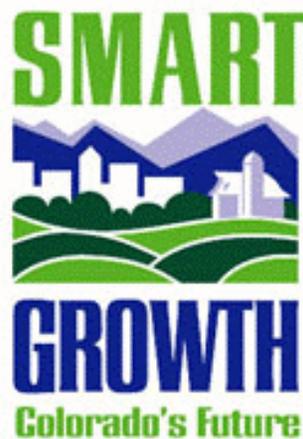


Colorado Heritage Report

BEST PRACTICES
IN
NATURAL HAZARDS
PLANNING AND MITIGATION



FEBRUARY 2003
Colorado Department of Local Affairs
Office of Smart Growth
1313 Sherman St, Room 521
Denver, CO 80203
(303) 866-2353

Compiled by

Office of Smart Growth
Colorado Department of Local Affairs
1313 Sherman Street, Room 521
Denver, CO 80203
(303) 866-2353
(303) 866-4819 (fax)

Contacts :

Charlie Unseld, (303) 866-2353, charles.unseld@state.co.us
Andy Hill (303) 866-3785 andy.hill@state.co.us
Eric Bergman (303) 866-4552, eric.bergman@state.co.us

In cooperation with

Colorado Counties Inc.
1700 Broadway, Suite 1510
Denver, CO 80290
Contact: Greg Bledsoe (303) 861-4076

Colorado Municipal League
1144 Sherman Street
Denver, CO 80203
Contact: Carolynne White (303) 831-6411

The Office of Smart Growth wishes to acknowledge the assistance of Marilyn Gally of the Colorado Office of Emergency Management, Karen Berry of the Colorado Geological Survey, Mark Matulik of Colorado Water Conservation Board, Rich Homann of the Colorado State Forest Service, Lillie Fuller and interns Beth Held and Bill Cornelius.

This report may be downloaded from the Office of Smart Growth website at:
www.dola.state.co.us/smartgrowth

CONTENTS

INTRODUCTION	iv
FLOODPLAIN MITIGATION	1
GEOLOGIC HAZARDS MITIGATION.....	11
WILDFIRE MITIGATION	31
DROUGHT MITIGATION	39
ADDITIONAL RESOURCES	55

This page intentionally left blank

INTRODUCTION

One of the biggest challenges facing local elected officials and staff in Colorado is how to reconcile new growth and development in areas that are subject to a variety of natural hazard threats. During this last year, severe drought and wildfires in our state garnered national headlines. Continuing concerns over these and related issues have prompted many communities to reevaluate both the process and rationale for approving new development in areas where known hazards exist.

Many county and municipal officials recognize that good land use planning can mitigate the impacts from such hazards as wildfire, drought, floods, unstable slopes and expanding soils. The Office of Smart Growth has gathered together a wide number of planning approaches, practices, and resources and compiled them into a comprehensive report, *Best Practices in Natural Hazards Planning and Mitigation*.

It is important to note that in the context of this report, the terms “planning” and “mitigation” refer not only to various land use practices (e.g., zoning, regulatory programs, building code requirements, etc.) but also to emergency planning efforts that delineate what action will be taken and how and when resources will be deployed to prevent or respond to a natural disaster. Ideally, local government land use planning and emergency planning efforts work together seamlessly to protect the health, safety and welfare of citizens.

This new report is the latest in a series of Colorado Heritage Reports on best practices, developed as part of Governor Bill Owens’ *Smart Growth: Colorado’s Future* initiative. The companion volumes to this report are:

Best Practices in Intergovernmental Agreements
Best Practices in Land Use Planning and Growth Management
Best Practices in Preservation of Open Space, Ranches and Farms

The Office of Smart Growth (OSG) in the Department of Local Affairs compiled these reports based on input from several sources. The summaries are presented as submitted by local jurisdictions or as summarized by OSG staff.

OSG will update these reports periodically. Those wanting to submit additional information for inclusion in these reports are encouraged to contact OSG at (303) 866-2353.

We are hopeful that these reports will assist Colorado communities in their efforts to plan for future growth while ensuring the safety and welfare of their citizens.

“We are the stewards of Colorado’s future. For the sake of our children and grandchildren, we must preserve Colorado’s natural beauty and provide opportunities for future generations to pursue their own dreams. Our task is nothing less than to protect that special Colorado way of life.”

- Governor Bill Owens

This page intentionally left blank

FLOODPLAIN MITIGATION

JURISDICTION: State of Colorado
DATE: 1999
TOPIC: Flood Hazard Mitigation Plan For Colorado
CONTACT: Colorado Office of Emergency Management, (303) 273-1622, and Colorado Water Conservation Board, (303) 866- 3441

The State of Colorado, its political subdivisions, and citizens are confronted daily with the possibility of flooding and related hazards. Floods have the potential for inflicting tremendous damages with significant losses of life and property, as well as posing a threat to the health, safety and welfare of Colorado’s citizens.

Growth and population migration require a heightened awareness that the impact of flooding may likely increase over time. Mitigation begins with effective hazard assessments and comprehensive disaster preparedness by implementing strategies, part of an overall plan to effectively reduce losses from disasters.

This flood mitigation plan represents a commitment to minimize potential losses and damages by isolating the primary causes and recommending courses of action. The intent of the information, ideas and recommendations contained in this plan is to make a concerted effort to reduce or limit flooding impact on the people of Colorado.

This plan reflects the state’s priorities for flood hazards mitigation. These priorities were developed through a private/local/state/federal team process. The goals and objectives outlined in the plan and within the appendices support this effort. Accomplishments can only be realized by joint efforts, dedication and commitment to mitigation.

JURISDICTION: State of Colorado
DATE: 2002
TOPIC: Model Land Use Code – Floodplain Area Regulations
CONTACT: Colorado Department of Local Affairs, Office of Smart Growth, (303) 866-2353, www.dola.state.co.us/smartgrowth

The Model Land Use Code for Colorado’s Small Communities features the most cutting-edge land use policies from around the state. The code was based on an innovative land use code prepared for the Town of Frederick with funding from the Colorado Heritage Planning Grant Program. The resulting model code contains an expanded section on floodplain area regulations that includes a development permitting and review process, conditions for issuing variances, standards for flood hazard reduction and a list of definitions. To request a copy of the model code, please refer to the Office of Smart Growth website at www.dola.state.co.us/smartgrowth.

JURISDICTION: Adams County
DATE: 2002
TOPIC: Flood Control Overlay Zone District
CONTACT: Adams County Planning and Zoning, (303) 853-7000,
www.co.adams.co.us/services/department/planning_development/
Dev_Plan/Chapter%2003.pdf

As part of Adams County’s land use regulations, the county has adopted a flood control overlay zone district to establish reasonable limitations and controls of land uses within the 100-year floodplain. The overlay district applies to lands located within the 100-year floodplain of a watercourse, lands located in areas of special flood hazards, and lands located in areas of shallow flooding. Within the overlay district, a floodplain use permit is required for all structures, facilities, fills, developments, storage or processing of materials or equipment, or changes in watercourse channels. The overlay district also features general performance standards for elevation and anchoring of residential and non-residential structures and a section on non-conforming uses.

JURISDICTION: Town of Bennett
DATE: 1999
TOPIC: Conservation of Floodplain Corridors
CONTACT: Town of Bennett Planning Department, (303) 644-4224

Due to the proximity to regional highways and availability of services, the Town of Bennett has experienced heightened pressure for residential development. Currently, the town is at a development stage where distinctions can be made among geographic areas within a three-mile area of interest. Four development tiers have been designated, one of which is entitled “Tier Four: Environmental Areas.” Tier Four comprises those areas within the planning area that have environmental significance to Bennett and the surrounding area. North Kiowa Bijou Creek, Lost Creek, Box Elder Creek and their tributaries form the natural corridors that cross through the Bennett area. The floodplains defined by these streams have been used to delineate Tier Four. Given the land resources available to Bennett for future urban population growth, Tier Four lands are left undeveloped in order to continue accommodating flood occurrences, provide for ground water recharge, and to serve as wildlife habitat.

JURISDICTION: Eagle County
DATE: 2002
TOPIC: Areas of State Interest (“1041” Designation) – Floodplain Hazard
CONTACT: Justin Hildreth, Eagle County Engineering Department, (970) 328-3560, www.eagle-county.com/comm_dev/ChapterVIAreasandActivitieso%20Stat%20Interest.htm

Utilizing “1041 powers,” the county developed a regulatory permitting scheme to facilitate the administration of floodplain hazard areas. These 1041 regulations set forth the process for designating floodplain hazard areas, adoption of official flood maps, establishment of floodplain hazard districts with distinctive development regulations for each, a streamlined permitting process for certain kinds of development, and a process for granting variances.

JURISDICTION: City of Fort Collins
DATE: 1999
TOPIC: Spring Creek Improvements
CONTACT: Marsha Hilmes, Floodplain Administrator, City of Fort Collins (970) 416-2861, www.ci.fort-collins.co.us/oem/

Since 1989, over \$5 million has been spent on improvements to Spring Creek. These projects included acquisition and relocation of structures; channelization to remove pre-FIRM (Flood Insurance Rate Map) properties from the floodplain; storm drainage improvements, reinforcement of the Burlington-Northern Railroad embankment, and bridge improvements. Approximately 86 structures were removed from the 100-year floodplain including approximately 41 that were acquired by the city.

Actions:

- Acquired Structures
 - 30 mobile homes in the area that is now Creekside Park (adjacent to the devastated Johnson Mobile Home Park). These structures were in a very high hazard portion of the Spring Creek floodplain.
 - Nine residential homes.
 - One retirement home that could have housed more than 15 people.
 - One business, located along College Avenue in the area that is now Creekside Park.
- Community Programs:
 - Residents in or near the floodplain receive floodplain brochures in the mail each year. These brochures discuss the local flood hazard, safety, property protection and flood insurance.
 - In the spring of each year, city council proclaims a “Flood Awareness Week.” Activities include newspaper articles and booths at city hall and the public library that feature informational brochures.
 - FEMA’s “Best Build” video and a local floodplain video are telecast on the local cable access channel annually in conjunction with “Flood Awareness Week.”
- Open Space:
 - Of the approximately 2,823 acres of floodplain in the City of Fort Collins, approximately 958 acres are preserved as open space. More open space is continually being acquired.
 - On Spring Creek, there are 313 acres of floodplain and 97 acres of open space. This includes several parks and a bike trail along the entire length of the creek.
- Designate creek as a “Class 6” on Community Rating System.
- Administer floodplain regulations for all floodplains within the city, including those not studied in detail by FEMA, to standards exceeding those of the National Flood Insurance Program (NFIP) minimum requirements.

JURISDICTION: City of Grand Junction and Mesa County
DATE: 2002
TOPIC: Proposed Redlands Area Plan - Floodplains
CONTACT: City of Grand Junction (970) 244-1450
<http://www.co.mesa.co.us/longrangeplan/redlands/Redlands%20draft%20plan%204-25-02.pdf>

The Redlands Planning Area is located along the Colorado River, just southwest of Grand Junction and directly adjacent to the Colorado National Monument. Residents of the Redlands must follow the City of Grand Junction and Mesa County Floodplain Regulations in order to be eligible for federal floodplain insurance. The primary goals of the floodplain regulations are:

- To help minimize property damage to Mesa County residents during flood events;
- To ensure that life, property, or new improvements will be safe during flooding events;
- To ensure that any structures or improvements in the floodplain will not cause additional drainage problems;
- To protect the natural resource values of floodplain areas;
- To guide development in the floodplain of any watercourse subject to flooding; and,
- To minimize the expense and inconvenience to property owners and the general public due to flooding.

The U.S. Fish and Wildlife Service designates the 100-year floodplains of the Gunnison and Colorado Rivers as critical wildlife habitat for several endangered fish species. The Mesa County Land Development Code and Grand Junction Zoning and Development Code require minimum setbacks from the Colorado and Gunnison Rivers. As new development occurs in unmapped floodplains, the developer is responsible for mapping and providing floodplain data to Mesa County. Development on five acres or more requires that construction runoff protection measures be used. A permit is required from the Water Quality Division of the Colorado Department of Public Health and Environment, and best management practices must be used to mitigate erosion on the development site for up to 15 years.

JURISDICTION: Town of Limon
DATE: 1999
TOPIC: Flood Mitigation Project
CONTACT: Town of Limon, Planning Department, (719) 775-2346,
<http://townoflimon.com/gov.htm> and Colorado Division of Wildlife,
(719) 775-2025

The Town of Limon needed to mitigate floodplain problems created by the long-bankrupt Rock Island Railroad. Past actions by the railroad enlarged the floodplain until it covered almost one third of the town. By town ordinance, development was prohibited within the floodplain as long as it existed, but neither the Town of Limon, Mid-States Port Authority nor Kyle Railways, Inc., had the resources needed to mitigate the problem. The project consisted of various phases: 1) channelization of the drainage way; 2) placement of concrete box culverts; 3) removal of silt from an existing highway structure; 4) removal and replacement of railroad tracks; and 5) creation of wetlands for the CDOT wetland banking program. An early and key component was the discovery that a fishing pond could serve as a portion of the required channelization. Not only did the project physically remove a large portion of town from the floodplain, but the resulting fishing pond has become a favorite destination of youth in the community.

Actions:

- Over 400 properties have been physically removed from the 100-year floodplain.
- Residents and businesses in the original floodplain will be saving the annual costs of flood insurance.
- Improved channel conveyance was achieved at the Colorado Highway 71 Bridge.

- The town will be allowed to develop open space initiatives in the area of the floodplain without costly and time-consuming restrictions.

