford, W. Harrington, E. Olson and E. Reichard. 2000. "U.S. Drinking Water Challenges in the Twenty-First Century." Environmental Health Perspective, Vol. 110, No. 1. Cary, NC. Pp.43-52.

CHAPTER 7.

1 Final Report (2007) *Upper Mokelumne River Watershed Management Assessment and Planning Project.* Upper Mokelumne River Watershed Authority.

Appendix A.

Ahwahnee Water Principles for Resource-Efficient Land Use

Preamble

Cities and counties are facing major challenges with water contamination, stormwater runoff, flood damage liability, and concerns about whether there will be enough reliable water for current residents as well as for new development. These issues impact city and county budgets and taxpayers. Fortunately there are a number of stewardship actions that cities and counties can take that reduce costs and improve the reliability and quality of our water resources.

The Water Principles below complement the Ahwahnee Principles for Resource-Efficient Communities that were developed in 1991. Many cities and counties are already using them to improve the vitality and prosperity of their communities.

Community Principles

1. Community design should be compact, mixed use, walkable and transit-oriented so that automobile-generated urban runoff pollutants are minimized and the open lands that absorb water are preserved to the maximum extent possible. (See the Ahwahnee Principles for Resource-Efficient Communities)

2. Natural resources such as wetlands, flood plains, recharge zones, riparian areas, open space, and native habitats should be identified, preserved and restored as valued assets for flood protection, water quality improvement, groundwater recharge, habitat and overall long-term water resource sustainability.

3. Water holding areas such as creek beds, recessed athletic fields, ponds, cisterns and other features that serve to recharge groundwater, reduce runoff, improve water quality and decrease flooding should be incorporated into the urban landscape.

4. All aspects of landscaping from the selection of plants to soil preparation and the installation of irrigation systems should be designed to reduce water demand, retain runoff, decrease flooding, and recharge groundwater.

5. Permeable surfaces should be used for hardscape. Impervious surfaces such as driveways, streets, and parking lots should be minimized so that land is available to absorb stormwater, reduce polluted urban runoff, recharge groundwater and reduce flooding.

6. Dual plumbing that allows greywater from showers, sinks and washers to be reused for landscape irrigation should be included in the infrastructure of new development.

7. Community design should maximize the use of recycled water for appropriate applications including outdoor irrigation, toilet flushing and commercial and industrial processes. Purple pipe should be installed in all new construction and remodeled buildings in anticipation of the future availability of recycled water.

8. Urban water conservation technologies such as low-flow toilets, efficient clothes washers, and more efficient water-using industrial equipment should be incorporated in all new construction and retrofitted in remodeled buildings.

9. Groundwater treatment and brackish water desalination should be pursued when necessary to maximize locally available, drought-proof water supplies.

Implementation Principles

1. Water supply agencies should be consulted early in the land use decisionmaking process regarding technology, demographics and growth projections.

2.City and county officials, the watershed council, LAFCO, special districts and other stakeholders sharing watersheds should collaborate to take advantage of the benefits and synergies of water resource planning at a watershed level.

3. The best, multi-benefit and integrated strategies and projects should be identified and implemented before less integrated proposals, unless urgency demands otherwise.

4. From start to finish, projects and programs should involve the public, build relationships, and increase the sharing of and access to information.

5. Plans, programs, projects and policies should be monitored and evaluated to determine if the expected results are achieved and to improve future practices.

* * * *

Authors: Celeste Cantu, Martha Davis, Jennifer Hosterman, Susan Lien Longville, Jeff Loux, John Lowrie, Jake Mackenzie, Jonas Minton, Mary Nichols, Virginia Porter , Al Wanger, Robert Wilkinson, Kevin Wolf.

Editor: Judy Corbett

For more information:
Local Government Commission
Center for Livable Communities
www.lgc.org
(916) 448-1198

Appendix B.

