City of Golden Community Wildfire Protection Plan

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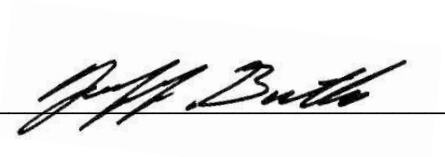
Prepared by: 

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TABLE OF CONTENTS

TABLE OF CONTENTS, CONTINUED

LIST OF FIGURES

LIST OF TABLES

LIST OF MAPS

(LOCATED IN APPENDIX A)

LIST OF APPENDICES

LIST OF ACROYNMS AND ABBREVIATIONS

BLM	Bureau of Land Management
BTU	British Thermal Unit
CAPCD	Colorado Air Pollution Control Division
CDPHE	Colorado Department of Public Health and Environment
CSFS	Colorado State Forest Service
CWPP	Community Wildfire Protection Plans
EM	Emergency Management
ERC	Energy Release Component
FBFM	Fire Behavior Fuel Model
FEMA	Federal Emergency Management Agency
FPD	Fire Protection District
GIS	Geographic Information System
HFRA	Healthy Forests Restoration Act
IC	Incident Commander
IMT	Incident Management Team
JFDRS	Jefferson County Fire Danger Rating System
JEFFCO	Jefferson County
mph	miles per hour
NEPA	National Environmental Protection Act
NFDRS	National Fire Danger Rating System
NFPA	National Fire Protection Association
NWCG	National Wildfire Coordinating Group
psi	pounds per square inch
RAWS	Remote Access Weather Station
USFS	U.S. Forest Service
WALSH	Walsh Environmental Scientists and Engineers, LLC
WFU	Wildland Fire Use
WUI	Wildland-Urban Interface

LIST OF FIRE BEHAVIOR TERMS

Aerial Fuels	All live and dead vegetation in the forest canopy or above surface fuels, including tree branches, twigs and cones, snags, moss, and high brush.
Aspect	Direction toward which a slope faces.
Direct Attack	A method of fire suppression where actions are taken directly along the fire's edge. In direct attack, burning fuel is treated directly, such as by wetting, smothering, or chemically quenching the fire or by physically separating burning from unburned fuel.
Chain	A unit of linear measurement equal to 66 feet.
Crown Fire	The movement of fire through the crowns of trees or shrubs more or less independently of the surface fire.
Dead Fuels	Fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity and precipitation), dry-bulb temperature, and solar radiation.
Defensible Space	An area either natural or manmade where material capable of causing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and the loss to life, property, or resources. In practice, "defensible space" is defined as an area a minimum of 30 feet around a structure that is cleared of flammable brush or vegetation.
Fire Behavior	The manner in which a fire reacts to the influences of fuel, weather, and topography.
Fire Danger	The broad-scale condition of fuels as influenced by environmental factors.
Fire Front	The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified the fire front is assumed to be the leading edge of the fire perimeter. In ground fires, the fire front may be mainly smoldering combustion.
Fire Hazard	The presence of ignitable fuel coupled with the influences of terrain and weather.
Fire Intensity	A general term relating to the heat energy released by a fire.
Fire Return	The historic frequency that fire burns in a particular area or fuel type,
Interval	without human intervention.
Fire Regime	The characterization of fire's role in a particular ecosystem, usually characteristic of a particular vegetation and climatic regime, and typically a combination of fire return interval and fire intensity (i.e., high frequency low intensity/low frequency high intensity).
Fire Weather	Weather conditions that influence fire ignition, behavior and suppression.
Flaming Front	The zone of a moving fire where combustion is primarily flaming. Behind this flaming zone combustion is primarily glowing. Light

	fuels typically have a shallow flaming front, whereas heavy fuels have a deeper front.
Fuel	Combustible material; includes, vegetation, such as grass, leaves, ground litter, plants, shrubs, and trees that feed a fire. Not all vegetation is necessarily considered fuels; deciduous vegetation such as aspen actually serve more as a barrier to fire spread, and many shrubs are only available as fuels when they are drought-stressed.
Fuel Loading	The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area.
Flame Length	The distance from the base to the tip of the flaming front. Flame length is directly correlated with fire intensity.
Fuel Model	Simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.
Fuel Type	An identifiable association of fuel elements of a distinctive plant species, form, size, arrangement, or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.
Ground Fuel	All combustible materials below the surface litter, including duff, tree or shrub roots, punchy wood, peat, and sawdust that normally support a glowing combustion without flame.
Indirect attack	A method of fire suppression where actions are taken some distance from the active edge of the fire due to intensity, terrain, or other factors that make direct attack difficult or undesirable.
Intensity	The level of heat radiated from the active flaming front of a fire, measured in BTUs (British Thermal Units) per foot.
Ladder Fuels	Fuels which provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.
Live Fuels	Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.
National Fire Danger Rating System (NFDRS)	A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.
Prescribed Fire	Any fire ignited by management actions under certain, predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. A written, approved prescribed fire plan must exist, and National Environmental Protection Act (NEPA) requirements must be met, prior to ignition.
Rate of Spread	The relative activity of a fire in extending its horizontal dimensions. It is expressed as a rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in

	area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history. Sometimes it is expressed as feet per minute; one chain per hour is equal to 1.1 feet per minute.
Risk	The probability that a fire will start from natural or human-caused ignition.
Surface Fuels	Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity; also grasses, forbs, low and medium shrubs, tree seedlings, heavier branchwood, downed logs, and stumps interspersed with or partially replacing the litter.
Topography	Also referred to as "terrain." The parameters of the "lay of the land" that influence fire behavior and spread. Key elements are slope (in percent), aspect (the direction a slope faces), elevation, and specific terrain features such as canyons, saddles, "chimneys," and chutes.
Wildland Fire	Any fire burning in wildland fuels, including prescribed fire, fire use, and wildfire.
Wildland Fire Use	The management of naturally ignited wildland fires to accomplish specific prestated resource management objectives in predefined geographic areas outlined in Fire Management Plans.
Wildfire	A wildland fire that is unwanted and unplanned.