JURISDICTION: City of Loveland
DATE: 1997
TOPIC: Big Thompson River Corridor Study
CONTACT: City of Loveland, (970) 962-2303,
www.ci.loveland.co.us/lrplanning/landplan.htm

In response to a request by the City of Loveland, a study was conducted of the Big Thompson River Corridor. The corridor was defined as a 15-mile area that extends from the mouth of the canyon on the west to the Larimer-Weld County line on the east. The Big Thompson River is a critical resource and an important asset for Loveland and adjacent portions of Larimer County. The corridor’s natural values should be maintained and enhanced while recognizing the rights of landowners. In order to define the corridor’s width, the 100-year floodplain, riparian habitat and the existing Open Lands Plan had to be considered. After these factors were mapped, an outer line, defining a preliminary corridor width was established. Of the 130 natural sites studied in the city’s open space plan, one-fifth are located along the Big Thompson River.

Currently, there are some restrictions regarding development within the floodplain, but it can occur so long as structures are elevated above the flood level. The Plan also recommends that the area within the 100-year floodplain remain in as undisturbed state as possible to protect wildlife habitat and to minimize flood damage. The Resource Protection Area is defined as “The area that includes the floodway and natural areas with an overall habitat rating of 6 and above, where no development shall occur.” The Big Thompson Buffer Area is defined as, “The land within the flood fringe (between the Resource Protection Area and the 100-year floodplain) plus all adjacent natural areas rated 5 and below for overall habitat quality.” According to the plan, “All new development within the buffer area should be located at least 50 feet beyond the Resource Protection Area. Any new development within the buffer area should include provisions for natural restoration and enhancement within the corridor.”

JURISDICTION: Mesa County
DATE: 2000
TOPIC: Floodplain Regulations
CONTACT: Mesa County Long Range Planning Division (970) 244-1650
<http://www.co.mesa.co.us/planning/2000%20Land%20Dev.%20Code.pdf>

Mesa County has established regulations to mitigate flood damage in unincorporated areas. By eliminating construction within the floodplain or dictating the types of structures that can be built within the floodplain, the county has taken steps to protect the health, safety and welfare of its citizens. The following is a summary of the some of the floodplain management regulations:

- Regulation of construction in the floodplain;
- Ensure that the structures currently within the floodplain are adequately protected;
- Protect the natural state of the watercourse to maintain historic flow capacity;
- Restrict hazardous uses;
- Minimize discharge into watercourses from waste disposal;
- Discourage citizens from purchasing land in the floodplain;

- Ensure that potential buyers are notified if prospective property is within the floodplain and may be subject to development limitations;
- Ensure that if property is purchased the new owners take full responsibility for their actions;
- Control filling of dredged material in waterway; and
- Prevent construction that causes major erosion to the watercourse.

These guidelines serve to protect the future tax base of the county and help control the damage in the event that a major flood event occurs.

JURISDICTION: Roaring Fork Valley Community
DATE: 1999
TOPIC: Roaring Fork and Fryingpan Rivers Multi-Objective Project Plan
CONTACT: Brian Hyde, Colorado Water Conservation Board, (303) 866-4803

In June and July of 1995, the Roaring Fork River Valley experienced snowmelt flooding following a heavy winter. Extensive problems with bank erosion and channel migration were experienced throughout the Roaring Fork Valley, leading to damage to property, infrastructure and river corridor habitat.

After flooding of the Roaring Fork River in 1995, landowners realized that levees and other hard controls had not successfully stabilized the river. In fact, these individual controls have often contributed to channel instability. The residents and governments of the valley recognized the need to live in harmony with the river and reach a greater understanding of the causes of instability and effective methods of stabilization. Although there are many issues to be addressed in river management, the core problem observed is channel instability, which leads to:

1. Threats to roadways, utilities, infrastructure and development in the geomorphic floodplain
2. Loss of property due to channel migration
3. Loss of fish habitat, due to the change from a pool-rapids sequence to predominately fast moving water in continuous rapids sections, and
4. Loss of wetlands and riparian zones due to high width-to-depth ratios and lateral bank migration.

In 1996 Colorado legislators introduced legislation funding a multi-objective study of the Roaring Fork River and the Fryingpan River to address the watershed's flood-related concerns. The study would include the investigation of: 1) problems related to recent flooding on the Roaring Fork and Fryingpan rivers, and 2) development of a multi-objective management plan to mitigate future flood losses and improve irrigation supply within the State of Colorado. However, other high priority river issues were identified, including: maintenance and protection of the floodplain, provision of public access to the river, protection of riparian and aquatic habitat, public access for fishing, boating and other recreation, irrigation diversions, effects of transbasin diversions, effects of Ruedi Reservoir operations, sediment loading and other effects from tributary streams and protection of existing infrastructure (such as roads, sewage treatment facilities and water delivery facilities.)

Guiding principles for the development of the Roaring Fork and Fryingpan Rivers Multi-Objective Project Plan:

- Encourage public involvement through the planning process and respond to concerns raised as a result of the flooding experienced during 1995 in the Roaring Fork and Fryingpan watershed.

- Devise strategies that provide protection of property from inherent river flood hazards. This includes identification of flood prone areas, tributary watersheds that experience instability or sediment loading problems, channel instability hazards, and selection of potential mitigation strategies.
- Enhance aquatic and wildlife habitat along riparian areas and promote recreational benefits to galvanize public support for channel improvement programs and encourage multiple use of the river resources.
- Provide public education to address flood hazards and river safety.
- Create a plan that is easy to use, that provides effective assistance in the selection of management options and that allows for updating and maintenance at the local level. (This includes development of both hard copy and computer-based Geographic Information Systems (GIS) reports.)
- Adopt a watershed-based approach whereby the resources of the river system are managed in a holistic manner.

The Multi-Objective Project was completed in June 1999. In late 1999 the Town of Basalt began addressing the Three-Mile reach of the Roaring Fork River within the corporate limits. At the same time, Basalt began a very detailed floodplain analysis and the Roaring Fork River Stewardship Master Plan. Under the guidance of the Volunteer Stewardship Roundtable, the town developed a detailed master plan for the reach of the river. The volunteers met 13 times over a year-and-a-half period. In March 2002, the master plan was completed. Work has already begun on implementation of some of the components for the plan. In addition, the revised floodplain study has been completed and submitted to the Federal Emergency Management Agency (FEMA) for updating of the Basalt Flood Insurance Study.

JURISDICTION: Teller County
DATE: 2002
TOPIC: Flood Hazard Areas
CONTACT: Teller County Community Development, (719) 687-5259
<http://www.co.teller.co.us/CSDS/CSDS.htm> and
<http://www.co.teller.co.us/CSDS/Planning/LandUseRegs/REG07-01-2002text.pdf>

The Flood Hazard Areas regulations apply to all areas of special flood hazards within the jurisdiction of the county. No structure will be constructed, located, extended, converted or altered without full compliance of the terms of the Flood Hazard Areas regulations and any other applicable regulations.

Purpose and intent of flood hazard area regulations:

- To minimize expenditure of public money for costly flood control projects;
- To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- To minimize prolonged business interruptions;
- To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in areas of special flood hazards;
- To help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future flood blight area;

- To ensure that potential buyers are notified that property is in area of special flood hazard; and
- To ensure that those who occupy the areas of special flood hazards assume responsibility for their actions.

Methods of Reducing Losses in Flood Hazard Areas:

- Restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities;
- Requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
- Controlling the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel flood waters;
- Controlling filling, grading, dredging, and other development which may increase flood damage; and
- Preventing or regulating the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards in other areas.

This page intentionally left blank

GEOLOGIC HAZARDS MITIGATION

NOTE: For purposes of this section, “Geologic Hazards” includes the following phenomena: avalanches, expansive or swelling soils, landslides, ground subsidence, dipping bedrock, earthquakes, steep or unstable slopes, and rockfalls.

JURISDICTION: State of Colorado
DATE: 1979
TOPIC: *Snow-Avalanche Hazard Analysis for Land-Use Planning and Engineering* (Bulletin 49)
CONTACT: Colorado Geological Survey, Avalanche Information Center, (970) 482-0421

Snow avalanches are a geologic hazard that land-use planners must consider when implementing comprehensive plans. Each winter in Colorado it is estimated that 20,000 avalanches fall. Most fall unobserved and cause no harm, but about 3-4 percent (600 or more) block highways, destroy timber, damage property, and injure or kill people. In an average winter, avalanches kill six people and injure another eight, cause \$100,000 in direct property damage, block highways 300-400 times, destroy untold acres of mature timber, and cause economic loss of \$5 million to \$10 million.

Avalanche paths consist of a starting zone, a track, and a run-out zone. In general the run-out zone is the critical area for land use decisions because of its otherwise attractive setting for development.

Lack of vegetation or a predominance of quick growing aspen and low shrubs often characterize active portions of an avalanche track and the run-out zone. Avalanches are extremely destructive due to the great impact forces of the rapidly moving snow and debris and the burial areas of the run-out zone. Structures not specifically designed to withstand the impacts are generally totally destroyed. Residences planned or erected in avalanche run-out zones may not qualify for financing or insurance. The cheapest and safest way to prevent property damage and save lives is to stay out of avalanche paths in winter. Methods of avalanche control include directional control of blowing and drifting snow by erecting snow fences to keep it away from the starting zone; planned release of small snowslides with explosives before the snow accumulation increases their destructive potential to unmanageable proportions; building snow sheds over particularly dangerous sections of railroads and highways.

Criteria for Recognition:

- The most reliable way of locating avalanche areas is to study long-term detailed records of past events when they are available. Usually, data on the location, frequency, or severity of avalanche activity are completely lacking when new areas are considered for highways, winter sports, mining operations, or mountain home sites.
- Active or recently active avalanche paths are most easily identified on air photos or from low-flying airplanes or helicopters. The next best viewpoint is the slope or ridge across the valley from the suspected avalanche areas.
- Field evidence apparent during summer conditions, are forested areas that appear as strips straight down the mountain, characterized by a different type or age of the dominant of vegetation. An accumulation of wood debris on lower slopes or in the valley may mark an avalanche run-out zone, as might a patch of aspen or young trees at the bottom of a likely avalanche path.
- Field evidence during winter conditions are usually confined to the starting zone and identified as a fracture line or fracture face where the unstable snow broke away as a slab

avalanche from the remaining snow cover. This is the most frequently observed and the most important, single, winter identification feature. The second most important winter identification feature is mounds of blocks of snow, which are major concentrations that usually mark the lower end of the avalanche. Lesser amounts may be scattered higher on the path, at breaks in the slopes, or curved in the track.

Mitigation Procedures:

- The safest and probably the most economic mitigation procedure is to avoid building or any type of development involving winter use in avalanche-prone areas. This implies that all avalanche prone areas can be identified and the avoidance is possible. Non-conflicting land uses of avalanche-prone areas include all uses that will not cause loss of life, property, or excessive maintenance. Agriculture and recreational activities that take place during non-avalanche months are desirable non-conflicting uses. Other uses that could be considered are those that involve no permanent unprotected structures in the avalanche path or those that could be moved or closed down during high avalanche-risk periods.
- The two basic methods of avalanche control are: 1) explosive and 2) structural. The theory of the explosive technique is to cause many smaller, controlled avalanches and thus avoid large unpredictable destructive avalanches. The principle methods of charge emplacement are: a) hand delivery, in which charges are placed on or in the snow-pack for immediate firing, and b) projectile delivery, in which charges are fired into the snow-pack by guns.

Structures for the Control of Snow Avalanches fall into four categories:

- Supporting structures in the starting zone are built in the upper part of the avalanche path to prevent avalanches from starting, or to retard snow movement before it gains momentum. Modern structures may be either rigid or flexible. The rigid ones are made of wood, steel, aluminum or pre-stressed concrete. Flexible supporting structures called “snow nets” are constructed of steel cables or nylon straps and are held up by steel poles. Deflecting and retarding structures in the run-out zone are massive structures usually made of earth, rock, or concrete located in or near the avalanche track.
- Structures to confine or deflect moving snow should deflect the avalanche as little as possible from the direction of natural flow. Walls built at sharper angles to the flowing snow will often be overrun by fast-moving masses of dry snow.
- Retarding structures are usually earth mounds or large concrete structures called breakers or tripods. They should be built on benches or less steep parts of the path where avalanches slow or stop naturally. The additional roughness and cross currents set up by these structures usually stop all but large, dry snow avalanches.

Direct protection structures are built immediately adjacent to the object to be protected, or in a few cases, incorporated in the design of the object itself. Avalanche sheds are roofs constructed over a road or railroad that allows avalanches to cross the road without interrupting or threatening traffic.

JURISDICTION: State of Colorado
DATE: 1998
TOPIC: *Geologic Hazards Avoidance or Mitigation - a Comprehensive Guide to State Statutes, Land Use Issues, and Professional Practices in Colorado (Information Series 47)*
CONTACT: Karen Berry, Colorado Geological Survey, (303) 894-2080

The 1990s have brought about an era of renewed interest in land use planning and development issues that in many ways mirrors events that occurred in Colorado during the 1960s and 1970s. The efforts made during previous decades resulted in many statutes that address growth and development and remain in effect today. However, there are many differences between the original intent of the citizens and legislature and what has actually occurred regarding one of the most important areas of land-use regulation: the avoidance or mitigation of geologic hazards in the land development process.

The purpose of this reference guide is to provide history, information, and perspectives relative to the foundation that has already been established. It is intended to inspire new thought regarding old topics, and to raise more questions than it answers. The reader is urged to use the information presented here to better understand the practical implications of existing regulations within their area of expertise, identify areas that need improvement, and formulate workable solutions to unsolved problems.

In light of the increased development in Colorado and the critical nature of situations where geologic hazard problems do occur, local government entities and practicing professionals need to ensure the early assessment of geologic hazard risks. Potential problems need to be identified and addressed at an early stage in the development process before damages, economic losses, and environmental losses have occurred. Reduction of risks can be accomplished through: 1) regulatory or other efforts that require qualified professional analysis and technical review, 2) preventive actions to address the problem before it arises, 3) mitigative actions, 4) avoidance of the hazard area from development activity if not mitigatable, and 5) follow through by local regulatory authorities to assure the risks have been appropriately addressed.