Stakeholder Advisory Committee Members

Gene Albaugh	City of Plymouth, City Manager
Kathy Allen	Amador Citizens for Smart Growth
Pete Bell	Foothill Conservancy Vice President
John Benoit	Calaveras County LAFCO
Kelly Birks	Rick Engineering Co.
Mary Boblett	District 3 Park and Recreation Commissioner
Krista Clem	Mokelumne Bluffs Nature Estates and Golden Vale Subdivisions
Jay D. Coles	Reynen & Bardis Communities
Mike Daly	City of Jackson, City Manager
Jeff Davidson	Calaveras County Water District
Bob Dean	Calaveras County Water District, Board President
Rob Duke	City of Sutter Creek, City Manager
Debbie Dunn	Amador County Recreation Agency
Duke Foster	Amador Dry Creek Watershed
Hienz Hamann	Amador Water Agency
Jim Hemminger	Calaveras County Department of Public Works
Rob Houghton	Calaveras County Department of Public Works
Cathryn Jackson	Calaveras Planning Coalition
Eric A Kokernak, P.E.	Rick Engineering Co.
Nathan Lishman	Amador County, Planner
Dick McCleery	NRCS-CSRC&D
Tim McSorely	Calaveras Council of Governments, Executive Director
Holly Mines	Calaveras County Parks and Recreation
Stephanie Moreno	Calaveras County Community Development Agency
Brian Oneto	Amador County Supervisor
Dave Pastizzo	Calaveras County Planning Department
Edwin Pattison	Calaveras County Planning Department
Colleen Platt	MyValleySprings.com
Lee Seaton	City of Angels
Terry Strange	Upper Mokelumne River Watershed Council
Roger Stuart	Amador County Public Works Agency
Steve Wilenksy	Calaveras County Supervisor
Mickey Williamson	Calaveras Planning Coalition
David Wood	Aperio, Inc.
Chris Wright	Foothill Conservancy
Muriel Zeller	MyValleySprings.com

Appendix C.

Transfer of Development Rights Programs

In a Transfer of Development Rights (TDR) program, landowners living on valuable land worthy of protection are able to trade or sell their development rights to another landowner, or apply them to another piece of property they own located within a designated growth area.

By designating "sending" areas (land where development rights can be sold or traded) and "receiving areas" (land where development rights can be applied), a community can shift development away from land it wants to protect but cannot afford to purchase.

At the same time, development is focused in designated growth areas that are able to accommodate more growth. These areas are usually located near existing communities and, therefore, near schools, shopping and within the service area of municipal water and wastewater providers.

A TDR program benefits both the landowner, who receives just compensation, and the community, which can protect important natural areas, agricultural lands or open space.

TDR programs do not work for every region and success depends on in-depth research and analysis before implementation. Many current TDR programs do not have active markets because they were not set up with much market knowledge. Therefore, it is recommended that communities considering a TDR program first conduct an economic feasibility study.

An economic feasibility study examines the potential market for buying and selling development rights by (1) determining developer and landowner interest, (2) studying trends in the local real estate market, (3) comparing options for allocating development rights, and (4) evaluating the viability of sending and receiving sites within the initial study area.

1. Determine developer and landowner interest.

Both sending and receiving area landowners need to see a financial benefit to participating in a TDR program. To attract sending-area landowners, local governments can offer "bonus" development rights. For example, a rural landowner may have one development right per acre but by participating in the TDR program can receive a bonus of 2-4 development rights per acre, therefore, providing compensation comparable to developing the land conventionally.

Alternatively, receiving area landowners need to be awarded enough density per each development right purchased to justify the investment in acquiring the rights. Investigating how much a developer is willing to pay for added density would allow rural landowners to know if selling their development rights would be comparable to selling their land for development. This is crucial for developing support for a TDR program among rural landowners.

Consistency within the decisionmaking process is key. Receiving density bonuses via the purchase of development rights should be the only way a developer can receive additional density.

Offering alternatives for granting density, such as permitting "up-zoning" or by providing density bonuses for affordable housing, will undermine the legitimacy of a TDR program. Simply put, why would developers buy something they could get for free? It is important to offer one

Partnering with Land Trusts to Direct Growth

The County of San Luis Obispo passed an ordinance to allow the Land Conservancy of San Luis Obispo County to sell development credits in areas that the County has designated for growth. A $200,000 State Coastal Conservancy grant was used to establish a revolving fund for purchasing environmentally sensitive properties, record deed restrictions on those properties, and sell the resulting Transfer of Development Rights credits to people wishing to develop at higher densities or add square footage above allowed levels within designated "receiving" areas.

The proceeds from these sales provide capital for the acquisition of additional property from willing sellers to be preserved as open space. The program costs the County nothing since the State Coastal Conservancy administers the sale of credits. The Land Conservancy of San Luis Obispo County has preserved more than 230 properties to date and doubled the amount of money in the revolving fund.

For more information: Land Conservancy of San Luis Obispo County
(805) 544-9096, lc@special-places.org

type of density "currency" – in this case, the purchase of development rights.

Other incentives that local governments can offer to encourage participation from both buyers and sellers include fast tracking application processing and creating a TDR bank to act as an intermediary to buy and sell development rights.

A TDR bank can be represented by an outside organization, such as a clearinghouse, bank or land trust. TDR banks can help stabilize the market and reassure rural landowners and developers by facilitating the purchase and sale of development rights. If these entities have initial seed money, they can take the initial risk by buying development rights and then choosing to hold, sell, or even retire development rights based on current market needs. Inevitably, TDR programs will need to be fine-tuned and adjusted over time to respond to changing market dynamics.