EXECUTIVE SUMMARY

Steep terrain, large areas of continuous fuels, and frequent high fire danger weather conditions make wildfire a significant concern in Jefferson County, Colorado, as substantiated by recent large fires. Wildfire is an eventuality that requires comprehensive planning and preparation to mitigate its potential negative effects. The Community Wildfire Protection Plan (CWPP) is a strategic plan that identifies wildland fire issues facing the community and outlines prioritized mitigation actions. Once the CWPP is adopted, it is the community's responsibility to move forward and implement the action items. This may require further planning at the project level, acquisition of funds, or simply motivating community members.

This CWPP is not a legal document. There is no legal requirement to implement the recommendations herein. Actions on public lands will be subject to applicable federal, state, and county policies and procedures. Action on private land may require compliance with county land use codes, building codes, and local covenants.

The Healthy Forests Restoration Act (HFRA) of 2003 provides the impetus for wildfire risk assessment and planning at the county and community level. HFRA refers to this level of planning as Community Wildfire Protection Plans. The CWPP allows a community to evaluate its current situation with regards to wildfire risk and devise ways to reduce risk for protection of human welfare and other important economic or ecological values. The CWPP may address issues of community wildfire risk, structure flammability, hazardous fuels and non-fuels mitigation, community preparedness, and emergency procedures. A Core Team provides oversight to the development of the CWPP while a separate Implementation Team may be used to carry projects forward.

The focus of this CWPP is on the City of Golden in Jefferson County, Colorado. Values at risk include human life and welfare, private residences, wildlife habitat, recreational land, businesses, and critical infrastructure. This risk is primarily associated with the large areas of grass and brush fuels bordering the community.

Wildfires are a relatively common occurrence in Jefferson County. The Golden Fire Department responded to 143 fires in grass, brush, and forests from 2000 through 2006. While the major fires that scorched hundreds of thousand of acres within the county in the last decade have occurred in the forested mountains some distance to the west and southwest of Golden, they indicate the scale of the wildland fire issue within Jefferson County and particularly in the wildland urban interface (WUI).

Natural resource management policy and changing ecological conditions have interacted to produce vegetation management concerns in and near the assessment areas. These issues include historic fire exclusion policy, overstocked or decadent vegetation communities, invasive plants, and changing climatic patterns. The accumulation of wildland fuels may set the stage for problematic wildfires, resulting in the loss of

important economic and ecological values. Key concerns in the Golden area are invasive weeds, encroachment of mountain mahogany into grasslands, and overall grassland health.

The Golden Fire Department maintains 11 pieces of apparatus garaged in four stations. Of the 48 volunteer firefighters, all have received training in wildland firefighting and 24 are on the wildland team. These dedicated volunteers respond to an average of more than 1,100 calls and 15 to 20 wildland fires per annum.

Public meetings were convened on February 8 and April 5, 2007 at 7:00 p.m. in the Golden Community Center. The meetings were announced through the Golden *Informer* newsletter, county and city websites, the posting of more than 100 fliers, and direct contact outreach to homeowner's associations. The purpose of the first meeting was to explain the wildfire risk assessment, present the findings of the risk assessment, provide an opportunity for the public to participate in the process, and comment on proposed mitigation possibilities such as hazardous fuels management and non-fuel projects. The purpose of the second meeting was to present the findings of the CWPP to the public.

Questionnaires were distributed at meetings and mailed to all residences to obtain information on public opinion towards wildfire risk in Golden, evaluate values at risk, and assess mitigation practices needed to reduce risk. WUI safety pamphlets and brochures that explained proper home construction and landscaping practices to reduce the risk of wildfire loss were also handed out at the meetings. A draft report of the CWPP was posted on the Jefferson County Emergency Management's website to encourage public review and comment.

The National Fire Protection Association (NFPA) Form 1144, Standard for Protection of Life and Property from Wildfire, 2002 Edition, was used to assess the level of risk and hazard to communities and individual houses during the community assessment conducted in February 2007. The evaluation rated attributes such as means of access, surrounding vegetation (fuels), presence of defensible space, topography, roofing and other construction materials, available fire protection, and placement of utilities. Scores were assigned to each element and then totaled to determine the level of risk. Low, moderate, and high hazard categories were determined based on the total score.

The City of Golden was divided into three assessment areas based on recommendations from the fire department. Though the urban core of Golden was not assessed as WUI, several general observations regarding fire potential are made. Using the NFPA assessment approach, the three assessment areas were rated moderate as to fire hazard (Table ES-1).

Table ES-1. Community Hazard Rating and Contributing Factors

Area	Hazard Rating	Contributing Factors
North	Moderate	• (+) Generally light fuels • (-) Clusters of homes with wood shake roofs and combustible building materials • (+) Excellent fire department response, water and street systems • (-) Cul-de-sacs in excess of 300 feet • (-) Steep slopes in proximity to homes • (-) Most homes would benefit from improved defensible space
Southwest	Moderate	• (+/-) Generally light fuels with some pockets of brush close to homes • (+/-) Combustible building materials, but generally non-combustible roofs • (+) Excellent fire department response, water and street systems • (-) Cul-de-sacs in excess of 300 feet • (-) Steep slopes in proximity to homes • (-) Most homes would benefit from improved defensible space
Southeast	Moderate	• (+) Generally light fuels • (+/-) Combustible building materials, but generally non-combustible roofs • (-) Above ground utilities • (+) Excellent fire department response, water and street systems • (-) Cul-de-sacs in excess of 300 feet • (-) Steep slopes in proximity to homes • (-) Most homes would benefit from improved defensible space
Urban Areas	NA	• (+) Much of the occluded open space is being developed or becoming irrigated for parks and golf courses • (-) Some park areas are remaining in undeveloped state and are more susceptible to fire • (-) Drainage and trail corridors are prone to brush build-up, often in proximity to homes • (+/-) Issues of weed problems typical of urban areas • (+) Wildfire is of a low and diminishing concern, though some unkempt areas merit attention

The highest priority hazardous fuels reduction project starts at the home, the most important line of defense in the event of a wildfire. The creation of defensible space around homes and the utilization of fire resistant construction materials, combined with some common sense practices around the home and property will significantly reduce the risk of life and property loss in the event of a wildfire. When these Firewise practices become the predominant model in a neighborhood the entire community benefits.