JURISDICTION: State of Colorado
DATE: 1988
TOPIC: Colorado Landslide Hazard Mitigation Plan
CONTACT: Colorado Geological Survey, (303) 866-2611 and Colorado Office of Emergency Management, (303) 273-1622

The Landslide Hazard Mitigation Plan was crafted in response to several years of disastrous flooding and landslide events. Events of 1984 were so severe along the western slope that a Presidential Disaster Declaration was obtained. The State of Colorado requested and received another declaration in 1999 for severe flooding, mudslides, and landslides.

The Landslide Plan identifies landslide hazards in Colorado, as well as related and secondary impacts. It describes types of landslides and factors that may trigger slides. The plan assesses vulnerability and potential impacts and evaluates mitigation approaches, including:

- modifying community vulnerability;
- modifying the physical system; and

- modifying the consequences of landslides.

The plan also addresses the role of local governments and local emergency management and mitigation efforts directed at landslides.

JURISDICTION: State of Colorado
DATE: 2001
TOPIC: Colorado Earthquake Project
CONTACT: Marilyn Gally, Office of Emergency Management, (303) 273-1622

Geologic studies indicate there are several active faults in Colorado and more than 400 earthquake tremors of magnitude 2.5 or higher have occurred in Colorado since 1870. The Colorado Earthquake Project (CEP) was designed to help reduce loss of life and decrease the economic losses resulting from Colorado earthquakes and the secondary hazards (e.g., landslides, dam failures) associated with earthquakes.

Authorization and funding for the program was a joint effort between the Federal Emergency Management Agency and the Colorado Office of Emergency Management. The CEP focused on education, mitigation and resource assistance to communities.

JURISDICTION: State of Colorado
DATE: 1999
TOPIC: *Colorado Earthquake Information, 1867-1996 (Bulletin 52) & Preliminary Quaternary Fault and Fold Map and Database of Colorado (Open File Report 98-8)*
CONTACT: Vince Mathews, Colorado Geological Survey, (303) 866-2611

Over the past 120 years Colorado has experienced hundreds of earthquakes. Most of the earthquakes were quite small, but several have exceeded Richter magnitude 5 and caused severe ground shaking. A plot of known earthquakes has the same general distribution as the potentially active faults. This suggests that Colorado is a moderately active earthquake area and in time larger earthquakes than have yet been experienced can occur. Several lines of geologic evidence suggest that the seismicity of several parts of Colorado may be considerably higher than indicated by the scanty historical record. Other indications that the state has a significant level of seismicity are derived from the “manmade earthquakes” triggered by fluid injections at three locations in Colorado.

Mitigation Procedures:

When the locations of active faults of an area are well known and surface rupture and displacement are known to accompany earthquakes, building near faults should be avoided completely except in cases where there is no alternative, such as for certain transportation and utility corridors. Mitigation of earthquake damage for Colorado must deal primarily with the broader effects of ground shaking on actual structures and on preventing associated effects such as landslides. Another special category consists of development activities and structures that have the potential for severe offsite impacts. Included in this category are nuclear facilities, large tailings impoundments, large reservoirs, hazardous waste storage and handling facilities and any other activity where a malfunction due to an earthquake could cause serious adverse effects to adjacent lands.

The identification of potentially active faults involves detailed geologic site investigations. If active faults are identified, complete avoidance of manmade structures is generally recommended for areas astride the known active faults. Non-conflicting uses such as open space or agriculture are recommended for areas described above and might be considered for other areas known to be highly susceptible to seismic-related ground failure. Engineered design and earthquake-resistant construction are the commonly accepted solution to increased safety in development of seismic areas. General studies of ground response should be conducted in areas of high seismicity to determine expectable local intensity of shaking and probable predominant frequencies. Both of which are necessary input for design of earthquake-resistant construction, which is intended to resist or at least to fail safely, under the greatest expectable earthquake that the structure will experience.

JURISDICTION: Boulder County
DATE: 1995
TOPIC: Natural Hazards Element
CONTACT: Boulder County Land Use Department, Graham Billingsley, (303) 441-3930 http://www.co.boulder.co.us/lu/bccp/nat_haz.htm

A natural hazard is any threat to human beings or their property by a process that is part of the natural environment. This natural hazards element of the comprehensive plan is directed at those hazards that are common to Boulder County. Most of the hazards discussed are normal processes, which only become a problem when humans get in their way or human activities upset their equilibrium and trigger or accelerate them to a hazardous level. Those capable of taking lives and/or inflicting property damage include wildfires, floods, tornadoes, earthquakes, severe storms, avalanches, and landslides. Those with more limited destructive potential include subsidence, rockfalls, high groundwater tables, unstable slopes, high winds, radioactivity, and problem soils. Although not a significant threat to human life, swelling soils cause more property damage annually than do hurricanes, tornadoes, landslides and earthquakes combined.

In view of the geologic diversity of Boulder County as described in the Geology Element and the multiplicity of existing and foreseeable land uses, it is intended that the land use policies presented here shall provide clear direction in the formulation and implementation of the county Land Use decisions so far as geological factors are concerned. The Natural Hazards Element is directly related to plan elements dealing with land use, environmental quality, and resource management. Its relationship to the Land Use Code and county building codes is critical; these codes should include measures to reduce the effects of natural hazards. The total economic, environmental and social costs associated with natural hazards should be reduced by 1) avoiding potential hazard situations/areas; 2) applying environmentally appropriate mitigation in areas that cannot be avoided; and 3) prevention measures combined with education and incentives for mitigation.

With tens of thousands of people moving to Colorado each year, building in areas that are prone to natural hazards has become a growing concern. Recent disaster events have focused increased attention at both local and state government levels on the need to mitigate such events. The purpose of the Natural Hazards Element of the county comprehensive plan is to avoid or reduce risk to an acceptable level, balancing the cost of incorporating safety measures in planning and development actions with the benefit of protecting life and property. Minimizing risk is an essential focus of public safety planning. Every land use or public facility action taken by local government should be based on a recognition that some risk exists. When the level of risk is unacceptable, government action may be necessary to protect citizens and property. Policies and implementation measures

established in this element of the comprehensive plan are directed at 1) avoiding the placement of people and structures where these natural events occur and 2) mitigating existing areas at risk; thereby minimizing the future loss of life, property and resource damage in the county resulting from natural disasters and hazards.

Specific requirements:

- Development activities should be designed to minimize alteration of the natural landform to the greatest extent possible, thus reducing slope instability and drainage problems.
- Areas (including any structures) around a proposed project should be protected from the potential adverse impacts caused by the project. These adverse impacts include, but are not limited to: a) disturbance of existing vegetation, which can lead to accelerated erosion and sedimentation; b) aggravation or acceleration of existing potential hazards (e.g., rockfall, flooding, and sediment accumulation).
- The county shall require the evaluation of all geologic hazards and constraints where such hazards or constraints may exist in unincorporated areas of the county as related to new intensive uses. Such evaluations shall be conducted by either a member of the American Institute of Professional Geologists, a member of the Association of Engineering Geologists, an individual registered as a geologist by a state, or a “professional geologist” as defined in C.R.S. 34-1-201(3).

JURISDICTION: Boulder County
DATE: 1995
TOPIC: Geological Hazards - Landslides
CONTACT: Boulder County, (303) 441-3930

Development activities should be designed to minimize alteration of the natural landform to the greatest extent possible, thus reducing slope instability and drainage problems.

Areas (including any structures) around a proposed project should be protected from the potential adverse impacts caused by the project. These adverse impacts include, but are not limited to: a) disturbance of existing vegetation, which can lead to accelerated erosion and sedimentation; b) aggravation or acceleration of existing potential hazards (e.g., rockfall, flooding, sediment accumulation).

The county shall require the evaluation of all geologic hazards and constraints where such hazards or constraints may exist in unincorporated areas of the county as related to new intensive uses. Such evaluations shall be conducted by either an engineering geologist, an individual registered as a geologist by the state, or a “professional geologist” as defined in C.R.S. 34-1-201(3).

JURISDICTION: Clear Creek School District RE-1
DATE: 2000
TOPIC: School Building Siting - Earthquake Fault Line
CONTACT: Richard Huwa, Clear Creek School District RE-1, (303) 567-4467

In 2000, the school district began a site investigation for the construction of a new high school. The

site is located near Beaver Brook Canyon Road and I-70 in Clear Creek County. A preliminary site investigation revealed that the proposed building site for the high school may be located on the Floyd Hill fault. The fault is not considered to be active, however, slight movements that can damage structures can still occur along inactive faults and it is not wise to locate structures on faults.

In response, the school district moved the building location away from the mapped location of the fault. The district also hired a geological engineer to trench the site in an effort to find the exact location of the fault trace as well as determine if there has been any recent movement along the fault. The district also incorporated some earthquake-resistant structural modifications in the design of the school in order to protect against some limited movement along the fault.

JURISDICTION: Costilla County
DATE: 1999
TOPIC: Environmental Constraints – Steep Slopes
CONTACT: Costilla County Planning Department, (719) 672-9109, www.costilla-county.com

As Costilla County has seen increased development in two major eco-regions, the Southern Rockies and the Arizona-New Mexico Plateau, steep slope development has moved to the forefront of environmental constraints. As slope increases, land becomes less suitable for development. Steep slopes generally have the following increased risks: wildfire; unstable soils; problems with road designs, construction, and maintenance; and difficulty with access by fire protection equipment. Slopes in excess of eight percent are the principal base constraint within Costilla County.

Slope analysis classifies slopes into four categories:

1. Slopes between 0% and 8%. Most road design standards and building codes allow construction within this range.
2. Slopes between 9% and 15%. Some mitigation may be necessary, with possible structural reinforcement along with undesired cut and fill activity.
3. Slopes between 16% and 33%. Significant mitigation is necessary, with need to evaluate proposed construction on a case-by-case basis. Development should be avoided where possible, using clustering or other techniques to avoid the steepest portions of the site.
4. Slopes greater than 33%. Mitigation not recommended, due to potential risk of hazards.
 - Development shall be avoided in areas with slopes over 33 percent. If development in these areas is unavoidable, measures should be taken to minimize excessive cut and fills in the design of roads and building site layout.
 - Development shall be avoided in areas with a history of slope failure complex, unstable slopes, or in areas prone to landslide and debris fans.
 - Unless required for construction, vegetation shall not be removed in areas that may contribute to a landslide, mudflow or debris flow. Areas of vegetation removed for construction shall be reclaimed with new vegetation.

JURISDICTION: Douglas County
DATE: 2001
TOPIC: Environmental Constraints and Hazards – Heaving Bedrock
CONTACT: Douglas County Planning Department, (303) 660-7460

Heaving bedrock is a distinctive geological hazard that encompasses highly expansive soils that expand when wet and shrink when dry, creating potential severe problems for building foundations. It is more complex and poses greater risks to roads, utilities, and structures than generalized expansive soils. Heaving bedrock is responsible for substantial damage along the Front Range. In Douglas County, homeowners have incurred several million dollars in damage since suburban development began in the mid-1980s.

A large area of mostly undeveloped land in Douglas County is underlain by potentially heaving bedrock and is derived from Colorado Geological Survey Special Publication 42. This map is based upon the coincidence of steeply dipping (tilted or upturned) layers of sedimentary expansive bedrock having dip angles of greater than 30 degrees from horizontal. Damage to roads, utilities, and lightly loaded residential and commercial structures has occurred where steeply dipping bedrock is encountered at shallow depth, thus deforming the adjacent improvements. These improvements have been constructed in or on the bedrock. Individual heave features may attain sizes as large as two feet high, tens of feet wide, and hundreds of feet long.

In some cases, mitigation measures have been used to allow development within steeply dipping bedrock. One example is the practice of over-excavation. In this case, soil underlying the base floor elevation (such as the ten feet below the basement floor) is ground up with inert soil and laid back down in a uniform manner. This breaks up the offending bands of bedrock. This technique appears to be successful, although it has only been used in the last ten years and long-term monitoring is necessary. All shrink-swell soils can become a problem when structures are built upon them and owners irrigate landscaping, causing soils to swell, thus cracking foundations.

In another example, soil erosion creates problems for the construction of roads, utilities and structures. Gullies created by eroding soils can undercut unstable slopes, causing slope failures, and the accompanying soil deposition can clog streams and reservoirs. Measures to mitigate potential problem situations must be addressed early in the development process. Although all geological constraints may be considered open to mitigation, costs and practicality may be prohibitive. Only new land use activities that do not aggravate hazardous geological conditions will be considered in severe hazard areas: agriculture, grazing, recreation, parks, and open space are good examples.

JURISDICTION: Douglas County
DATE: 2001
TOPIC: Environmental Constraints and Hazards
CONTACT: Douglas County Community Development Department, (303) 660-7460, www.douglas.co.us/Departments.htm

Environmental conditions that affect or reduce the capability of the land to accommodate growth are termed environmental constraints. Constraints occur in varying degrees. Constraints posing a significant threat to life and property are termed environmental hazards. Constraints, which are not hazards, can still cause damage to structures and infrastructure. State law [C.R.S. 24-65.1-101], as amended, directs state agencies to identify environmental conditions affecting development and enables local governments to adopt regulations for affected areas. Much of the county's land area exhibits at least one identified environmental constraint. Some of Douglas County's most noticeable natural features, such as riparian zones, buttes, mesas, and the foothills, contain significant environmental hazards, including flood hazards, rockfalls, slope failure, and subsidence areas.

At the same time, these areas also exhibit spectacular scenic beauty, prime wildlife habitats, and constitute a major public asset. Environmental hazard areas are encouraged to maintain non-urban land uses. Uses such as agriculture or grazing, open space, parks, or certain nonpolluting recreational uses are encouraged, unless unusual circumstances exist. Limiting development in hazard areas creates dual benefits: residents are spared the expense of hazard mitigation and repairs, and as some of the most scenic land in the County contains significant environmental hazards, these areas can be preserved as open space and may be used as buffers between various land uses and/or new communities. The Douglas County Community Development Department mapped the environmental constraints and hazards with assistance from the Colorado Geological Survey (geophysical), Colorado State Forest Service (wildfire), and Federal Emergency Management Agency (floods). In order to present a composite picture of the constraints, a classification system was created based on ability to accommodate various intensities of uses or the degree to which they can be mitigated.