2. Study trends in the real estate market.

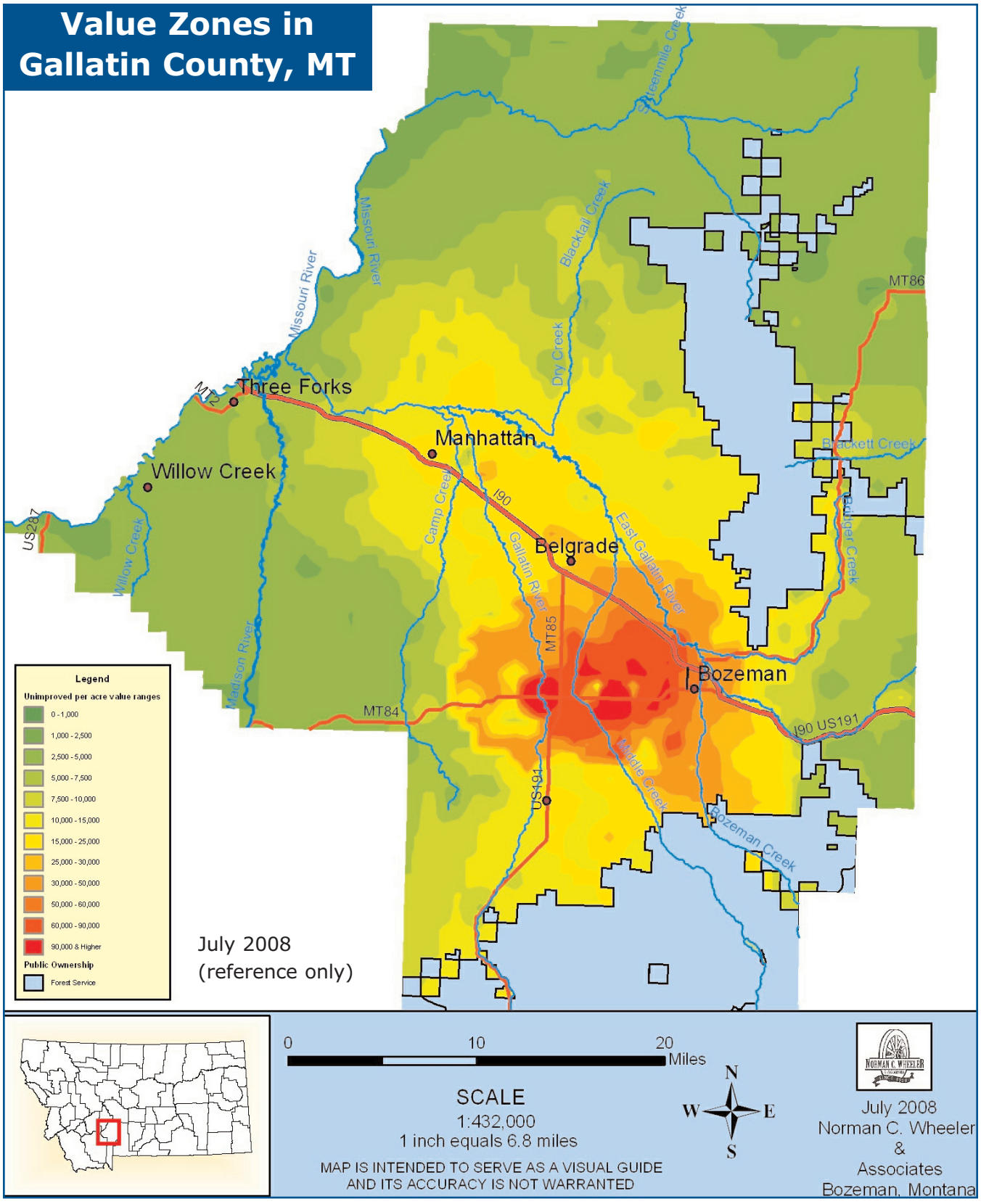
Past activity within the real estate market can expose trends in supply and demand for housing, the types of developments being built (i.e., commercial, suburban subdivision, etc.), and average housing prices. These factors point to how many players might be in the market for purchasing development rights. Lot developers would be the potential buyers in a TDR market, not the individual home builder. Therefore, demand analysis should focus on lot developers and hinge on the market prices of improved lots, which are largely influenced by home and raw land prices.

3. Compare options for allocating development rights.

There are a variety of approaches to determining the "currency" of a TDR program. Three examples of how development rights can be allocated are summarized below:

- ***Value-based:*** A value-based method allocates TDR credits on a case-by-case basis, determined by appraised land values. This method has been used where there is a range of land values within the sending area. This allows the TDR credits to reflect each property's development potential, which can be evaluated based on current zoning, proximity to existing development, access to roads, and access to public amenities and infrastructure, such as sewers and water systems.