The predominant fuels in the assessment area are grasses and shrubs. In neighborhoods that interface with these fuel types, effective hazard reduction occurs by establishing a

mowed perimeter on private property that interfaces with open space. Other priority action items include:

- Improving defensible space
- Phasing out wood shake roofs
- Clean-up of brush in proximity to homes
- Fire prevention education

Table ES-2 summarizes the proposed community mitigation projects and schedule for the City of Golden.

Table ES-2. Proposed Wildfire Mitigation Projects and Schedule

Year	Project	Actions
1	Annual spring outreach	▪ Contact and/or organize homeowners
	Annual spring mitigation (Defensible Space)	▪ Basic yard clean-up and disposal ▪ Clean roofs and gutters ▪ Trim limbs/bushes within 3-5 feet of home ▪ Rake yard ▪ Help a neighbor ▪ Organize debris disposal
2	Annual spring outreach	▪ Contact and/or organize homeowners
	Annual spring mitigation (Defensible Space)	▪ Brush clean-up along property lines ▪ Repeat basic yard clean-up ▪ Organize debris disposal
3	Annual spring outreach	▪ Contact and/or organize homeowners ▪ Advise individual home owners on needed improvements to construction features
	Annual spring mitigation (Defensible Space)	▪ If necessary, coordinate defensible space efforts between homeowner groups who have created defensible space, and adjacent open space land managers.
4	Annual spring outreach	▪ Contact and/or organize homeowners ▪ Follow-up on construction feature recommendations
	Annual spring mitigation (Defensible Space)	▪ Complete any outstanding projects from previous years ▪ Begin maintenance phase ▪ Initiate construction feature improvements

Implementing, sustaining, and monitoring the CWPP is key to success. Building partnerships among community-based organizations, fire protection authorities, local governments, public land management agencies, and private landowners is necessary in identifying and prioritizing measures to reduce wildfire risk. Maintaining this cooperation is a long-term effort that requires the commitment of all partners involved. The CWPP encourages citizens to take an active role in the CWPP process by identifying needs, developing strategies, and implementing solutions.

CITY OF GOLDEN COMMUNITY WILDFIRE PROTECTION PLAN

1 INTRODUCTION

1.1 CWPP Purpose

Steep terrain, large areas of continuous fuels, and frequent high fire danger weather conditions make wildfire a significant concern in Jefferson County, Colorado. Both general and specific actions are needed to mitigate wildfire risk and improve ecosystem health. Mitigation of hazardous conditions, prevention of unwanted fires, and effective response to fires must all be addressed to ensure safety of the community.

The Community Wildfire Protection Plan (CWPP) is a strategic plan that identifies wildland fire issues facing the community and outlines prioritized mitigation actions. Once the CWPP is adopted, it is the community's responsibility to move forward and implement the action items. This may require further planning at the project level, acquisition of funds, or simply motivating individual community members. To this end, an Implementation Team should be formed with the charter to implement action items and monitor their efficacy.

Decades of aggressive fire suppression in fire-adapted ecosystems has removed a critical natural cleansing mechanism from the vegetation growth–death–regeneration cycle. Fire exclusion has altered historic forest and scrubland conditions and contributed to an unprecedented build-up of naturally occurring woody fuels. Suppression tactics have also led to an alteration of prairie habitats, supporting the invasion of highly flammable aggressive noxious weeds and grasses that can force out naturally occurring species. Add to this situation years of persistent drought that has resulted in a weakened forest infrastructure and regional epidemics of disease and insect infestation. At the same time, demographic trends have shifted the nation's population growth centers to western and southwestern states where these ecosystems are predominant. The region where these worlds intersect, where the risk of human loss is greatest, is known as the Wildland Urban Interface (WUI). The potential consequences are explosive and are receiving Congressional attention.

Precipitated by years of increasing wildfire activity and the devastating 2002 fire season, the Healthy Forests Restoration Act (HFRA) of 2003 provides the impetus for wildfire risk assessment and planning at the community level. This level of planning is referred to as the Community Wildfire Protection Plan (CWPP) and empowers the community to take advantage of wildland fire and hazardous fuel management opportunities offered under HFRA legislation. The CWPP also provides a community perspective as land management agencies prioritize fuel mitigation projects.

The CWPP offers a framework for evaluating community wildfire hazard, risks, and mitigation strategies. This plan addresses issues of community wildfire risk, structure flammability, hazardous fuels and non-fuels mitigation, community preparedness, and emergency procedures specific to the City of Golden.

1.2 City of Golden's need for a CWPP

The focus of this CWPP is on the City of Golden in Jefferson County, Colorado (Map 1 in Appendix A). The Golden Fire Department covers approximately 9 square miles, which is bounded by large areas of steep open space. Values at risk include human life and welfare, private residences, wildlife habitat, recreational land, businesses, and critical infrastructure. This risk is primarily associated with the large areas of grass and brush fuels bordering the City of Golden.