- **Class 1** areas are of low to moderate constraints that require an awareness of the condition and may require engineering to minimize the impact on development. Only a small portion of the County contains Class 1 constraints, including:
 - Low-erosion-susceptibility areas;
 - Low to moderate shrink/swell soils; and
 - All minimal and moderate-severity wildfire areas.

- **Class 2** areas are of moderate to high threat to public safety. Special studies are necessary in these areas to determine the extent of constraint and necessary mitigation, including, in some cases, elaborate and expensive engineering. The constraints are as follows:
 - Unstable or potentially unstable slopes;
 - Moderately accelerated erosion area;
 - Moderate to high erosion-susceptibility area;
 - High and very high shrink/swell potential soils; and
 - Severe wildfire areas.

- **Class 3** areas are of very high to extreme threat to public safety where potential loss of property and life is significant enough to warrant preservation of their natural states. These constraints are classified as *hazards*. Severe hazards may exist even after corrective engineering measures are taken. Nearly one-quarter of the County outside the Pike National Forest contains Class 3 Constraints including:
 - Rockfall-rockslide/debris avalanche areas;
 - Slope failure areas;
 - Subsidence areas;
 - Floodplains; and
 - Debris-flow areas.

The Environmental Hazards Map illustrates the extent of the Class 3 Environmental Constraint (hazard) areas. More detailed maps illustrating the locations of all environmental constraints are available at the Douglas County Community Development office.

Development should not take place until a detailed evaluation of adverse geological conditions within the area have been made. The evaluation must show that the conditions will not result in a significant threat, or show that engineering and design can mitigate the adverse conditions so that no serious threat remains.

JURISDICTION: El Paso County
DATE: 2000
TOPIC: El Paso County Natural Hazards Clearinghouse
CONTACT: Kelly Sparks, University of Colorado at Colorado Springs, (719) 262-4025, <http://web.uccs.edu/geogenvs/Hazards/>

The Department of Geography and Environmental Studies at the University of Colorado at Colorado Springs has developed an interactive web-based GIS map of natural hazards in the county. The map shows a variety of hazards, including expansive soils, landslides, unstable slopes, and areas with mine subsidence risk. The website also features information on a variety of natural hazards and links to related information. The project was partially funded by El Paso County and the City of Colorado Springs.

JURISDICTION: Gunnison County
DATE: 2001
TOPIC: Resource Protection Standards
CONTACT: Gunnison County Planning Department, (970) 641-0360, www.co.gunnison.co.us/Planning/regs.html

The Resource Protection Standards division establishes standards to protect areas subject to geologic hazards, natural resources, wildlife habitat, and the agricultural lands of Gunnison County, and to ensure that proposed land use changes avoid or mitigate the hazards from natural areas that could pose threats to person and to property. It is designed to achieve the maximum protection of areas that are environmentally sensitive or that provide sensitive wildlife habitat, whether because of the nature, quality or location of certain natural features.

It is also designed to preserve the natural landscape and unique and visually significant landforms (including mountain peaks, ridgelines, hillsides, buttes, and foreground areas including irrigated meadows), and to protect significant or unusual areas of water-land interface (scenic or sensitive stretches of shore, river, and streams, natural springs, wetlands, or other riparian areas), and aquifer recharge areas. The protection of these areas may be achieved by avoiding development in these areas whenever possible, minimizing unavoidable adverse development, and mitigating the impacts of development to the maximum extent feasible.

JURISDICTION: Jefferson County
DATE: 2001
TOPIC: Geologic Hazard Overlay Zone District
CONTACT: Pat O'Connell, Jefferson County, (303) 271-8700, http://ww2.co.jefferson.co.us/ext/dpt/public_works/planning/zoning/sec44.htm and Karen Berry, Colorado Geological Survey, (303) 894-2080

In Colorado, development in landslide hazard areas is occurring at a greater rate than in previous years. Local governments in Colorado are trying to balance growing development pressures with community interests, such as decreasing property values and public safety.

Following destructive landslides in the Green Mountain region, Jefferson County passed new regulations concerning geologically hazardous areas and improved its building permit and

construction inspection process.

The Geologic Hazard Overlay Zone District includes that portion of any other zone district, including Planned Development Zone Districts, located in a geologic hazard area. The regulations of this District shall be construed as being supplementary to the regulations imposed on the same lands by any underlying zone district or other overlay district. When the regulations of this District conflict with any provision of the underlying zone district, the provisions of the Geologic Hazard Overlay District shall control; otherwise, the provisions of any underlying district shall remain in full force and effect.

Restrictions

Unless authorized under the provisions of the "Permitted Uses and Activities" or "Provisional Uses" portions of this Section, the following activities or uses are prohibited within the Geologic Hazard Overlay Zone District:

- a. Permanent or temporary structures and buildings, including mobile homes and trailers but not including signs, fences, corrals or other open facilities for the containment of livestock.
- b. Physical improvements or modifications, such as roads, bridges, bikeways, excavation or fills, solid or liquid waste disposal, utilities, or underground bulk storage of fuels.
- c. Other land use activities that significantly increase the danger from the geologic hazard.
- d. Restrictions a. through c. shall not apply to legal mining operations or accessory activities.

Provisional Uses

1. The Jefferson County Department of Highways and Transportation and the County Geologist may authorize, in writing, certain uses that are permitted in the underlying zone district, and specified below, providing that plans and design criteria have been approved by both the County Department of Highways and Transportation and the County Geologist as having reasonably mitigated the potential danger to persons and property of the geologic hazard, and that necessary permits are obtained from the County Departments of Highways and Transportation, Planning and/or Building prior to starting any earthwork, construction or installation.

Uses that may be permitted:

- Roads, bridges, bikeways and similar improvements.
- Excavations or fills.
- Utilities, above or below ground.
- Energy collection devices, such as windmills or solar collectors.
- Structures exclusively for livestock.
- Structures exclusively for bulk storage, such as silos.
- Park or recreational uses without occupied structures or buildings.
- Accessory out buildings and garages.
- Underground bulk storage of fuels.

2. Under certain conditions, the Board of Adjustment may permit by Special Exception those uses allowed in underlying zone districts, but prohibited by the provisions.

JURISDICTION: Jefferson County
DATE: 2002
TOPIC: Geologic Hazards - General
CONTACT: Jefferson County Planning and Zoning, (303) 271-8700,
http://206.247.49.21/ext/dpt/public_works/planning/index.htm

The Jefferson County Land Development Regulations took into consideration the effects of building in natural hazards areas. The following is a list of standards and regulations to guide development in or near these areas:

- Buildable areas within lots and, if applicable, within tracts will be reasonably free from geologic hazards or protected from geologic hazards.
- Streets/roads drainage improvements and trails will be constructed away from geologic hazards or protected from geologic hazard.
- Development of subdivisions will not interfere with the extraction of any known commercial mineral deposit.
- A Geologic Map will be included to show: natural and proposed final topography; bedrock geology; sites of special geologic interest; geologic hazard overlay zone; sufficial geologic conditions; groundwater hydrology conditions; mineral resources conditions; formation boundaries; isopach map with thickness and distribution of sufficial materials; and contour map.
- Geologic Report will include the following: bedrock geology; rock types present, including formation names and ages, if possible; bedrock characteristics; degree of weathering; erodibility; aquifer characteristics; shrink-swell potential; radioactivity; slope stability - including mudflows, rockfall, creep, subsidence, settlement and slumping; strike and dip of bedding planes; ease of excavation; well and septic system suitability; and bedrock surface topography.
- Geologic Mitigation Recommendations: will assure that geologic factors affecting the planning, design, construction, operation, and maintenance of engineered structures are recognized, adequately interpreted, and presented for use in engineering practice, and will include, if applicable, but not limited to the following:
 - The geologic processes, constraints, and hazards, which will or could affect proposed structures or the intended uses of the site. Recommendations for additional site exploration, testing, development, which are necessary to assure adequate performance of mitigation methods.
 - Methods to mitigate adverse geologic conditions on proposed structures.
 - Mineral resource recovery, if applicable, in accordance with the Jefferson County Mineral Extraction Policy Plan.
 - The entity/entities that will implement the mitigation recommendations, construct required improvements, and be responsible for the maintenance of the improvements and appropriate easements, if any.

JURISDICTION: Jefferson County
DATE: 1993
TOPIC: Dipping Bedrock Overlay District
CONTACT: Pat O'Connell, Jefferson County, (303) 271-8700,
http://ww2.co.jefferson.co.us/ext/dpt/public_works/planning/zoning/s ec46.htm

The Jefferson County Dipping Bedrock Regulations were developed through a comprehensive cooperative effort between developers, planners, engineers, geologists, homebuilders, home warranty companies and local and state officials. The regulations establish minimum standards for development in dipping (expansive) bedrock. The regulation also establishes minimum standards for geologic and geotechnical reports in the county land development regulations. Standards for the construction of water and sewer lines, roads and building foundations within the Dipping Bedrock Overlay District are also contained in the county's land development regulation and building code.

The county also established a technical review board that reviews any waiver requests to the county's dipping bedrock standards. The Engineering Advisory Board (EAB) is composed of technical experts in geology, geotechnical, civil and structural engineering. The EAB advises the planning commission and Board of County Commissioners on technical issues related to development in the Dipping Bedrock Overlay District.

Restrictions

1. All rezoning applications submitted after the adoption of this Resolution, which propose structures not exempted in the "Permitted Uses and Activities" portion of this Section, and which fall within the Designated Dipping Bedrock Area shall be subject to the following:
 - a. Detailed grading plans shall be submitted which show overburden soil or fill at least ten (10) feet thick beneath the anticipated level of the bottom of the structure foundation(s) and the top of bedrock. For purposes of this Section, the bottom of the structure foundation is defined as the bottom of footing/pad or bottom of grade beam, whichever is applicable. If deep (pier) foundations are proposed, the Zoning Administrator may require review of such plans by the Engineering Advisory Board; or
 - b. If ten (10) feet of overburden or fill are not proposed, detailed engineering plans shall be submitted to the Engineering Advisory Board. The alternate mitigation plans shall contain the information necessary to determine that potential hazards can be adequately mitigated by other methods. The recommendations of the Engineering Advisory Board shall be forwarded to the Planning Commission and/or Board of County Commissioners before any decision on rezoning by each body.
2. The rezoning application shall include geologic and soils/geotechnical reports prepared according to Part III, Sections 10 and 11 of the "Jefferson County Land Development Regulation."

Engineering Advisory Board

The recommendations of the Engineering Advisory Board shall not be binding on the Planning

Commission, Board Of County Commissioners, Chief Building Official or the Board of Review. Each official or board may impose any conditions it deems necessary to mitigate the hazard caused by dipping bedrock. The Planning Commission and the Board of County Commissioners may also decide that the recommendations of the Engineering Advisory Board do not conform to, or are not compatible with other land use plans, policies and considerations.

JURISDICTION: Town of Mt. Crested Butte
DATE: 1997
TOPIC: Avalanche Zone Overlay District
CONTACT: Steve Westbay, Town of Mt. Crested Butte, (970) 349-6632

The Avalanche Zone District is based upon a detailed avalanche study done for Mt. Crested Butte in 1989. The study is titled “Avalanche Hazard and Mapping Analysis, Town of Mt. Crested Butte, Colorado by Arthur I. Mears, P.E. The Avalanche Zone District consists of three zones: R1 Red Zone (high hazard), B Blue Zone (moderate hazard) and R2 Red Zone (snowslide areas).

The Avalanche Zone District is an overlay zone district where additional requirements apply to the uses and structures permitted in the underlying zone district. No construction is allowed within the R1 Red Zone unless the applicant can demonstrate, through detailed engineering reports, that the avalanche hazard can be mitigated without increasing the danger to adjacent property. A public hearing before the town council is required to obtain a conditional use permit for construction in a R1 Red Zone (high hazard).

Construction is allowed in other avalanche designation zones, if the applicant can demonstrate that the proposed structure is designed to withstand avalanche forces. In the B Blue and R2 Red Zones, the avalanche mitigation plans are approved by the zoning administrator.

Real estate professionals are required to disclose to potential purchasers that a property or structure is located within a R1 Red Zone. Prior to sale, real estate professionals must obtain a written acknowledgment from the buyer that the buyer is aware the property is located in a R1 Red Zone. In addition, anyone who leases or rents property located in a R1 Red Zone must notify tenants or lessees of potential avalanche hazards before a lease is signed or at the time of check-in.

JURISDICTION: Ouray County
DATE: 2001
TOPIC: Land Use Code - Hazard Areas
CONTACT: Ouray County Land Use office, (970) 626-9775, www.co.ouray.co.us/

The purpose and intent of the Ouray County Geological Hazard Areas Regulations is to minimize significant hazards to public health and safety or to property in a designated geological hazard area, to promote safe use in geologic hazard areas, and to reduce the impact of geologic hazards on life and property. Geologic hazard areas are: avalanche, landslides, rockfall, mudflow, unstable slope, and ground subsidence. Ouray County will regulate land uses in geologic hazard areas by:

- Prohibiting certain land uses which are dangerous to life or property;
- Restricting the land use which would be hazardous to the public health and safety or property;
- Restricting the land uses which are particularly vulnerable to geologic hazards so as to alleviate hardship and reduce the demands for public expenditures for relief and protection;

and

- Requiring land uses permitted in geologic hazard areas, including public facilities, which serve such uses, to be protected from geologic hazards by providing for geologic hazard investigation and the avoidance of or mitigation of such hazard impacts at the time of initial construction.

JURISDICTION: Park County
DATE: 2001
TOPIC: Natural/Cultural Resources and Environmental Hazards
CONTACT: Park County, (719) 836-4258

In addition to Park County's efforts to protect wildlife habitat and riparian areas, steps should be taken to protect sensitive natural areas (e.g., steep slopes, flood plains, and identified areas susceptible to wildfire) from incompatible development and incentives should be used to encourage landowners and new development to preserve such areas. Development on such sensitive areas, while often visually intrusive, can also cause serious soil erosion and the potential for safety problems if those areas are unstable. Also, while the county currently has good minimum regulations regarding wildfire protection, with the increasing amount of development scattered throughout forested areas, these provisions need to be consistently applied and enforced to assure protection for human life and property.