  Though this method recognizes that not every rural property holds the same value, it can discourage participation from rural



Property value map prepared by Thomas Kingsbury of Norman C. Wheeler and Associates for Northern Gallatin County.

Tahoe Protects Sensitive Lands Based on Land Capability

The Tahoe Regional Planning Agency (TRPA) has a track record of success in protecting sensitive, high-value lands within the watershed through a Transfer of Development Rights program, which allows for the transfer of land coverage, residential development rights and residential development allocations.

TRPA uses a land capability ranking system – the Bailey Land Scoring System – to determine each property's ecological value as well as its potential to accommodate development. The system creates a "score" for each property based upon various site features, such as topography, stream channels, slope and soil types.

TRPA's incentive program is based on the scores created by the Bailey System. Landowners who own parcels identified as "sensitive" can receive additional bonuses, such as extra allocation of development rights.

For more information: Tahoe Regional Planning Agency, www.trpa.org
trpa@trpa.org, (775) 588-4547

landowners because they are uncertain how may TDR credits they would receive for their land until an appraisal is done. (See the Gallatin County value-based map at left).

- ***Acreage-based:*** Basing TDR credits on acreage is a catch-all method that levels the playing field among sending-area landowners. This option is attractive because it is predictable, straightforward and easier to manage on the administrative end. The downside is that this approach does not take into account the conservation value of different parcels. For some areas, this is not a problem because a uniform allocation of TDR credits can be profitable for most or all sending site owners.
- ***Capability-based:*** TDR credits can be based on specific capabilities of the land. For example, if the TDR program's goal is to preserve or improve water quality, then sending sites can be rated according to their capability of providing water quality services. Property owners who own highly rated land can be given an extra incentive to participate in the program by receiving more TDR credits per acre than other sites. This allows regions to prioritize lands based on their program's goal, but still allow other landowners to participate.

4. Evaluate the viability of sending and receiving sites within the initial study area.

The initial study area for a TDR area will be determined by conservation and growth management goals. Some conservation goals, such as maintaining water quality within a watershed, may cross several jurisdictions and require regional collaboration, while other programs can be managed at a smaller, more local scale.

A drawback to small-scale TDR programs is that they can only provide "spot" treatment for larger issues, such as balancing growth within a region and conserving large swaths of contiguous, high-value land. Expanding the scope of a TDR program can provide a larger palette of options for achieving both conservation and growth management goals as well as allowing for more players (buyers and sellers of development rights) to participate.

When getting down to site specifics, the first step is mapping all land that falls within the scope and goals of a TDR program. The broad area will be further refined by evaluating site challenges, opportunities, and development constraints (such as steep slopes, wetlands and floodplains). Some programs even require landowners to prove their land is developable.

The best sending areas support conservation goals, have willing sellers, and are financially viable, meaning the property can be purchased at a value that most closely matches what developers are willing to pay for increased density.

When identifying potential receiving areas, the first areas to consider are unincorporated areas adjacent to cities, areas where it makes sense to form new towns, and areas within incorporated cities (i.e., infill and redevelopment opportunities).

Local perception of density and the strength of local real estate markets will also heavily influence the viability of receiving areas. Local resistance to density can make the incentive of density bonuses unattractive for developers since there is not a strong market or public acceptance for this type of development.

TDR programs do not decrease overall development that a region will receive, but direct it to better locations based on local values.

The appropriate distance between sending and receiving areas will affect the available supply of each for a TDR program. TDR programs tend to be supported both politically and publicly when sending and receiving areas are within an acceptable range, which will vary by region. For instance, it is much easier for residents to accept density in their neighborhood when they can benefit from preserved open space close by. Often land located at the boundary of urban areas is targeted for protection because these lands are in the direct path of development. The drawback to this approach is that these lands usually have a high price tag due to development speculation, and therefore, less land is protected. The lesson here is that the distance between sending and receiving lands must satisfy financial limitations as well as public perception of benefits.

TDR programs are a mix of voluntary participation and regulatory enforcement, and finding a balance between these two forces is imperative to sustaining a healthy market. If a program is too financially burdensome either for the government to administer or for the developer to participate in, then the program will likely fail.

The long-term success of a TDR program will also rely on broad support from the community and elected officials and must have a straightforward, effective process consistent with other policies and programs.

Development rights, land use and growth management are highly charged topics. A program can have rural landowners and developers willing to participate, but if community members are not supportive or oppose development "in their backyard," then the program will eventually fail. Support from both the community and government officials will help a TDR program withstand the pressure to be modified or changed.

Appendix D.

Low Impact Development (LID) Toolbox

The term "low impact development," or LID, describes a set of alternative stormwater management systems that minimize the water quality impacts of development. An LID approach tries to mimic the natural hydrologic system as much as possible, using vegetation to slow down and treat stormwater, and soils to absorb and percolate stormwater.