Wildfires are a relatively common occurrence in Jefferson County. The Golden Fire Department responded to 143 fires in grass, brush, forests, and natural fuels from 2000 through 2006. While the major fires that scorched hundreds of thousand of acres within the county in the last decade have occurred in the forested mountains some distance to the west and southwest of Golden, they indicate the scale of the wildland fire issue within Jefferson County. Significant fires in close proximity to homes in the lower elevation grass and brush near Golden have also occurred with a frequency warranting attention to WUI issues.

Though the wildland fuels proximate to the structures of the Golden WUI are generally grass and light brush, the steep slopes and commonly high winds of the area can generate intense fire behavior capable of endangering lives and property. This is especially true in areas of heavier brush concentration. A coordinated effort among the City of Golden, Jefferson County, and private landowners in the assessment areas is needed to manage hazardous fuels and reduce the risk from wildfire.

The CWPP provides an assessment of neighborhood wildfire risks and hazards and outlines specific mitigation treatment recommendations designed to make the City of Golden a safer place to live, work, and play. The CWPP development process can be an educational tool for people who are interested in improving the environment in and around their homes. It provides ideas, recommendations and guidelines for creating a defensible space around the house and ways to reduce structural ignitability through home improvement and maintenance.

1.3 CWPP Process

This CWPP is tailored to meet the specific needs of the City of Golden, but follows the standardized steps for developing a CWPP (Table 1) as outlined by state and federal agencies (Colorado State Forest Service 2005; Society of American Foresters 2004).

Table 1. Eight Steps to Developing a CWPP for the City of Golden

Step	Task	Explanation
One	Convene Decision Makers	Form a Core Team made up of representatives from local governments, fire authorities, and Colorado State Forest Service (CSFS).
Two	Involve Federal Agencies	Engage local representatives of the U.S. Forest Service (USFS) and other land management agencies as appropriate.
Three	Engage Interested Parties	Contact and encourage participation from a broad range of interested organizations and stakeholders.
Four	Establish a Community Base Map	Develop a base map of the district that defines communities at risk, critical infrastructure, and forest/open space at risk.
Five	Develop a Community Risk Assessment	Develop a risk assessment that considers fuel hazards, risk of wildfire occurrence, homes, business, and at risk infrastructure and other values, and preparedness capability. Rate the level of risk and incorporate into the base map as appropriate.
Six	Establish Community Priorities and Recommendations	Use the risk assessment and base map to facilitate a collaborative public discussion that prioritizes fuel treatments and non-fuel mitigation practices to reduce fire risk and structural ignitability.
Seven	Develop an Action Plan and Assessment Strategy	Develop a detailed implementation strategy and a monitoring plan that will ensure long-term success.
Eight	Finalize the CWPP	Finalize the CWPP and communicate the results to interested parties and stakeholders.

The initial step in developing the City of Golden CWPP is to organize an operating group that serves as the core decision-making team (Table 2). At a minimum, this Core Team consists of representatives from local government, local fire authorities, and the CSFS. In addition, the Core Team should include relevant land management agencies and active community stakeholders. Collaboration between agencies and with communities is an important CWPP component as it drives sharing of perspectives, plans, priorities, and other information that would be useful to the planning process. Together these entities guide the development of the CWPP as described in the HFRA and must mutually agree on the plan's final contents.

Table 2. City of Golden CWPP Core Team Members

Team Member	Organization	Phone Number
Jerry Stricker, Fire Marshal	Golden Fire Department	303-384-8093
Allen Gallamore, District Forester	Colorado State Forest Service	303-278-9757
Rocco Snart, Wildfire Mitigation Specialist	Jefferson County Emergency Management	303-271-4900
Randy Frank, Natural Resource Management Supervisor	Jefferson County Open Space	303-271-5925

As a strategic plan, the success of the CWPP hinges on effective and long-term implementation of identified objectives. The Golden CWPP Core Team will identify an Implementation Team that will move the plan forward, implement prioritized recommendations and maintain the plan as the characteristics of the WUI change over time. This team should include stakeholders such as representatives from affected homeowners associations, water districts, local public land management agencies, forest product interests, and city or community council members, to name a few. CWPP Core Team representatives may, but are not required to help implement the action plan. Public meetings are recommended as a means to generate this needed support.

The successful CWPP utilizes available geographical information (GIS) to develop a community base map. Comprehensive risk assessment is conducted at the neighborhood or community level in order to determine relative levels of wildfire risk to better address hazard treatment prioritization. A standardized survey methodology is utilized in order to create an addressable rating benchmark for comparative future assessments.

CWPP fuel treatment recommendations derived from this analysis are prioritized through an open and collaborative effort with the Core Team and stakeholders. Prioritized treatments target wildfire hazard reduction in these WUI communities and neighborhoods, including structural ignitability and critical supporting infrastructure. An action plan guides treatment implementation for high priority projects over the span of several years.

The finalized CWPP represents a strategic plan with Core Team consensus, which provides prioritized wildfire hazard reduction treatment projects, preferred treatment methods, a base map of the WUI, defensible space recommendations, and other information relevant to the scope of the project.

1.4 Policy and Regulatory Framework

This CWPP is not a legal document, but rather a planning document. There is no legal requirement to implement the recommendations herein. Actions on public lands will be subject to applicable federal, state, and county policies and procedures. Action on private land may require compliance with county land use codes, building codes, and local covenants.

There are several federal legislative acts that set policy and provide guidance to the development of the CWPP for the City of Golden:

- Healthy Forests Restoration Act (HFRA) (2003) – Federal legislation to promote healthy forest and open space management, hazardous fuels reduction on federal land, community wildfire protection planning, and biomass energy production.

- National Fire Plan and 10-year Comprehensive Strategy (2001) – Interagency plan that focuses on firefighting coordination, firefighter safety, post-fire rehabilitation, hazardous fuels reduction, community assistance, and accountability.