The following are steps the county will be taking to improve natural areas:

1. Augment existing county standards for development on steep slopes and other potential hazards areas, including:
 - Limited development on some steep slopes, even if an engineered solution is plausible
 - Limits on percent disturbance of a site (which helps avoid erosion and sedimentation, protects native vegetation, and reduces the opportunity for invasion of noxious weeds.)
 - Revegetation of disturbed areas and controls on cutting of steep slopes to provide road access or building sites.
 - Limits on the height and length of engineered retaining walls.
2. Ensure that existing county standards for development on steep slopes and other potential hazard areas are consistently applied and enforced.
3. Ensure that county regulations requiring mitigation of geological hazards on site, including the preparation of geotechnical reports and Colorado Geological Survey review at the applicant's expense, are consistently applied and enforced.
4. Ensure that county regulations requiring minimum defensible space around existing dwellings located in areas of high wildfire potential, and regulations requiring wildfire mitigation plans for new developments are consistently applied and enforced. In addition, the county should require subdivisions of five or more parcels to provide water storage for fire protection.
5. Prohibit or limit residential development on or adjacent to lands identified as having proven commercially recoverable deposits for future mineral extraction.

JURISDICTION: Pueblo County
DATE: 2002
TOPIC: Natural Hazard Areas and Mineral Resources Areas
CONTACT: Pueblo County Planning and Development Department, (719) 583-6100; www.co.pueblo.co.us/codification_frm.html

The purpose and intent of the Pueblo County Natural Hazard and Mineral Resources Regulations is to regulate development in natural hazards areas, including geologic hazard areas, and flood plain hazard areas, so as to minimize significant hazards to public health and safety.

For geologic hazard areas:

- Minimize significant hazards to public health and safety or to property in a designated geologic hazard area;
- Promote safe use of geologic hazard areas;
- Reduce the impact of geologic hazards on life and property by:
 - Prohibiting certain land uses which are dangerous to life or property in geologic hazard areas;
 - Restricting the land uses which would be hazardous to public health and safety or to property in geologic hazard areas;
 - Restricting the land uses which are particularly vulnerable to geologic hazards so as to alleviate hardship and reduce the demands for public expenditures for relief and protection; and
 - Requiring land uses permitted in geologic hazard areas, including public facilities which serve such uses, to be protected from geologic hazards by providing for geologic hazard investigation and the avoidance of or mitigation of such hazard impacts at the time of initial construction.
- Protect geologic hazard area occupants or users from the impact of geologic hazards which may be caused by their own, or other, land use and which is or may be undertaken without full realization of the danger by:
 - Regulating the area in which, or the manner in which, structures designed for human occupancy may be constructed so as to prevent danger to human life or property within each structure; and
 - Designing, delineating and describing areas that could be adversely affected by geologic hazards so as to protect individuals from purchasing or improperly utilizing land s for purposes which are not suitable
- Protect the public from the burden of excessive financial expenditures from the impacts of geologic hazards and relief by:
 - Regulating land uses within geologic hazard areas so as to produce the pattern of development or a soundly-engineered manner of construction which will minimize the intensity and/or probability of damage to property and loss of life or injury to the inhabitants or users of geologic hazard areas;
 - Regulating the cutting, filling or drainage changes and other manmade changes which could initiate or intensify adverse conditions within geologic hazard areas; and
 - Encourage such uses as agriculture, grazing, greenbelt, open space, and recreation within geologic hazard areas.

JURISDICTION: San Miguel County
DATE: 2001
TOPIC: Areas of State Interest (“1041” Designation) – Geologic Hazards
CONTACT: San Miguel County Planning Department, Michael Rozycki, (970) 728-3083; [www.sanmiguelcounty.org/LUC/LUC5%20\(Amd%20-%2008-22-01\).pdf](http://www.sanmiguelcounty.org/LUC/LUC5%20(Amd%20-%2008-22-01).pdf)

This section of the code contains development standards for geologic hazard areas under the county’s “1041 powers.” The standards apply to areas mapped on San Miguel County’s adopted Environmental Hazard Maps and to unmapped areas known to be Areas of Local and State Interest.

General Standards

- **Development in Hazard-Free Areas.** Restrict development to a hazard-free area if such an area exists on a site.
- **Development in Hazard Areas.** If no adequate hazard-free area exists on site, the diversity of permitted uses in a zone district and permitted residential land use densities may be limited to minimize potential danger to persons or wildlife.
- **Development Prohibited.** Development shall be prohibited within an Area of Local and State Interest if:
 - Site planning and engineering techniques cannot completely mitigate potential hazards to public health, safety and welfare.
 - Development subjects persons or the county to dangers or expenses required to mitigate hazardous conditions, respond to emergencies created by such conditions or rehabilitate improvements and lands.

Geologic Hazard Areas

Identifies development standards applicable to specific geologic hazard areas in addition to the General Standards (listed above).

- Avalanches
- Landslides
- Potential unstable slopes
- Rockfalls
- Slopes greater than 30 percent
- Alluvial fans
- Talus slopes
- Mancos shale
- Faults
- Expansive soil and rock
- Ground subsidence

JURISDICTION: Teller County
DATE: 2002
TOPIC: Geologic Hazard Prone Areas
CONTACT: Teller County Community Development Services, (719) 687-5259, www.co.teller.co.us/CDSD/CDSD.htm and www.co.teller.co.us/CDSD/Planning/LandUseRegs/LandUseRegs.htm

The county will keep on file for public inspection a set of maps clearly showing all known and

identified geologic hazard prone areas. The county will not approve any subdivision plan if the proposed subdivision is either in one of these identified geologic hazard prone areas, or pending provision of maps, is in an area suspected by the county to be geologic hazard prone, unless the developer can submit adequate evidence prepared by a professional engineer or geologist that the proposed subdivision is not in a geologic hazard area or unless the property subdivision meet the following criteria:

- Disclosure
- Protection
- Financial burden
- Safety of structure
- Permitted land uses
- Impact of man-made changes
- Professional geologist requirements
- Geologic report

JURISDICTION: Town of Vail
DATE: 1997
TOPIC: Avalanche Hazard Regulations
CONTACT: Russell Forrest, Community Development Department, Town of Vail, (970) 479-2100, <http://ci.vail.co.us>

The purpose of these regulations is to inform the inhabitants of the Town of Vail about the dangers relating to development in avalanche paths, to regulate the use of land areas which may be subject to avalanche; to protect the aesthetic and recreational values and natural resources of the town, which are sometimes associated with avalanche areas and areas of geological sensitivity and slopes; to minimize damage to public facilities and utilities and minimize the need for relief in cleanup operations; to give notice to the public of certain areas within the town where avalanche areas and areas of geologic sensitivity exist; and to promote the general public health, safety and welfare.

The Town Manager formulates and develops master hazard plans for the town. The hazard plans will be based on engineering studies and indicates the location of known flood plains, avalanche and geological hazard zones of influence, known red and blue avalanche and geological hazard areas, and forty percent (40%) slope areas. In addition, the plans may show other information or data considered relevant by the Town Manager. Citizen participation during the formulation of the plans and other regulations is encouraged. The purpose of the master hazard plans is to identify and alleviate present and future problems created by the construction of improvements in the hazard areas within the town by means of presenting in an orderly fashion the general data and information which are essential to the understanding of the relationship between the hazards and improvements located within said areas. The master hazard plans may be altered from time to time to conform with new information or changing conditions.

For the purposes of this regulation, the words contained herein are defined as follows:

Blue Hazard Avalanche Area: An area impacted by a snow producing a total static and dynamic pressure less than six hundred (600) pounds per square foot on a flat surface normal to the flow and/or a return interval in excess of twenty five (25) years.

Substantial improvement: Any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds fifty percent (50%) of the market value of the structure. Market value shall be determined by a qualified assessor designated by the Town Administrator. The market value of a structure is determined either:

- A. Before the improvement or repair is started; or
- B. If the structure has been damaged and is being restored, before the damage occurred. For the purposes of this definition "substantial improvement" is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure. The term does not, however, include any project for improvement of a structure to comply with existing State or local health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions.

Zone of influence: Any area in a potential avalanche hazard zone, where detailed information is not currently available but which may be impacted by said hazard. These zones of influence shall be designated on the appropriate maps of the Town Administrator.

WILDFIRE MITIGATION

JURISDICTION: State of Colorado
DATE: 1995
TOPIC: Colorado Wildfire Hazard Mitigation Plan
CONTACT: Colorado State Forest Service, (970) 491-6303 and Marilyn Gally,
Colorado Office of Emergency Management, (303) 273-1622

The plan was developed and updated according to the 1994 FEMA-State Agreements for the Wake Complex Fires, the South Canyon Fire and the Roxborough Complex Fires. The document lists the problem categories, the issues and background within the problem categories, action elements, agencies responsible, estimated costs, funding sources, and schedules.

This plan groups issues into five major problem categories:

- Education and awareness;
- Legislation and regulation;
- Preparedness;
- Emergency response; and
- Secondary hazards.

This plan is currently being updated to incorporate lessons learned from the 2002 fire season.

JURISDICTION: State of Colorado
DATE: 2001
TOPIC: Report to the Governor: Colorado's Wildland Urban Interface
CONTACT: Rich Homann, Colorado State Forest Service, (970) 491-7538,
www.colostate.edu/Depts/CSFS/govpage.html

In 2000, Gov. Owens appointed a diverse working group of local, state, and federal leaders to examine the wildfire threat in Colorado's wildland urban interface and make recommendations on ways the state could improve preparedness and suppression. Over a six-month period, the Governor's Interagency Wildland Urban Interface Working Group identified several areas of concern:

- Wildfire suppression in the interface stretches the capability of response personnel in terms of safety, training, and equipment and challenges the ability of local and state governments to cover related costs. Interface protection also demands a higher level of interagency communication and coordination than currently exists.
- Mitigation of hazardous fuels in the interface is not occurring on a landscape scale, across ownerships. The implementation of planned mitigation projects is complicated by costs to private landowners, availability of a trained work force, compliance with federal requirements, and the lack of options for utilizing removed materials.
- Efforts to combat wildfire risk are complicated by a lack of awareness and/or support from local communities and the urban public.

Out of the working group's deliberations came a series of recommendations in the areas of preparedness and suppression, hazard mitigation, and public awareness. The report also contains a glossary of wildland fire terms.

JURISDICTION: Boulder County
DATE: 2000
TOPIC: Wildfire Mitigation Plan
CONTACT: Eric Philips, Boulder County Land Use Department, (303) 441-3930

In response to the Black Tiger Fire on Sugarloaf Mountain that burned 2500 acres and destroyed 44 homes, Boulder County revised their building codes and implemented defensible space practices for all new development, including requirements that addresses be clearly posted and that roads be well marked and built to allow easy access for fire equipment. Boulder County has also adopted the following guidelines to minimize the danger of fire in the urban-wildland interface area:

- New homes constructed along the foothills and in the mountains to the west are subject to a roof cover requirement that prohibits some types of roofing materials. In cases where the trees are thick and close to the home, the structures must be erected with fire-resistant walls or glass that can withstand higher temperatures. Defensible space practices require that trees around new homes be thinned, or cut down.
- Development/site plan reviews in areas identified to be at risk of wildfires should address site location, building construction and design, landscaping/defensible space/fuel management, access and water availability. These factors should be analyzed from the standpoint that wildfires may present a hazard to development and/or that development may present an ignition hazard to the forest.
- The county has been surveyed and mapped to locate the extent of wildfire hazards and areas at risk using the Wildfire Hazard Identification and Mitigation System (WHIMS).
- Accepted methods of forest land ecosystem management should be used to reduce all severe wildfire hazard areas to a low or moderate rating, particularly in those areas inhabited with human development as defined by WHIMS.
- The county encourages private and public landowners to manage their forests to preserve the forests' ecosystem processes by developing and maintaining a diversity of species, ages, and stand densities to serve as a natural deterrent to pest and fire outbreaks.

JURISDICTION: Clear Creek County
DATE: 2002
TOPIC: Fire Safety Checklist
CONTACT: Site Development Department, (303) 679-2421,
www.co.clear-creek.co.us/New/red_zone.htm

Many jurisdictions have made defensible space policies and guidelines more accessible to the public by posting them online. Clear Creek County's website features an entire section devoted to wildfire protection information. The site features a list of commonly asked questions, a fire safety checklist for homeowners living in the wildland/urban interface and a number of links to other wildfire information.

JURISDICTION: City of Colorado Springs
DATE: 2001
TOPIC: Wildfire Hazard Rating Map
CONTACT: Colorado Springs Fire Department, (719) 385-7281,
<http://csfd.springsgov.com/>

In 2001, the city fire department conducted an inventory of more than 43,000 parcels in the foothills area that comprises the city's wildland/urban interface. Each parcel was given a wildfire hazard rating based on geographic information system (GIS) data and a number of risk factors, including roof type, siding material, topography, adjacent vegetation, defensible space, and address visibility. An online parcel-by-parcel wildfire hazard rating map was then developed and made available on the fire department's web page, allowing each resident of the wildland/urban interface to see their parcel's rating. The website also contains information on how to improve hazard ratings, a link to a Firewise video and the city's wildfire mitigation plan.

JURISDICTION: City of Colorado Springs
DATE: 2002
TOPIC: Class A Roofing Ordinance
CONTACT: Pikes Peak Regional Building Department, (719) 327-2880,
www.springsgov.com/Page.asp?NavID=3125

Following the adoption of a new Wildfire Mitigation Plan, the city convened a roofing task force to develop a new ordinance prohibiting wooden and shake shingle roofs. The task force included builders, roofers, representatives from neighborhood groups, and members of both the city's building department and fire department. The resulting ordinance requires all new residential units to feature a Class A (excludes solid wood products) roof covering. The ordinance also applies to re-roofing activities where 25 percent or more of the existing roof is being replaced. This ordinance supercedes all homeowner association covenants in the city.