An LID approach can be applied at multiple scales from a constructed wetland that seeks to treat runoff from an entire community to a small rain garden designed to capture runoff from a single part of one rooftop. From this perspective, a set of design strategies can be linked together to create a "treatment train" of LID practices from the point where rain falls to the point of discharge into the creek, stream or lake.

It is important to get in early with an LID approach. It is far easier and less costly to plan these features and design concepts at the initial concept plan stage and then follow through with detailed design than to try to add them later.

The following provides a toolbox of techniques and design types that can be used for specific areas and projects.

BIO-RETENTION

Bio-retention techniques are vegetated areas used to provide temporary storage for stormwater. Water does not leave the site but is slowly allowed to infiltrate into the ground.

Types of Bio-retention:

Rain Gardens are swales planted with attractive vegetation and are typically used in residential and highly visible commercial areas, though they have been adapted to work in municipal situations as well. Many of Portland's "Green Streets" projects are examples of rain gardens.

Rain garden

Grassy Swales are, as their name implies, swales planted with a palette of short grasses. They are typically used in large commercial projects, and generally are not designed and sited to be a main feature.

Design Considerations:

- Retention bio-swales require flat or nearly flat land and soils that drain quickly.
- Do not install a retention bio-swale on a slope greater than 5%.
- Incorporate retention bio-swales into the site design as soon as possible.
- Keep the slopes of the swale shallow, perhaps a one-foot rise to a three-foot run for safety.
- Provide safe overflow for very large volumes of stormwater.

A network of open swales at the Village Homes development in Davis, CA, provides an aesthetic landscape as well as manages all stormwater on site.

Swales can be integrated into the landscape design of planted areas located between sidewalks and roads.

- Use plants that can survive wet conditions.
- Consider bio-remediating plants for specific pollutants and habitat-providing and/or native plants for other purposes.
- Install periodic check dams in a retention bio-swale to increase infiltration on a slightly sloped site.
- Locate swales sufficiently far from building foundations to prevent damage.

Maintenance Notes:

- Periodically weed, mulch or mow swales to keep them looking good and bio-remediating pollutants.
- Remove trash and other accumulated pollutants.
- Check swales periodically to ensure they are draining properly.

PERVIOUS PAVEMENT

Pervious pavement is any constructed surface that allows water to percolate into the ground. Pervious pavements are "infiltration friendly" alternatives for low-traffic applications like parking stalls, driveways, pathways and emergency vehicle access. Pervious pavements are made from normal building materials and installed with normal building equipment, making them readily available and easy to install.

Types of Pervious Pavement:

Porous Concrete has nearly the same make-up as normal concrete but does not include fine aggregate, thus resembling exposed aggregate concrete in appearance. Installation requires specially-trained professionals.

Porous Asphalt is visually coarser than regular asphalt due to the elimination of fine aggregate and some of the tar-bonding agent normally added to regular asphalt. No special training or equipment is required to install porous asphalt.

Unit Pavers, Bricks and Cobble can be installed with permeable joints set on a permeable base to allow for water conveyance.

Reinforced Grass, often referred to as "turf block," or "grasspave," is an open-cell unit

paver made from metal or concrete and filled with aggregate or turf. Such surfaces are not comfortable for walking and most appropriate for low-traffic conditions. This is a common solution for emergency access with minimal visible impact. (See manufacturer for compliance with Fire Emergency Code 902.2.2.2.)

Crushed Aggregate, or gravel, can be used for driveways, walkways, or in other areas to promote drainage. It is hard to traverse via bicycle and wheelchair but stabilization can be increased by mixing aggregate with an epoxy resin before being laid. Epoxy resin can be slippery, so a light dusting of clean white sand should be applied to the top layer of the paving before the epoxy hardens.

Design Considerations:

- Typically used in low traffic situations such as low volume roads, all parking surfaces, driveways, walkways and emergency vehicle access routes.
- Costs slightly more than impervious counterpart.
- Do not install on slopes greater than 5%.
- Requires well-drained soils for infiltration.
- Freeze/thaw conditions: Aggregate base needs to be deep enough that stormwater does not fill aggregate base layer void space and heave paving above. Depth depends on soil but is usually at least 12 inches, and potentially to the frost line.
- Aggregate Base: Aggregate base should be constructed with one- to three-inch washed aggregate with 40% void space. Depth varies but is generally at least 12 inches. The base should be deep enough to store at least the two-year storm event and drain within 72 hours of the storm event. Note: The two-year storage can be sufficient to meet peak-flow runoff from the 25- to 100-year storm event.

Maintenance Notes:

- Periodic cleaning is required to keep fine sediment, grease and oil from accumulating and reducing permeability.

The Port of Portland Terminal 6 project used a combination of porous pavement laid over a coarse aggregate base and vegetated swales to handle 100% of the stormwater generated on a 51-acre redevelopment site.