- Federal Emergency Management Agency (FEMA) Disaster Mitigation Act (2000) – Provides criteria for state and local multiple-hazard and mitigation planning.

An additional resource for WUI communities is the Firewise program. Firewise is a national educational program that encourages enhanced fire safety in the WUI by providing resources and guidance in the principles of prevention, mitigation, and preparedness targeted to local communities and individuals (www.firewise.org).

1.5 City of Golden Wildfire Management Goals and Objectives

There are several goals and objectives for the CWPP process, as summarized in Table 3.

Table 3. City of Golden Goals and Objectives for Wildfire Management Planning

Goals	Objectives
Facilitate a CWPP in the City of Golden of Jefferson County	• Provide oversight to all activities related to the CWPP. • Ensure representation and coordination among agencies and interest groups. • Develop a long-term framework for sustaining CWPP efforts.
Conduct a wildfire risk assessment	• Conduct a community-wide wildfire risk assessment. • Identify areas at risk and contributing factors. • Determine the level of risk that wildfires and contributing factors pose to structures.
Develop a mitigation plan	• Identify and prioritize hazardous fuel treatment projects. • Identify and prioritize non-fuels mitigation needs.
Manage hazardous fuels	• Stimulate homeowner initiatives in fuels reduction. • Identify priority fuel treatments based on risk, secure funding, and help implement projects. • Focus strategic hazardous reduction projects near values-at-risk.
Facilitate emergency planning	• Develop strategies to strengthen wildfire emergency management, response, and evacuation capabilities. • Build relationships between county government, fire authorities, and communities.
Facilitate public outreach	• Develop strategies to increase citizen awareness and action for Firewise practices. • Promote public outreach and cooperation for all fuels reduction projects to solicit community involvement and private landowner cooperation.

2 WILDLAND FIRE MANAGEMENT PRIMER

Wildland fire is defined as any fire burning wildland fuels and includes prescribed fire, wildland fire use, and wildfire. Prescribed fires are planned fires ignited by land managers to accomplish resource management objectives. Wildland fire use (WFU) is when naturally occurring fires are allowed to burn under carefully prescribed conditions in order to accomplish resource management objectives. Wildfires are unwanted and unplanned fires that result from natural or human-caused ignitions. The Golden Fire Department actively suppresses all wildfires, and WFU is not authorized in the City of Golden.

Wildland fires may be further classified as ground, surface or crown fire. Ground fire refers to burning/smoldering materials beneath the surface including duff, tree or shrub roots, decaying wood, peat, and sawdust that normally support a glowing combustion without flame. Surface fire refers to loose fuels burning on the surface of the ground such as leaves, needles, small branches, as well as grasses, forbs, low and medium shrubs, tree seedlings, fallen branches, downed timber, and slash. Crown fire is a wildland fire that moves rapidly through the crowns of trees or shrubs independently of a surface fire.

2.1 Wildland Fire Behavior

Fire risk is the probability that wildfire will start from natural or human-caused ignitions. Fire hazard is the presence of ignitable fuel coupled with the influences of terrain and weather. The nature of fuels, terrain, and weather conditions combine to dictate fire behavior, often described in terms of rate of spread and intensity. Wildland fuel attributes refer to both dead and live vegetation and include such factors as density, fuel bed depth, continuity, loading, vertical arrangement, and moisture content.

When fire burns in the forest understory or through grass, it is generally a surface fire. When fire burns through the canopy of vegetation or overstory, it is considered a crown fire. The vegetation that spans the gap between the forest floor and tree crowns can allow a surface fire to become a crown fire and is referred to as ladder fuel.

For fire to spread, materials such as trees, shrubs, or structures in the flame front must meet the conditions of ignitability. The conditions needed are the presence of oxygen, flammable fuel, and heat. Oxygen and heat are implicitly available in a wildland fire. But, if the potential fuel does not meet the conditions of combustion, it will not ignite. This explains why some trees, patches of vegetation or structures may survive a wildland fire and others in the near vicinity are completely burned.

Potential surface fire behavior may be estimated by classifying vegetation in terms of fire behavior fuel models (FBFM) and using established mathematical models to predict potential fire behavior under specific climatic conditions (Table 4). In this analysis,

FBFMs were determined through a combination of field evaluations and interpreting satellite images. Climatic conditions were derived from local weather station records.

Table 4. Fire Behavior Fuel Models 1 through 10 (Anderson 1982)

Group	FBFM Number	Description
Grass	1	Short grass (1 foot)*
	2	Timber, grass, and understory
	3	Tall grass (2.5 feet)
Brush	4	Chaparral (6 feet)
	5	Brush (2 feet)
	6	Dormant brush, hardwood slash (4 feet)*
	7	Southern rough
Timber Litter and Understory	8	Closed timber litter (short-needle)*
	9	Hardwood timber, long-needle litter
	10	Timber, litter, and understory (heavy understory)*

*Fuel models found in the assessment area

Weather conditions such as high ambient temperatures, low relative humidity, and windy conditions favor fire ignition and high intensity fire behavior. Under no-wind conditions fire burns more rapidly and intensely upslope than on level terrain, but wind tends to be the driving force in fire behavior in the most destructive WUI fires. The "chinook" winds common along the Front Range may rapidly drive wildfire down slope.

Fire behavior is a description of the manner in which a fire reacts to the influences of fuel, weather, and topography. Fire behavior is observed and assessed at the flaming front of the fire and described most simply in terms of fire intensity (in feet of flame length) and in rate of forward spread (Table 5). The implications of observed or expected fire behavior are important components of suppression strategies and tactics. Fire severity, on the other hand, refers to the immediate effect a fire has on vegetation and soils.