JURISDICTION: Douglas County
DATE: 2002
TOPIC: Wildland Fire Management Plan
CONTACT: Jim Raymond, Douglas County, (303) 660-7589

Utilizing the new countywide fire planning authority in CRS 30-11-124, the county worked with the Colorado State Forest Service to prepare and adopt a comprehensive wildland fire management plan. The county has also adopted the National Fire Protection Association (NFPA) 299 Standards to address development in the wildland urban interface. The plan requires a hazard assessment for all proposed subdivisions and mandates that the defensible zone requirements set forth in NFPA 299 must be met in order for new residential structures in the wildland urban interface to receive a Certificate of Occupancy. The plan also details the Colorado Firewise Program and how informational workshops are being used to educate landowners, homeowners associations and other stakeholders in the county.

The plan details policies for issuing open burn permits and establishes the planning required for conducting prescribed burns. The plan also sets forth policies regarding wildland fire training, suppression efforts, the use of incident command systems during fire events and the roles of the various local, state and federal agencies during wildland fires within the county.

The county recognizes that in many instances wildland fire plays a crucial role in forest ecosystem health. This philosophy is reflected in the designation of fire management zones within the county. These zones show where wildland fires will be immediately suppressed to protect life and property and where fires will be allowed to burn in order to enhance natural resource and ecological values.

JURISDICTION: Eagle County
DATE: 2002
TOPIC: Wildfire Regulations
CONTACT: Eagle County, (970) 328-8730,
www.eagle-county.com/WildfireRegs12_02.htm

Eagle County has certain areas that are at a higher risk of endangerment to human safety. Wildfire danger in these areas can be a significant threat to human life. Eagle County has put into place regulations that help dictate the direction and supply proper constraints to help reduce the risks of loss of human life and property. These regulations are not only meant to reduce risk, but also to help provide a set of guidelines to help minimize impact to adjoining properties and provide firefighter access when wildfires do occur. When possible, development in these high-risk locations should be avoided altogether.

The following guidelines shall be used to help mitigate the impact of wildfires:

- **Require a Vegetation Management Plan.** This plan should be prepared by a natural resource professional with experience in the field of vegetation management and wildfire management.
- **Require fire resistant construction materials.** The shell of the structure should be fire resistant at a one hour rating usually 5/8” thick gypsum board interior walls and ceiling with a non-combustible exterior such as brick or mortar.
- **Require defensible space.** Provide adequate space around the structure for fuel modification for the reduction of fire spread potential between the structures and surrounding vegetation.
- **Require a firefighting water supply and access plan.** The developer shall provide fire hydrants, water tanks, and cisterns capable of providing fire fighting water supply according to the standards of the local fire authority. All streets shall be designed to provide sufficient turn-around locations preferably at 1000-foot intervals.
- **Provide dual point access.** New development shall provide multiple access points accessible by emergency vehicles at a maximum grade of 8 percent. Driveways in excess of 150-feet in length shall provide adequate emergency vehicle turnaround capacity.
- **Require developer to obtain a Wildfire Hazard Rating.** This rating will be required before any building permit is issued. This rating will help determine the level of mitigation needed for construction.

JURISDICTION: Jefferson County
DATE: 2002
TOPIC: Wildfire Hazard Overlay District
CONTACT: Jefferson County Planning and Zoning Dept., (303) 271-8700,
http://206.247.49.21/ext/dpt/public_works/planning/zoning/45.pdf

Jefferson County developed a Wildfire Hazard Overlay District (WHOD) to promote the public health, safety and general welfare of its citizens. The WHOD was created to minimize the risk to the loss of life and property; and encourage and regulate prudent land uses so as not to increase the danger to public health, safety and property. The WHOD will reduce the demands for public expenditures for relief and protection of structures and facilities permitted in WHOD; and regulate buildings and structures so as to minimize the hazard to the public, and to public or private property.

Standards applied to WHOD are as follow:

- a. Defensible space and associated fuel break thinning will be created around the dwelling, or a wildfire mitigation site plan has been reviewed and a special exception granted by the Board of Adjustment for the property for which a building permit has been requested.
- b. Access standards as specified in Section 2 of the Zoning Resolution have been satisfied. (Where the property owner chooses to submit a wildfire mitigation site plan for review by the Board of Adjustment, a building permit will not be issued until such time as the wildfire mitigation site plan has been reviewed and a special exception granted by the Board of Adjustment.)
- c. The standards and criteria governing the design of defensible space and associated fuel break thinnings will be contained in the Colorado State University's Cooperative Extension Fact Sheet 6.302 and will be administered, with flexibility, by the Colorado State Forest Service or a qualified wildfire interface fire specialist.
- d. The standards and criteria contained in the "Jefferson County Roadway Design and Construction Manual" will govern the design and construction of all roadways in this overlay district, including private roads and driveways.

JURISDICTION: Moffat County
DATE: 2001
TOPIC: Wildland Fire and Fuel Management Plan
CONTACT: Ann Franklin, Moffat County Natural Resources, (970) 824-9151,
www.co.moffat.co.us/NaturalResources/index.php3

House Bill 00-1283, passed during the 2000 legislative session, expanded governing bodies' authority to not only suppress wildland fires but also to manage wildland fires and fuels and conduct county-wide fire planning. This statutory change allowed Moffat County to collaborate with the federal government agencies, private landowners, and local partners (i.e., fire departments) to develop a comprehensive Wildland Fire and Fuel Management Plan that creates more flexibility in wildland fire management across the landscape with cross-boundary vegetation treatments, prescribed fires, fire mitigation and community assessments.

Moffat County, located in the northwestern corner of Colorado, has experienced wildland fire suppression and limited use of prescribed fire over the last few decades, altering landscape and vegetation patterns originally adapted to frequent fires. The purpose of Moffat County's Wildland Fire and Fuel Management Plan is to effectively manage fire and hazardous fuels within Moffat County in accordance with a common vision shared by property owners. Every private landowner's objectives for fire management on their property are identified and considered in the public land agency's objectives. The plan facilitates the accomplishment of goals from private property owners as well as the public land agencies in a coordinated and cost-efficient manner. Essentially, the plan erases property boundaries and allows fire to be managed at a landscape level in order to meet both private landowner and agency objectives.

To date, Moffat County has completed and adopted fire planning policies for the western half of the county. The entire county will be covered under a fire plan by May 1, 2003. Participation in the plan is strictly voluntary and any landowner choosing not to participate is placed in a fire suppression category, meaning that any and all wildland fires will be extinguished on their property. Landowners may change objectives for fire on their property at any time. In addition, Moffat

County has identified 27 communities at risk and formed mitigation recommendations for those communities. Currently, contractors are drafting a community defendability and survivability plan for nineteen communities/housing developments in the county.

Upon notification of a fire ignition, the county commissioners, the county sheriff, the Bureau of Land Management (BLM), and affected private landowners immediately consult a wildland fire use and decision criteria checklist to determine whether to proceed with suppression, containment or monitoring of the fire. This checklist includes consideration of objectives and desired resource management effects, safety considerations, external concerns, and environmental concerns. Projected fire growth and firefighter safety is of paramount importance in all instances.

In June 2002, Moffat County hired a natural resources specialist to implement the Wildland Fire and Fuel Management Plan through coordination and cooperation with private landowners and other agencies for fuel treatment planning, implementation, monitoring and consistency between land jurisdictions. Public and staff understanding and awareness of fire ecology and wildland fire management will also be enhanced through interpretive and educational programs. In addition, as fire planning and mitigation is carried out on private and public lands and potential for risk to life and property is reduced, the county sheriff and BLM will be given much more latitude in fire suppression and management over the entire landscape, allowing them to restore ecological values and create a safe working environment for wildland firefighters.

JURISDICTION: Ouray County
DATE: 2001
TOPIC: Wildfire Mitigation Regulations
CONTACT: Ouray County Land Use, (970) 626-9775, www.co.ouray.co.us/

Ouray County Wildfire Mitigation Regulations are for the purpose of reducing the threat of wildfire and the resulting damage to property as a result of fire. The county has extensive forested and high desert lands that are subject to drought conditions that significantly increase the fire danger. Most of the county is a rural environment with relatively low density and with many residential dwellings located in forested or semi-forested areas. Ouray County is served by three locally based volunteer fire departments with specific district responsibilities and by the Montrose Fire District on the north end of the county. A significant amount of the county is not included in a fire district and some private properties do not have fire-fighting service available.

The Ouray County Wildfire Mitigation Regulations are intended primarily to improve the fire safety of structures and to reduce the threat of personal injury or residential loss of life and/or property resulting from fires. Implementation of accepted fire safety techniques and the availability of on-site fire fighting capability, primarily the availability of an adequate source of water, will reduce the potential for personal injury or death and/or loss of property from fires.

The regulations will apply to:

- New regular Planned Unit Developments (PUDs)
- Intra-family and Limited Planned Unit Development
- All new residential structures
- Residential structures existing at the time the regulations were adopted, and are increased by 50 percent or more in total square footage of living area
- Accessory structures (except those that are included in a residential dwelling) are exempted

- from these regulations
- Resort Planned Unit Development

Any building site outside of a municipality has to be rated according to the Ouray County Fire Safety Rating Form before the county will issue a building permit. Property owners must complete the form, and the county's building inspector will review both the form and property to ensure correct completion.

If the site is in a subdivision with 35 acres or less, it has to score a minimum of 800 points on the fire safety rating form. If the lots are larger than 35 acres, the score has to be a minimum of 700 points. Mitigation is required in both situations if minimum scores are not met.

A two-hour water supply of at least 200 gallons per minute is required for fire suppression. If the site's water supply cannot meet this requirement, then a water cistern must be provided, with a storage capacity of at least one gallon per square foot of all residential buildings on the parcel.

JURISDICTION: San Miguel County
DATE: 2001
TOPIC: Areas of State Interest ("1041" Designation) – Wildfire Areas
CONTACT: Michael Rozycki, San Miguel County Planning Department, (970) 728-3083, [www.sanmiguelcounty.org/LUC/LUC5%20\(Amd%20-%2008-22-01\).pdf](http://www.sanmiguelcounty.org/LUC/LUC5%20(Amd%20-%2008-22-01).pdf)

Using "1041 powers," the county incorporated development standards for wildfire areas into the county land use code. Development within areas designated as wildfire areas on San Miguel County's adopted wildfire maps or on densely vegetated slopes in excess of 30 percent must comply with the following standards:

- **Roof coverings.** Roof coverings shall be of a noncombustible material approved by the Underwriter's Laboratory.
- **Firebreak.** A minimum 10-foot firebreak shall be maintained between combustible structures and vegetation.
- **Power and telephone lines.** Power and telephone lines shall be buried.

DROUGHT MITIGATION

JURISDICTION: State of Colorado
DATE: 2001
TOPIC: Colorado Drought Mitigation and Response Plan
CONTACT: Marilyn Gally, Colorado Office of Emergency Management, (303) 273-1622 and Brad Lundahl, Colorado Water Conservation Board, (303) 866-3339

Drought differs from other natural hazards in that it has a slow onset, evolves over months or even years, affects a large spatial region, and causes little structural damage. It follows no path like tornadoes or floods, and usually has no clear beginning or end. The impacts of drought span economic, environmental, and social sectors. However, like other natural hazards, drought's impacts can be reduced through mitigation and preparedness. Several indexes have been developed to better monitor emerging drought; 1) Palmer Drought Severity Index, 2) U.S Drought Monitor, 3) Standard Precipitation Index, 4) Surface Water Supply Index. The growth of Colorado's population is resulting in the need for more water for municipal and industrial (M&I) use. Assuming one acre-foot per four persons per year, the need for additional M&I water is projected to increase from 1.0 million acre-feet in the present year to 2.2 million acre-feet in 2100. The patterns of water use are also changing from a seasonal demand to a year round demand placing added pressures on downstream users.

In an effort to combat Colorado's average annual precipitation of 17 inches, the state implemented the Colorado Drought Response Plan on April 22, 2002. The Colorado Office of Emergency Management developed the plan for the purpose of providing a mechanism for coordinated drought monitoring, impact assessment, and emergency drought response in a systematic and effective manner. The plan does not create a new government entity to deal with drought but provides a means for coordinating the efforts of public and private entities that would be called upon to deal with drought impacts. There are two main sections of the plan: Assessment and Response. The Water Availability Task Force (WATF) implements the initial phase of the Assessment process. Once WATF determines drought conditions are reaching significant levels, the chair of WATF will notify the Governor and recommend activation of the Plan.

Recommendations on drought preparedness:

- Informing the public as drought develops allows people to observe voluntary water conservation guidelines, thereby avoiding emergency measures, such as mandatory rationing.
- Agricultural producers can use the information on subsoil moisture levels at the start of the growing season as they decide which crops and which varieties to plant, how much seed to order and how to till the soil.
- State and federal agencies can reserve funds and staff time for drought assistance programs such as emergency food and water for livestock and low-cost loans for emergency well drilling.

To reduce long-term vulnerability:

- State or regional authorities can develop drought early warning systems and contingency plans, and implement policies such as water banking that add flexibility to water allocation systems.
- Municipal water suppliers can assess the vulnerability of their systems, detect and repair leaks, charge customers according to how much water they use rather than charging a flat

fee, and offer rebates for customers who install low-flow showerheads and toilets.

- Planning authorities and developers can each play a role in land stewardship in ways that reduce vulnerability to drought. Overusing delicate soils can contribute to long-term desertification, reducing the productivity of marginal lands. Draining wetlands to accommodate agriculture or other development affects regional water supplies for both wildlife and people. Many communities in water-short areas require developers to secure water rights, typically by buying rights from farmers, before permitting new housing construction.
- Homeowners can xeriscape (sometimes called “dry” or “conservation” landscaping) by selecting grass and flowers that require minimal water, fix leaky plumbing, install water-conserving showerheads and toilets, and reuse gray water from bathing and laundry.
- Agricultural producers can install more efficient irrigation systems (such as drip systems), and/or devise long-term crop rotation plans that feature crops that require less water.