Pavers are ideal for areas that do not receive heavy traffic, such as driveways.

Pavers provide a permeable area for people to use when exiting or entering their car when it is parked along the street.

Reinforced grass

New technologies keep gravel in place and increase permeability.

- Avoid heavy loads and compaction.
- Snow removal: Raise plow heights slightly above surface (no more than three to four inches) to remove snow but preserve porous pavement. Do not apply sand for icy conditions.

FLOW THROUGH BIO-SWALE

Flow through bio-swales are vegetated areas that are designed to slow down the conveyance of stormwater while allowing for water to be filtered by plant material and soil, as well as infiltrate into the ground. They do not decrease the volume of stormwater runoff, only the amount of pollutants in it. Plant selection, soil preparation and design are the determining factors for pollutant removal.

Types of Flow Through Bio-swales:

Planter Boxes are constructed or pre-manufactured devices filled with sand or other filtering material and then planted with vegetation selected to remove a specific pollutant or pollutants from stormwater. Runoff is not retained in the planter box, therefore, planter boxes should be used as one component in an larger stormwater management system.

Vegetative Filter Strips function in much the same way as flow through bio-swales. Vegetative filter strips are narrow strips of vegetation that form a buffer around natural elements or drain inlets, allowing only filtered stormwater to enter that element. Width and plant species are the most important components of vegetative filter strips. Depending on the design and plant materials selected, they can be very visually appealing, provide habitat for wildlife and provide an opportunity for bio-remediation. If used on the sides of a road, filter strips can be a hazard to vehicles pulling off on to the road shoulder.

Design Considerations:

- Use on a variety of vegetation-supporting soils.
- If used on the side of a hill that is more than a 5% slope, keep the slope of the swale itself between 1% and 4% by wrapping it around the side of the hill and/or using switchbacks.

These planters in Emeryville, CA, are designed with overflow boxes and underdrains.

- Plant selection should depend on location, desired filtering levels, potential for bio-remediation, and aesthetic and general environmental value.
- When selecting construction materials, keep in mind that this will be a temporary, miniature stream. Avoid bark mulch, undersized pea gravel or other materials that will float or easily erode and cause maintenance problems downstream.
- Allow for air space when positioning planter boxes near buildings.

Maintenance Notes:

- Periodically weed, mulch (if appropriate), and remove trash and debris that may have collected.
- Check for signs of erosion and poor drainage.

Rain barrels come in a variety of styles and can be an easy way to store and collect rain water for later use.

CISTERNS

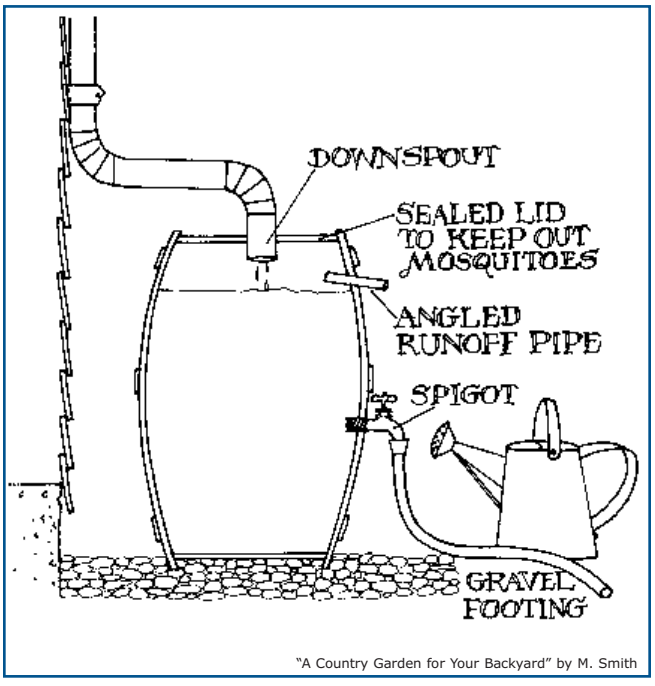
Capturing rainwater in cisterns can be an effective means of securing additional water supplies and keeping rainwater on-site. Cisterns are enclosed devices that are able to store and capture rainwater, making it available at a later date for irrigation or other outdoor uses. They reduce demand for tap or potable water supplies. They can be located at, above or below grade, and usually rely on gravity to collect rainwater from rooftops.

Cisterns come in a variety of sizes and can be used for residential, commercial and institutional applications. Size selection will depend on the region's climate variability (i.e., occurrence of drought periods versus rainy weather), and how long water will need to be stored.

Rain barrels are a type of cistern commonly used for private residences. Rain barrels are often barrel-shaped, inexpensive pre-manufactured water storage devices used to store rainwater collected from roofs for irrigation purposes.