Table 5. Fire Behavior Ratings (Stubbs 2005)

Adjective Rating	Flame Length (ft)	Implication
Low	0 - 1	Fire will burn and will spread; however, it presents very little resistance to control and direct attack by firefighters is possible.
Moderate	1 - 3	Fire spreads rapidly presenting moderate resistance to control but can be countered with direct attack by firefighters.
Active	3 - 7	Fire spreads very rapidly presenting substantial resistance to control. Direct attack by firefighters must be supplemented with equipment and/or air support.
Very Active	7 - 15	Fire spreads very rapidly presenting extreme resistance to control. Indirect attack may be effective. Safety of firefighters in the area becomes a concern.
Extreme	> 15	Fire spreads very rapidly presenting extreme resistance to control. Any form of attack will probably not be effective. Safety of firefighters in the area is of critical concern.

2.2 History of Fire

Lightning and human-caused fire has long been an integral part of vegetation communities in the assessment area. Lightning-ignited fire is a natural component of Jefferson County ecosystems, and its occurrence is important to maintaining the health of forest and open space ecosystems. Native Americans used fire as a tool for hunting, improving wildlife habitat, land clearing, and in warfare. As such, many of the plant species and communities are adapted to recurring fire through phenological, physiological, or anatomical attributes. Some plants, such as lodgepole pine and western wheatgrass, require reoccurring fire to persist.

European settlers, land use policy, and changing ecosystems have altered fire behavior and fuels accumulation from their historic setting. Euro-American settlers in Jefferson County changed the natural fire regime in several interrelated ways. The nature of vegetation (fuel) changed due to land use practices such as homesteading, livestock grazing, agriculture, water development, and road construction. Livestock grazing reduced the amount of fine fuels such as grasses and forbs, which carried low-intensity fire across the landscape. Continuous stretches of forest and open space fuels were broken up by land clearing activities. The removal of the natural vegetation facilitated the invasion of non-indigenous grasses and forbs, some of which create more flammable fuel beds than their native predecessors.

In addition, more than a century of fire suppression policy has resulted in large accumulations of surface and canopy fuels in western forests and brushlands. Fuel loads are also increased as forests and brushlands encroach into grasslands as a result of fire exclusion. This increase in fuel loading and continuity has created hazardous situations for public safety and fire management, especially when found in proximity to communities. These hazardous conditions will require an array of mitigation tools, including prescribed fire and mechanical treatments

2.3 Prescribed Fire

Prescribed fire in Jefferson County is used to accomplish a number of resource management objectives, such as ecosystem maintenance, hazardous fuels reduction, plant species diversity, noxious and invasive weed abatement, and wildlife habitat improvement. Multiple resource management objectives are often achieved concurrently. The use of prescribed fire in the WUI is carefully planned, enacted only under favorable weather conditions, and must meet air quality requirements of the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (CAPCD). Open burning permits are obtained from Jefferson County, Environmental Health Services (www.co.jefferson.co.us/health/health_T111_R38.htm) and must also be obtained from the Golden Fire Department.

Prescribed fire may be broadcast over a defined area or concentrated in localized burn piles. Broadcast burns are used to simulate natural occurring fire but they only occur

under carefully pre-planned and specified conditions. Pile burns are the use of fire to dispose of concentrations of non-merchantable woody fuel that are collected after a mechanical treatment. Pile burning is utilized when cost or issues of access make other methods of disposal unrealistic.

2.4 Wildland Urban Interface (WUI)

The WUI is the zone where communities and wildland vegetation meet, and is the central focus of this CWPP. The past several decades have seen an alarming loss of life and property in the WUI, and the creation of defensible space around homes is of critical importance to avoiding such losses. This defensible space consists of pruning trees, applying low flammability landscaping, and cleaning up surface fuels and other fire hazards near the home. These efforts can substantially increase the chance for structure survival or create an area for firefighters to work in the event of a wildfire.

While reducing hazardous fuels around a structure is very important to preventing fire loss, recent studies indicate that the attributes of the structure itself determines ignitability to a great extent. Studies of home survivability indicate that homes with noncombustible roofs and defensible space had an 85 percent survival rate (Cohen 2000). Conversely, homes with wood shake roofs and no defensible space had a 15 percent survival rate.

2.5 Hazardous Fuels Mitigation

Wildfire behavior and severity are dictated by fuel type, weather conditions, and terrain. Because fuel is the only variable of these three that can be practically managed, it is the focus of many mitigation efforts. The objectives of fuels management may include reducing surface fire intensity, reducing the likelihood of crown fire initiation, reducing the likelihood of crown fire propagation, and improving forest health. These objectives may be accomplished by reducing surface fuels, limbing branches to raise canopy base height, thinning trees to decrease crown density, and/or retaining larger fire resistant trees.

By breaking up vertical and horizontal fuel continuity in a strategic manner, fire suppression resources are afforded better opportunities to contain wildfires and community assets will have an increased probability of survival. In addition to the creation of defensible space, fuel breaks may be utilized to this end. These are strategically located areas where fuels have been reduced in a prescribed manner, often along roads. These fuel breaks may be associated with or tapered into larger area treatments. When defensible space, fuel breaks, and area treatments are coordinated, a community and the adjacent natural resources are afforded an enhanced level of protection from wildfire.

Improperly implemented fuel treatments can have negative impacts in terms of ecosystem health and fire behavior. Mowing or prescribed fire improperly applied in grasslands can degrade the health of indigenous species and create openings for invasive species. Some brush species respond to mechanical treatment with vigorous resprouting unless

combined with additional cuttings, prescribed fire, or chemical treatment. Thinning forest stands in wind prone areas too rapidly can result in subsequent wind damage to the stand. Thinning can also increase the amount of sun and wind exposure on the forest floor, which can increase surface fire intensity if post treatment debris disposal and monitoring are not properly conducted. The overall benefits of properly conducted mitigations treatments are, however, well documented.