JURISDICTION: State of Colorado
DATE: 2002
TOPIC: Colorado Drought & Water Supply Assessment
CONTACT: Larry Lang, Colorado Water Conservation Board, (303) 866-3989,
www.cwcb.state.co.us

The Colorado Water Conservation Board (CWCB) will utilize this assessment to reinforce its statewide advocacy focus on water supply issues. Using its technical, policy development and financial capabilities, the CWCB will support basin-wide and local planning to help mitigate the impacts of drought.

Understanding Individual Interests

Suppliers have specific issues, interest and motivations when addressing water supply needs. The CWCB will engage all Colorado water suppliers in this project, including the following interests:

- Agriculture
- Municipal and Industrial
- Federal and State
- Recreational and Special Interest

Assessment Focus

- Sources and Use of Water
- Nature and Use of Storage
- Differentiate Dry from Average Year Operations
- Understanding Status of Drought Planning and Awareness
- Identify and Support Local Planning Needs and Projects

Needs Identification

- Technical Assistance
- Funding Support and Requirements
- Funding Sources (federal, state, local, and private)
- Conservation
- Supplemental Water Storage Projects

Report

- Highlight Methodologies
- Perform Analyses
- Identify Constituent Needs
- Present Recommendations

Outcomes

- Planning Models for Drought
- Justification for Funding
- Project Identification and Support (loans, grants)
- Drought Education
- Infrastructure Development and Mitigation Measures

Colorado Revised Statutes 37-60-126 requires that water efficiency plans be developed with the assistance of the Office of Water Conservation (OWC) staff, for water providers that retail 2,000 acre-feet or more of water per year. These plans are to encourage domestic, commercial, industrial and public facility customers to use water more efficiently. This is done on a voluntary basis since no enforcement mechanisms exist should a provider choose not to comply with the requirements of the bill.

Water use efficiency plans are site specific and tailored to meet the needs of the implementing entity. Therefore, anticipated water savings vary and are difficult to measure. Most entities have chosen to implement measures that are lowest in cost, with distribution system leak repair and dissemination of information regarding water use efficiency measures receiving the most use in plans to date. As the program proceeds during future years, the development of baseline data will assist in measuring true water savings as a result of the plans.

As outlined in the statute, nine conservation measures should be considered in any efficiency plan. Those measures are:

1. Water efficient fixtures;
2. Low water use landscapes and irrigation;
3. Water efficient industrial/commercial water-using processes;
4. Water reuse systems, potable and non-potable;
5. Distribution system leak repairs;
6. Dissemination of information;
7. Water rate structures to encourage efficiency;
8. Regulatory measures; and
9. Incentives to implement water efficiency techniques.

JURISDICTION: City of Alamosa
DATE: 1997
TOPIC: Water Conservation Plan
CONTACT: Don Koskelin, City of Alamosa, (719) 589-6631

Water use efficiency is an important component of the city's water supply planning. Reduced water demand will decrease both the amount of water needed in the future and the need for additional distribution facility development. These facility demand reductions can save the city millions of dollars in future capital costs. The city can particularly benefit by reducing peak demand, which is constrained by current water decree pumping limits. Reducing peak demand will maximize the capacity of existing facilities and reduce pumping costs.

Alamosa has a four-fold increase in water usage from winter to summer, which is attributed to irrigation. The plan will concentrate on increasing the effectiveness of irrigation of the city's parks, golf courses and fields at educational facilities. A secondary consideration is to further reduce usage in the domestic sector.

Most Effective Tools to Reduce Demand:

- **Scheduling Use of Water**
 - Delay irrigation if raining
 - Water by evapotranspiration (ET) rate
 - Check scheduling on a monthly basis (what works in July might be too much in September)
 - Water after dark to reduce evaporation and decrease peak demand
 - Watering slightly longer and less frequently will get the water deeper for sustained moisture
- **Design** - Properly designed, installed, and maintained irrigation systems can reduce water use substantially. Even distribution patterns will eliminate the overwatering of some areas in order to ensure the entire zone receives adequate water.
- **Education** - The importance of conservation must be conveyed to customers.
- **Landscaping** - Good design saves time, money, water and adds value to property. By limiting turf area and using soil amendments and mulching, water use can be greatly reduced.
- **Leak Detection** - A formal leak detection and repair program should be implemented.

Tools to Encourage and/or Require Water Conservation

- Adequate and appropriate rate structure
- Ordinance for Watering - Enact an ordinance, which would address sprinklers, permitted hours of irrigation, and types of grasses and landscaping allowed.

Develop Alternative (non-potable) Water Sources

- Pursue reuse of treated wastewater or diversion of these water rights to public irrigation uses through construction of irrigation wells. These wells and distribution lines would be independent of existing wells and distribution systems.

Alamosa "In-house" Plan

- By setting a good example, the city will influence individuals to voluntarily reduce water consumption. The plan's focuses can include:

- Xeriscape Demonstration
- Education
- Information
- Public Meetings

Residential Plan

- Residential users can also adopt many of the techniques used by large irrigation users for their own lawn care. The careful selection and use of appliances, such as clothes washers, toilets, and water heaters, can also provide water savings.

JURISDICTION: City of Aspen
DATE: 1996
TOPIC: Water Conservation Element - Water Management Plan
CONTACT: Phil Overeynder, City of Aspen, (970) 920-5110, www.aspengov.com

Water Management Plan

The Water Management Plan describes the benefits of water conservation programs, which are implemented to reduce, delay, or eliminate the need to construct surface water storage reservoirs on Castle and Maroon Creeks. Water conservation measures already in place include the following:

- Adoption of a 3-phase drought emergency ordinance, which implements progressively more restrictive limits on water usage during a period of water shortage.
- Mandatory metering of water use
- Water pricing. The city utilizes a version of an “inverted” price structure which charges higher water rates for excessive water usage to discourage water waste
- Water education programs
- Implementation of state statutes regarding use of low-flow fixtures in new construction
- Raw water distribution system for irrigation and snowmaking

JURISDICTION: City of Brighton
DATE: 1997
TOPIC: Water Conservation Plan
CONTACT: City of Brighton, (303) 655-2000

Based on an analysis of existing water usage characteristics and projected water needs, the city set out to address the following issues in its water conservation efforts:

- Unaccounted-for water
- Inaccurate water meters
- Park irrigation
- Peak demand

Water Conservation Goals

Recognizing identified critical issues - long-term water goals recommended

- Reduce unaccounted-for water to ten percent of finished water production.
- Reduce per capita consumption to 160 gallons per capita demand.
- Reduce peak day demand to 6.0 million gallons demand.
- Become a leader in the community in water conservation through example and education

Develop water regulations that encourage water conservation

- Adopt water rates that charge customers an amount commensurate with the cost of providing water and encourage water conservation
- Prohibit irrigation between 10:00 a.m. and 6:00 p.m. due to the high evaporation rate at those times. A potential water savings of five to 20 percent of outdoor water use could be realized with the shift in watering time. This savings could be as much as 60 million gallons (184 acre-feet) per year.
- Adopt a schedule of alternating irrigation days to lower peak demands. Sufficient lowering of peak demand could defer capital expenses for expanding the water treatment plant.
- Require biennial water audits of the 10 largest system customers to ensure the most efficient use of water.
- Require replacement of meters on a regular basis to assure accurate readings of the amount of water used.
- Require xeriscaping in the public areas of all new developments. New or refurbished landscape should feature low water-use turf and plants.
- Consider reuse of water as a possible source of water conservation.

Water conservation education

Education programs are an integral part of a successful water conservation program. Education programs will complement the city's conservation efforts by increasing the customer's awareness.

- Provide customers with a water audit kit to detect leaks in old plumbing fixtures and review current water usage.
- Distribute customer bill inserts on conservation annually to all water customers.
- Arrange school programs to educate students on water conservation.
- Submit articles on water conservation to the local newspaper, especially during spring and summer months.
- Schedule seminars in the winter and early spring to provide customers with information about xeriscaping.

JURISDICTION: City and County of Broomfield
DATE: 2002
TOPIC: Water Conservation Plan
CONTACT: City and County of Broomfield, (303) 438-6363,
www.ci.broomfield.co.us/environment/Water%20Conservation%20Page.shtml

The City and County of Broomfield developed a Water Conservation Plan in accordance with the requirements set forth in the Colorado Water Conservation Act.

The city's goals are to reduce future operating costs, reduce peak demand water treatment facilities, satisfy current and future regulatory requirements, and develop a good relationship with the public through public education.

The plan includes the following measures:

- Water-efficient textures and appliances
- Low water-use landscapes and efficient irrigation
- Water-efficient industrial and commercial water-using processes
- Water reuse system, both potable and non-potable

- Distribution system leak repair program
- Dissemination of information regarding water use efficiency measures including public education, water use audits, and water saving demonstrations
- Water rate structures designed to encourage water use efficiency in a fiscally responsible manner
- Regulatory measures, including standards for the use of water-use efficiency fixtures and landscapes, and ordinances, codes, or other laws designed to encourage water-use efficiencies
- Incentives to implement water use efficiency techniques, including rebates to customers or others to encourage the installation of water-use efficiency measures

JURISDICTION: City of Colorado Springs
DATE: 1996
TOPIC: Water Conservation Plan
CONTACT: Anna Cedar, Colorado Springs Utilities, (719) 448-4800,
www.csu.org/

The purpose of the Colorado Springs’ Water Conservation Plan is to provide the Colorado Springs Water Resource Department’s board with current and proposed conservation measures, historical perspective on water conservation philosophy, an overview of the conservation master planning process and guidance on how efficient water use will effect future water demands.

The Water Resources Plan - An Integrated Effort

The department worked on a long-term planning process, which culminated in improving the delivery system sufficient to meet the city’s water needs through the year 2040. The department saw this effort as the appropriate vehicle for reassessing its existing conservation programs in full view of the public. A Citizens Review Committee was formed of volunteers and special interest group representatives to study “Water for the 21st Century.” The entire Water Resources Plan was presented to and adopted by city council in March of 1996.

Developing a Future Conservation Master Plan

The Water Resources Plan identified as goal for the Water Resource Department to attain an additional three percent of water savings through the expansion and development of conservation programs. The majority of achievable new water savings would come from the enactment of an evapotranspiration (ET) program. The plan also called for from the distribution of rain sensors and the conduct of commercial landscape audits. The recommendations are:

- Continue all existing programs;
- Add rain sensors and commercial landscape audits;
- Designate an official Water Conservation Office and Officer;
- Study a new rate structure to encourage conservation; and
- Greatly expand public education about conservation.

JURISDICTION: City of Cortez
DATE: 2002
TOPIC: Water Conservation Plan
CONTACT: City of Cortez, (970) 565-3402
<http://www.swcolo.org/Family/Cortez.html>

The City of Cortez has implemented a water conservation program to promote the efficient consumption of water by residents, businesses, and local governments to more beneficially utilize the city's water resources. Cortez already has several water saving policies in place that have existed for many years. Some of these key policies are system-wide metering, aggressive line repairs for problem areas, and constant leak investigations. The city is currently in a position of having to pay for a lot of raw water supply whether utilized or not. This situation does not put pressure on the city to limit usage, but to stress more efficient usage without waste.

The goals for Cortez's water conservation program are as follows:

- Achieve cost-efficient, reliable, and permanent reduction in per capita water demand for the city from the implementation of specific conservation measures.
- Fully meter all lines in the city that serve water. The primary un-metered water users are parks irrigation and large city buildings. This would allow the city to more closely monitor its water losses that are currently unaccounted for.

Listed below are the potential areas where water conservation can be realized:

- Metering
- Efficient Irrigation Practices
- Xeriscape
- Education & Public Awareness
- Commercial and Governmental Use
- Water Efficient Fixtures
- Regulatory Measures
- Water Rate Structures
- Water Re-Use
- Incentives for Water Conservation
- Imposition of Emergency or Conservation Restrictions
- Prohibitions on Wasting Water
- General Maintenance

JURISDICTION: City of Craig
DATE: 2002
TOPIC: Water Resource Conservation Guide
CONTACT: City of Craig Water Department, (970) 824-8151, Ext. 2001,
www.craigwater.com/

The city has implemented the following measures to conserve drinking water:

Waste of Water

It is a violation of the Craig Municipal Code for citizens to knowingly waste drinking water. It is also mandated by city code that water service lines to any building be kept free from leaks to avoid the unnecessary waste of water.

Water Rates

The city charges a flat rate (\$14.20 inside the city limit, \$28.40 outside the city limits) to cover debt service in addition to a consumptive rate for water users. The consumptive rate of \$1.56 per 1,000 gallons adds additional cost to the water bill, encouraging water conservation.

Water Meters

The city's municipal code requires that a water meter be installed for all water service connections to the city water mains. Water meters are continuously being replaced as older, inaccurate or failing water meters are located in the system.

Water Mains and Leak Detection

The city has invested approximately \$9,000,000 over the past 15 years (1987 - 2002) in water main improvements. This large-scale replacement program has practically eliminated all the water mains in the city that were known to have leakage problems. Long-range capital plans dictate additional main replacements while the city continues to make repairs on an "as-needed" basis.

Public Awareness and Xeriscaping

The city encourages the use of water efficient fixtures by all water users. The Uniform Plumbing Code has been adopted for use as a standard for construction and requires that all indoor plumbing fixtures and toilets be of the type that conserve water.

Xeriscaping models are in place at the Wastewater Treatment Plant for public inspection. Local citizens are encouraged to tour the landscaping for ideas on xeriscaping for their personal use at home. This program has been received well by members of the community and has the added benefit of beautification of the wastewater treatment plant grounds.