Design Considerations:

- Filter rainwater before it enters cisterns or rain barrels.
- Size cisterns for usage needs.



Small spaces between housing can be used as infiltration areas for stormwater management.

- Consider gravity-fed designs.
- Provide an alternative source of water for drought years.
- Combine cisterns with water-efficient design to maximize usefulness.

Maintenance Notes:

- Stored water may require periodic treatment.
- Rainwater filters and cisterns require periodic cleaning.

INFILTRATION UNITS

Infiltration units provide subsurface temporary storage of stormwater and allow stormwater to percolate into soil below. These units can be as simple as excavated areas lined with filter fabric and filled with aggregate, or as complicated as pre-manufactured units installed in various areas. Subsurface storage of water negates problems of drowning and vector breeding.

Infiltration units can also be combined with other LID strategies to enhance results. For example, an infiltration unit installed under pervious paving can capture water that has already percolated through one medium and allow for additional storage time and an extended period of release.

Types of Infiltration Units:

Infiltration Trenches are long, narrow excavated areas filled with an aggregate sized to store a specific volume of stormwater based on site needs. They are often installed down the center of driveways and on the edges of large impervious areas.

Drywells are excavated deep areas usually lined with filter fabric and filled with a material that has a lot of void space such as an aggregate. Drywells increase water infiltration into the soil to maximize stormwater infiltration in a small area, especially if a clay layer such as hardpan is close to the surface and can be punctured.

Pre-manufactured Infiltration Units are commercially available and designed to provide high levels of water storage in tight spaces. Designs of these units vary considerably, but they are often made from plastic.

Design Considerations:

- Install in well-drained soils on slopes less than 5%.
- Consider installing vegetative filter strips around infiltration units to prevent sediment buildup.
- Keep plants and organic matter away from infiltration units to prevent clogging.
- Consider installing infiltration units under porous pavement, bio-swales (with root barrier) and other Low Impact Development strategies for added infiltration benefit.
- Place in less visible locations, or design in such a way to be visually appealing.

Maintenance Notes:

- Infiltration units require some maintenance, typically raking or removing sediment if possible.

- Check to be sure infiltration units drain properly.

CONSTRUCTED WETLANDS

A constructed wetland is a series of constructed vegetated basins that have a permanent pool of water throughout the year or wet season. Typically, constructed wetlands are wide and shallow man-made marshes, averaging 1-1.5 feet deep, but they can be up to 4 feet deep. Vegetation typically covers up to 50% of the wetland's surface.

Constructed wetlands are usually used for regional or neighborhood storage and filtration and, depending on the design, can be relatively inexpensive to construct and maintain.

As long as the topography is relatively flat but still drains, constructed wetlands can be built in most soil conditions and can provide additional benefits such as flood protection, habitat for local as well as regional species, and can reduce channel erosion of streams lower in the watershed.

There are variations on the typical constructed wetland, such as a wet pond and extended detention basin.

A wet pond is the deepest type of constructed wetland, averaging 4-6 feet deep, and is often a visual attraction to a site. Vegetation for a wet pond typically covers up to 25% of the water's surface.

Extended detention basins are a series of swales that are seasonally dry and only temporarily hold water after storm events. Extended detention basins are designed to remove moderate to high levels of pollutants from stormwater runoff, but both wet ponds and constructed wetlands remove more.

Constructed wetlands require a large amount of space. If wetlands are meant to retain water year-round, supplemental water may be needed during dry months to maintain water level. If improperly designed, a wetland area can become a drowning hazard or a source for vector breeding (i.e., mosquitoes).

This constructed pond in Davis, CA, receives stormwater from surrounding development, provides habitat for migrating and local birds, and has walking paths along the perimeter for residences to use.

Design Considerations:

- Depth varies by type.
- For yearly/seasonally wet: Design a safety shelf around the water's edge that is a maximum of one foot deep and several feet wide. Base flow must be provided to maintain the water level.
- Slopes should have a 1.5-to-1 length to width ratio.
- In colder climates where salts are used on the roadways, consider a multi-entry approach to constructed wetland design where the upper section is designed with salt-tolerant plants and the lower section uses more bio-remediating plants.
- Provide for a 48-hour drawdown time for non-permanent water bodies.
- Size constructed wetlands to treat 85% of annual runoff.
- Provide a maintenance ramp for access to the wetland.
- If soils infiltrate too quickly, consider installing an impervious layer to prevent groundwater contamination.
- If year-round base flow is not an option, consider a seasonally-wet constructed wetland.
- Select plants according to conditions and pollutants.

Maintenance Notes:

- Sediment removal is necessary to maintain volume and functionality of constructed wetland.
- Plant harvesting may become necessary if constructed wetland becomes overgrown or if stormwater routinely contains large amount of pollutants.
- Monitor and provide vector control as necessary.