3 CITY OF GOLDEN PROFILE

3.1 City and County Setting

Jefferson County was established in 1861 as one of the original 17 counties created by the Colorado Territorial Legislature with a land base of 774 square miles. The county population is currently estimated at 529,401 people with approximately 184,640 people living in the incorporated areas.

The City of Golden is located between 5,600 and 6,200 feet in eastern Jefferson County (Map 1). Surrounding the 9 square miles protected by the Golden Fire Department, the landscape rises steeply to mesas and peaks ranging from 6,200 to 7,500 feet. Golden is surrounded by more than 7,500 acres of city and county open space, including North Table Mountain, South Table Mountain, Mount Galbraith, Wind Saddle, Apex, Matthew Winters Park, and Lookout Mountain Nature Center (Map 2). Lakewood's 2,500 acre Green Mountain Park lies close to the southern end of the Golden area.

Golden is a rapidly growing city of over 17,160 people, with numerous businesses large and small, as well as numerous schools including the Colorado School of Mines. As the county seat, it is also home to county offices and facilities including the jail. Outdoor recreation is an important draw for residents and visitors alike. Nearby recreational opportunities include hiking, kayaking, climbing, cycling, camping, and fishing.

3.2 Climate

The Golden climate is relatively dry with the majority of precipitation occurring with spring rains and summer monsoons (Table 6). The area receives more than 240 days of sunshine per year and receives an average of 17 inches of annual precipitation. Winter high temperatures are typically in the mid 40s and summer highs in the mid 80s. The low precipitation months are typically December, January, and February. Fire weather conditions are discussed in Section 4.3.

Table 6. Average Monthly Climate Summary for Golden, Colorado (National Oceanic and Atmospheric Administration)

Climate Attribute	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Maximum Temperature (F^o)	44	47	53	59	68	80	86	84	76	65	51	45	63.2
Average Total Precipitation (inches)	0.48	0.46	1.37	2.08	2.59	2.17	1.87	1.83	1.95	1.02	1.14	0.6	17.06

3.3 Topography

Topography and elevation play an important role in dictating existing vegetation, fuels and wildland fire behavior. Topography also dictates community infrastructure design, further influencing overall hazard and risk factors. The City of Golden is located in a relatively flat valley between 5,600 and 6,200 feet in elevation. The surrounding terrain rises steeply to mesas and peaks between 6,200 and 7,500 feet. These slopes typically exceed 17 percent and regularly exceed 35 percent.

3.4 Wildland Vegetation and Fuels of the Assessment Area

The vegetation in the assessment area is typical of the foothills of the Colorado Front Range. The existing vegetation is described in detail and is categorized into FBFMs for use in modeling potential fire behavior. Historic conditions are discussed in terms of historic fire regimes to describe the fuels and role of fire in this area prior to Euro-American settlement.

Map 3 illustrates existing vegetation and FBFMs that were derived from Landsat multispectral satellite imagery, field checked at 24 points throughout the assessment area, and documented in a series of 72 photographs. Narrow draws and northern exposures below 6,500 feet tend to favor the mountain mahogany/needle-and-thread community. In the drainages to the west of Golden, Douglas-fir stands dominate the north facing slopes above 6,500 feet. Ponderosa pine is found scattered on ridge tops, southern exposures, and mixed in with the Douglas-fir stands above 6,500 feet. Grass with scattered shrubs characterizes the majority of wildland fuels within a mile of the Golden WUI.

For classifying fuels, this CWPP employs the most commonly used fire behavior fuel model set as developed by Anderson (1982). The FBFMs are used as input into fire behavior prediction models that are based on weather and fuel conditions. The differences among the 13 models relate to fuel load and the distribution of fuel-size classes. The four most prevalent FBFMs of this area are briefly outlined in Table 7 and then described in detail, including the default fuel loading from Anderson's (1982) fuel model guide and fire behavior under normal conditions. This information is valuable for planning and prioritizing fuel management projects.

Table 7. Fire Behavior Fuel Models Occurring in the Assessment Area (Anderson 1982)

Fire Behavior Fuel Model	Description
1 Short Grass	**Grass Group** – Fire spread is determined by the fine, very porous, and continuous herbaceous fuels that have cured or are nearly cured. Surface fires move rapidly through the cured grass and associated material. Very little shrub or timber is present, generally less than one-third cover of the area. Annual and perennial grasses occur in this model.
6 Intermediate Brush	**Shrub Group** – Fire spreads though the shrub layer with flammable foliage but requires moderate winds to maintain the foliage fire. Fire will drop to the ground in low wind situations. Shrubs are mature with height less than 6 feet. These stands include Gambel oak and mountain mahogany less than 6 feet tall.
8 Short-Needl Timber Litter	**Timber Group** – These fuels produce slow-burning ground fires with low flame lengths. Occasional "jackpots" may occur. Only under severe weather conditions with high temperatures, low humidity, and high winds do the fuels pose a fire hazard. These are mixed conifer stands with little undergrowth.
10 Timber with Heavy Understory	**Timber Group** – Surface fires burn with greater intensity than the other timber litter models. Dead and down are heavier than other timber models and the stands are more prone to hard-to-control fire behavior such as torching, spotting, and crown runs.

Grass, FBFM 1

The foothills grasslands are identified as FBFM 1 and are characterized by mid-grass species such as blue grama, western wheatgrass, needle-and-thread, and prairie Junegrass. These western annual grasses are adapted to the relatively frequent disturbance of fire and benefit from fast moving, "cool" fire as it will remove excessive dried biomass and add nutrients to the soil. When the accumulation of thatch and the encroachment of brush increases fuel loads, high intensity fires may have damaging affects. This may include the reduction of grass cover, increased erosion, or the encroachment of non-native species. Smooth brome is a relatively common non-native grass species found in patches on North and South Table Mountains. This relic of agricultural land use is most common on the mesa tops.