JURISDICTION: Crestview Water and Sanitation District
DATE: 1996
TOPIC: Water and Sanitation District Water Conservation Plan
CONTACT: Bill Roecker, Crestview Water and Sanitation District, (303) 429-1881

The purpose of the Water Conservation Plan is to promote and encourage domestic, commercial, industrial and public facility customers of the Crestview Water and Sanitation District to use water efficiently and to foster conservation of the water of the district, Denver Water and the State of Colorado.

The plan is intended to:

- (A) Comply with the requirements of the State of Colorado Office of Water Conservation, specifically HB 91-1154 as promulgated;
- (B) Remain consistent and in compliance with contractual obligations with Denver Water and Metro Wastewater Reclamation District; and
- (C) Meet the needs and desired water conservation results of the citizens and representatives of the district within the framework of the rules and regulations of the district and prudent operation of the water distribution system.

The board of directors of the district adopted rules and regulations to govern the management, control and supervision of all the business and affairs of the district, and the construction

installation, operation and maintenance of district improvements pursuant to statutory authority. The board has also established policies for water use for the beneficial purposes only and water provided to consumer is to be used at the premises of the consumer and not elsewhere. The district's Water Conservation Plan addresses the following required elements of HB 91-1145:

- Leak repairs
- Public information
- Water and sewer rates
- Water efficient fixtures and appliances
- Low water-use landscapes and efficient irrigation
- Water efficient industrial and commercial water using processes
- Water reuse system, potable and non-potable
- Distribution system leak repair
- Dissemination of information regarding water use efficiency measures
- Public education
- Customer water use audit
- Water savings demonstrations
- Water rate structure
- Regulatory measures
- Standards for the use of water use efficiency fixtures and landscapes
- Ordinances, codes and laws to encourage water use efficiency
- Incentives to implement water use efficiency techniques
- Rebates to customers to encourage the installation of water use efficiency measures

JURISDICTION(S): City and County of Denver
DATE: 2002
TOPIC(S): Drought Response Plan
CONTACT: Denver Water, (303) 628-6000,
www.denverwater.org/indexmain.html

Even though Denver Water's supply of water currently exceeds customer use, it must be prepared to recognize drought conditions early and respond appropriately. Denver Water's prime drought response goals are to budget water use so that supply will be available for the most essential uses for the drought's duration. A Drought Response Plan (DRP) was developed to provide the Board of Water Commissioners with a set of options to consider in dealing with drought. The DRP addresses three areas-water supply and use, strategies and potential drought response, and public outreach.

Water Supply and Use:

Weather is usually the single biggest factor affecting use. Other factors affecting use include population growth and the effects of Denver Water's long-term water conservation efforts.

Strategies and Potential Drought Response:

The DRP is based on three levels of drought, each of which is triggered by the expected or actual reservoir storage levels on July of any given year.

Drought Level	Trigger
Mild	Reservoirs are less than 80% full
Moderate	Reservoirs are less than 60% full
Severe	Reservoirs are less than 40% full

The plan identifies two ways to respond to a drought: increasing water supply and decreasing water use.

- Increasing Water Supply - Denver Water would augment its water supply from other sources. There are several options for doing this, each presenting its own set of intergovernmental and technical considerations. Among the possibilities are:
 - Call back water rights that Denver Water allowed others to use.
 - Pay a downstream water user to allow diversion of more water.
 - Seek waivers from federal and state agencies to allow diversion of more water.
 - Drill wells.
 - Install pumps and pump otherwise unusable water from reservoirs.
 - Implement clauses in legal documents allowing the drawing of reservoir storage below minimum levels.

- Decreasing Water Use - Denver Water’s prime drought response is to budget water use so supply will be available for the most essential uses for the drought’s duration. There are a wide variety of options that could be used to decrease water use. In general, the reductions would be voluntary during a mild drought, with mandatory measures being phased in if drought conditions become more serious. It is important to ensure that any discomfort, difficulty or potential loss is shared as equitably as possible across all customer classes. In the event of a prolonged drought, Denver water staff and the Citizens’ Advisory Committee would seek customer ideas and preferences in order to help the Board of Water Commissioners select and prioritize drought response measures.

JURISDICTION: Denver Water
DATE: 2002
TOPIC: Model Water Saving Ordinances
CONTACT: Denver Water, Public Affairs, (303) 628-6045,
www.denverwater.org/indexmain.html

Denver Water has made available a series of model water saving ordinances that can be modified and incorporated into local codes. The ordinances cover the following areas:

- **Rain sensor.** Requires that all new automatic sprinkler systems installed shall include a rain or humidity sensor that will override the irrigation cycle of the sprinkler system when rainfall has occurred in an amount sufficient to negate the need for irrigation at the scheduled time.

- **Sub-metering.** New multi-family residential developments shall provide a water meter, commonly referred to as a sub-meter, for each individual dwelling unit, and shall arrange for billing the occupants of each unit based on actual water use. Sub-meters shall be the property of the owner or building management who shall be responsible for maintenance and repair of sub-meters.

- **Soil preparation.** All soils upon which any cool season lawn, turf or sodded area is to be installed or enlarged must be properly amended with organic matter. A minimum of three cubic yards of organic matter per each one thousand square feet of soil must be incorporated to a depth of at least six inches by tilling, discing or other suitable method.
- **Turf limitation.** Limits the amount of turf that can be planted on a building site. Turf limitations will vary, based on the type of structure (e.g., single family, multi-family, commercial buildings, etc.).
- **Water waste.** Waste of water is prohibited. “Waste of water” is defined as the use of water for non-beneficial purpose, and includes continuous application of water to any lawn, turf, sodded or landscaped area resulting in the pooling or flowing of water into drainage or storm drainage facilities, failure to repair any irrigation system that is leaking, and the use of hoses for washing of vehicles and other outdoor uses other than irrigation, not equipped with a shutoff valve that is normally closed and necessitates hand pressure on the valve to permit the flow of water.
- **Median sub-surface irrigation.** Any new landscaping or irrigation installation or re-installation in a median or similar strip of permeable surface less than fifteen feet in any horizontal dimension, adjacent to a vehicular roadway, shall be irrigated only by a subsurface irrigation system.
- **Restrictive covenants.** No person or association may impose private covenants, conditions, restrictions, deed clauses or other agreements between the parties, which prevent the use of water-efficient landscaping, including xeriscaping. Landscape review denials shall not be based solely on the use of water-efficient landscaping, but may require that such landscaping demonstrate evidence of care.

JURISDICTION: Douglas County
DATE: 1998
TOPIC: Water Supply Overlay District
CONTACT: Douglas County Planning Department, (303) 660-7460,
www.douglas.co.us/DC/planning/documents/Zoningres/section18A.htm

In 1997 the county hired a water consultant to assist staff and elected officials in the development of water supply standards to address and evaluate the physical existence of the water needed for any development application. The county subsequently adopted a new water supply overlay zoning district that covers the entire county and sets forth water supply standards for all new development. The overlay district provides standards for existing water providers, new special districts and rural wells. For most of the county, the overlay district requires a 100-year water supply - a standard that mirrors state law. In the higher elevations, however, additional water requirements are placed on development. Due to greater potential for declines in aquifer levels at elevation, developments in the foothills area of the county must demonstrate a 200-year water supply and may be required to connect to a renewable water source and/or observe well spacing requirements.

JURISDICTION: City of Longmont
DATE: 2002
TOPIC: Drought Response Plan
CONTACT: City of Longmont, (303) 651-4348,
www.ci.longmont.co.us/water_waste/drought/index.htm

The purpose of the Drought Response Plan is to anticipate, identify and respond to the existing levels of drought in the Saint Vrain Creek Watershed area. The city's plan will evaluate the impact on raw water availability for the City of Longmont and recommend responses to the current drought. The plan will also begin formalizing the city's planning for future droughts and the possibility that the current drought may last longer than the current water year.

Methodology and Responsibility:

The city's Drought Response Plan will be managed by the Water/Wastewater Utilities Department. Personnel in the Water Resources Division will monitor indicators of drought. The Water Department will recommend appropriate action, guided by the response measures as outlined in this plan, for response to differing levels of drought.

The following outline addresses the policy and actions the city will take in the event of a drought:

Drought Supply Policy

Description of Indicators and Forecasting Methods:

- Natural Resources Conservation Service's monthly streamflow forecasts
- Natural Resources Conservation Service's monthly snowpack survey
- Saint Vrain Creek Basin Reservoir storage levels
- Trans-mountain water supply availability
- Raw water availability for the City of Longmont
- City of Longmont treated water demands greater than normal

Description of Drought Response Action Plans for differing response levels:

Level I

- Increase public information about the drought severity and review and enactment of appropriate conservation efforts.
- Mandatory measures for raw water reduction in municipal and school use of water.
- Raw water leases and bulk water sales
- Voluntary water conservation by service customers
- In average and above average water years, there are many uses of water that will change in drought years. Some changes are: Use of water in Golden Ponds will gradually change from primarily piscatorial to supply. Union Reservoir water levels will be lower than normal, resulting in lowered ability to conduct late season recreation activities.
- Staff will begin developing plans for implementing Level Two policies in the event Level I occurs.

Level II

- Same as Level I, but with mandatory water conservation by service customers.

Level III

Upon determining a Level III drought exists, the city may perform any or all of the following:

- Continue public information about the drought severity and enactment of mandatory conservation efforts.
- Mandatory measures for raw water reduction in municipal and school use of water.
- Raw water lease and bulk water sales.
- Mandatory water conservation by service customers.

Staff will continue to develop plans for responding to the drought. The Water Department will monitor drought response effectiveness, recommend adjustments, and report to the public regularly. Water staff will continue to monitor and enforce watering restrictions as necessary.

JURISDICTION: City of Pueblo
DATE: 2002
TOPIC: Drought Emergency Response Plan
CONTACT: Pueblo Board of Water Works, (719) 584-0250,
www.pueblowater.org

The rules and regulations of the Board of Water Works are necessary and desirable to establish standards for the operation. During drought or similar emergency in which the water supply is not adequate to meet customary delivery standards, the following action plan will be implemented.

A. Conservation Actions

1. Stage I (Voluntary): A goal of 15 percent savings in comparison to average summer usage is expected.
2. Stage II (Mandatory): All outdoor water use such as lawn irrigation and car washing will be limited to two days per week. This includes lawn irrigation at all residences, businesses, city parks, golf courses, highway rights-of-way, and other city, state, and federal property. A goal of 30 percent water savings in comparison to average summer usage is expected.
3. Stage III (Mandatory): All outdoor water use such as lawn irrigation and car washing (except at commercial washes) is prohibited. A goal of 65 percent water savings in comparison to average summer usage is expected.

B. Exemptions

The Executive Director will have the authority to allow exceptions to the drought response action plans outlined above.

C. Enforcement and Penalties

1. The first violation will be a written warning. The warning is a legal notice that customer is violating the lawn watering restriction.
2. The second violation will result in a \$100 wasted water charge added to customer's monthly water bill.
3. The third violation will result in a \$300 wasted water charge added to customer's monthly water bill.
4. The fourth violation will result in a restriction of service and a \$500 wasted water

charge added to customer's monthly bill.

5. Any subsequent violations will result in discontinuance of service.

The above violations apply to all residential, commercial, and industrial customers, with the exception of a \$500 wasted water charge that applies to improper or unauthorized use of public or private fire hydrants.

ADDITIONAL RESOURCES

General:

Colorado Office of Emergency Management
Department of Local Affairs
15075 S. Golden Road
Golden, CO 80401
(303) 273-1622
Fax (303) 273-1795
www.dola.state.co.us/oem/oemindex.htm

Colorado Geological Survey
Department of Natural Resources
1313 Sherman Street, Room 715
Denver, CO 80203
Phone: (303) 866-2611
Fax: (303) 866-2461
<http://geosurvey.state.co.us/>

Federal Emergency Management Association, Region VIII
Building 710, Box 25267
Denver, CO 80225-0267
(303) 235-4800
Fax (303) 235-4976
www.fema.gov/regions/viii/index.shtm

Institute for Business and Home Safety:
Survey of State Land-Use and Natural Hazards Planning Laws
www.ibhs.org/research_library/view.asp?id=302

Wildfire Mitigation:

Colorado State Forest Service
Colorado State University
Fort Collins, CO 80523
(970) 491-7538
Fax: (970) 491-7736
www.colostate.edu/Depts/CSFS/homefire.html

Colorado State Cooperative Extension
1 Administration Building
Colorado State University
Fort Collins, CO 80523-4040
(970) 491-6281
Fax (970) 491-6208
www.ext.colostate.edu

USDA Forest Service, Rocky Mountain Region
State and Private Forestry
P.O. Box 25127
740 Simms Street
Lakewood, CO 80225
(303) 275-5735
Fax: (303) 275-5754
www.fs.fed.us/spf/

Bureau of Land Management
National Fire Plan
2850 Youngfield Street
Lakewood, CO 80215
(303) 239-3600
Fax: (303) 239-3933
www.co.blm.gov/fire/

Creating Wildfire-Defensible Zones: www.ext.colostate.edu/pubs/natres/06302.html

FIREWISE: www.firewise.org

National Weather Service: www.boi.noaa.gov/firewx/denfwfden.html

Colorado Wildfires: <http://wildfires.nwcg.gov/colorado/index.shtml>

National Interagency Fire Center: www.nifc.gov/information.html

Drought:

Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, CO 80203
(303) 866-3441
Fax: (303) 866-4474
http://cwcb.state.co.us/owc/Drought_Planning/2002_Drought_Information.htm

Colorado Drought Mitigation and Response Plan:
www.dola.state.co.us/oem/Publications/droughtplan.402b.pdf

Colorado Climate Center: <http://climate.atmos.colostate.edu/>

National Drought Mitigation Center: <http://enso.unl.edu/ndmc/>

University of Nebraska U.S. Drought Monitor: <http://drought.unl.edu/dm/monitor.html>

USGS Colorado Drought Watch Page: <http://co.water.usgs.gov/drought/index.html>

USDA Secretarial Disaster Designations: <http://drought.fsa.usda.gov/designations.htm>