ADDITIONAL RESOURCES

General Low Impact Development information:

- Low Impact Development Center
  www.lowimpactdevelopment.org
- U.S. Environmental Protection Agency
  www.epa.gov/nps/lid
- California Stormwater Quality Association
  www.casqa.org
- River Friendly Landscapes by the Sacramento Stormwater Quality Partnership
  www.sacramentostormwater.org/SSQP/Riverfriendly/Documents/RiverFriendly_Guidelines.pdf
- Sacramento Stormwater Quality Partnership
  www.sacramentostormwater.org/SSQP/SSQP.asp
- Stormwater Authority
  www.stormwaterauthority.org
- National NEMO Network
  nemonet.uconn.edu
- University of New Hampshire
  www.unh.edu/erg/cstev
- Storm Water Center
  www.stormwatercenter.net

Site Analysis information:

- The U.S. Department of Agriculture Natural Resources Conservation Service provides online Web Soil Survey Maps, including soil infiltration rates, depths to bedrock and groundwater levels (http://websoilsurvey.nrcs.usda.gov/app).
- The U.S. Geological Survey National Map Viewer includes topographic maps to determine a project's slope and location in the watershed (http://nmviewogc.cr.usgs.gov/viewer.htm).
- Google Earth and Terraserver, a fast and user-friendly way to gather aerial photos (http://terraserver-usa.com).
- The planning offices of both Amador and Calaveras counties have maps available to the public, including those on zoning (General Plan) and natural hazards.
  Amador County: ww.co.amador.ca.us/depts/planning/index.cfm?id=18
  Calaveras County:
  www.co.calaveras.ca.us/cc/Departments/CommunityDevelopmentAgency/PlanningDepartment/tabid/111/Default.aspx
- The UC Davis Center for Water and Land Use has a stormwater calculator and LID case studies (http://extension.ucdavis.edu/cwlu).
- UC Davis Extension offices in Amador and Calaveras counties have information for each county (http://ceamador.ucdavis.edu and http://cecalaveras.ucdavis.edu).

Appendix E.

List of Acronyms

ADU	Accessory Dwelling Unit
ASCE	American Society of Civil Engineers
AWA	Amador Water Agency
BMP	Best Management Practice
BTA	Bicycle Transportation Account
CAPP	Conceptual Area Preservation Plan
CCOG	Calaveras County of Governments
CC&R	Conditions, Covenants and Restrictions
CCWD	Calaveras County Water District
COG	Council of Government
CRWMP	Calaveras River Watershed Management Plan
DTC	Downtown Commercial
DWR	Department of Water Resources
EBMUD	East Bay Municipal Utility District
FAR	Floor Area Ratio
GIS	Geographic Information System
GRP	Grassland Reserve Program
HC	Historic Commercial
HCP	Habitat Conservation Plan
HDR	High Density Residential
IRCUP	Inter-Regional Conjunctive Use Project
IRWM	Integrated Regional Watershed Management
IRWMP	Integrated Regional Watershed Management Plan
LAFCO	Local Agency Formation Commission
LC	Light Commercial
LID	Low Impact Development
LSC	Local Service Center
LSV	Low Speed Vehicle
MDR	Medium Density Residential

MLLT	Mother Lode Land Trust
MOU	Memorandum of Understanding
NCCP	Natural Community Conservation Plan
NPDES	National Pollutant Discharge Elimination System
NPS	Non-point Source
OWTS	On-site Wastewater Treatment System
PD	Planned Development
PDC	Purchase of Development Credit
PDR	Purchase of Development Rights
PES	Payment for Ecosystem Services
PO	Professional Office
RCD	Resource Conservation District
RSC	Regional Service Center
RWQCB	Regional Water Quality Control Board
SAC	Stakeholder Advisory Committee
SEWD	Stockton East Water District
SPA-R	Special Planning Area – Residential
SSO	Sanitary Sewer Overflow
SWRCB	State Water Resources Control Board
TC	Town Center
TDC	Transfer of Development Credit
TDPUD	Truckee Donner Public Utility District
TDR	Transfer of Development Rights
TMDL	Total Maximum Daily Load
TRPA	Tahoe Regional Planning Agency
UMRWA	Upper Mokelumne River Watershed Management Authority
UMRWAMP	Upper Mokelumne River Watershed Assessment and Management Plan
UMRWSA	Upper Mokelumne River Watershed Association
U.S. EPA	United States Environmental Protection Agency
VMT	Vehicle Miles Traveled
WARMF	Watershed Analysis Risk Management Framework
WCB	Wildlife Conservation Board
WQVZ	Water Quality Vulnerability Zone
WWTF	Wastewater Treatment Facility

Printed on 100% postconsumer paper using soybased inks • editing+design: dave davis