Fire return intervals for these grasslands range from approximately 10 to 35 years, allowing for a rapid departure from the historic fire regime conditions when fire is excluded. Though brush and timber fires are known for more intense fire behavior than grass fuels, the potential impact of grass fires should not be underestimated. These light, flashy fuels can be very resistant to suppression, producing incredibly rapid rates of spread and flame lengths in excess of 10 feet. They can pose a very real risk to firefighter safety and a serious threat to homes.

Characteristics: Grassland and savanna vegetation are dominant (Figure 1). Very little shrub or timber overstory is present, generally less than 30 percent of the area. Western perennial and annual grasses are common. Grass-shrub combinations that meet the above criteria are also represented.

Figure 1. FBFM 1 – Grassland

Fire behavior: Fire spread is governed by the fine, very porous, and continuous herbaceous fuels that have cured or are nearly cured. Fires are surface fires that move rapidly through the cured grass and associated material.

Fuel Model Values for Estimating Fire Behavior:

Total Fuel Load, <3-inch dead & live	.74	tons/acre
Dead Fuel Load, 0 - ¼ inch	.74	tons/acre
Live Fuel Load, foliage	0.0	tons/acre
Fuel Bed Depth	1.0	feet

Shrubland, FBFM 6

The brush fuels throughout the assessment area are typically best represented by FBFM 6 (Figure 2). Mountain mahogany is the dominant species in this area's shrublands, but little literature exists pertaining to fire behavior and fire effects in mountain mahogany. While less notorious for intense fire behavior than some shrubs, years of fire exclusion can result in dense, continuous stands with a high dead fuel component. When combined with drought conditions, this can produce extreme fire behavior.

Characteristics: Shrubs are not as tall and do not contain as much fuel as the chaparral of FBFM 4. Fuel situations to be considered include intermediate stands of Gambel oak brush, mountain mahogany, and pinyon-juniper shrubland (Figure 2).

Figure 2. FBFM 6 – Mountain Mahogany Shrublands

Fire Behavior: Fires carry through the shrub layer where the foliage is more flammable than FBFM 5 but this requires moderate winds (> 8mph @ midflame height). Fire will drop to the ground at low wind speeds or breaks in continuous stands.

Fuel Model Values for Estimating Fire Behavior		
Total Fuel Load, <3-inch dead & live	6.0	tons/acre
Dead Fuel Load, 0 - ¼ inch	1.5	tons/acre
Live Fuel Load, foliage	0.0	tons/acre
Fuel Bed Depth	2.5	feet

Timber Fuels

Forest stands begin approximately 0.3 mile from Golden's western edge. Forests on northern slopes above 6,500 feet are dominated by Douglas-fir with some ponderosa pine. This forest type is best represented by FBFM 8 (Figure 3) or by FBFM 10 where large amounts of dead material have built up on the forest floor (Figure 4). Fire exclusion may be contributing to the dominance of Douglas-fir and leading to a conversion from FBFM 8 to FBFM 10.

On drier ridge tops and south facing slopes, scattered ponderosa pine is found with a grass or shrub understory. Within a mile of Golden's boundaries, the pine is low enough in density that the fuel models are best defined as FBFM 1 for grass and FBFM 6 for shrub.

Closed Timber, FBFM 8

Characteristics: Closed canopy stands of short needle conifers or hardwoods that have leafed out support fire in the compact litter layer (Figure 3). This layer is mainly needles, leaves, and twigs because little undergrowth is present in the stand. Representative conifer types are white pine, lodgepole pine, spruce, and fir. Ponderosa pine can also be included if the understory reflects these characteristics.

Fire Behavior: Slow burning low intensity ground fires, although a fire may encounter an occasional area of heavy fuels concentration that can flare up (jackpot). Only under severe fire weather conditions does this fuel model pose a significant fire hazard, and this is typically due to fire becoming active in the crowns of trees.

Fuel Model Values for Estimating Fire Behavior

Total Fuel Load, <3-inch dead & live	5.0	tons/acre
Dead Fuel Load, 0 - ¼ inch	1.5	tons/acre
Live Fuel Load, foliage	0.0	tons/acre
Fuel Bed Depth	0.2	feet

Figure 3. FBFM 8 – Closed Canopy Timber Stands

Figure 4. FBFM 10 – Timber with Dense Understory

Timber with Woody Debris, FBFM 10

Characteristics: Any forest type may be considered FBFM 10 if heavy down woody material is present. Locally this model is represented by dense stands of over-mature ponderosa pine and Douglas-fir (Figure 4). Dead-down fuels include large quantities of 3 inch or larger limbwood resulting from over-maturity or natural events that create a large load of dead material on the forest floor.

Fire Behavior: Fire will burn in the surface and ground fuels with greater intensity than the other timber litter models. Crowning out, spotting, and torching of individual trees is more frequent in this fuel situation, leading to potential fire control difficulties.

Fuel Model Values for Estimating Fire Behavior

Total Fuel Load, <3-inch dead & live	12.0	tons/acre
Dead Fuel Load, 0 - ¼ inch	3.0	tons/acre
Live Fuel Load, foliage	2.0	tons/acre
Fuel Bed Depth	1.0	feet

Fire Regimes

Historic fire regimes describe the frequency and severity of fires prior to Euro-American settlement (Appendix A, Map 4). Burn severity refers to a fire's impact on an aspect of an ecosystem resulting from a combination of heat produced in the flaming front (intensity) and the duration of an areas exposure to heat. Historic fire return intervals vary from less than 15 to more than 200 years with fire intensity and severity being similarly variable from surface fires to crown fires. The shrublands and montane forests of the Colorado Front Range are products of a mixed fire regime, experiencing both low and high severity fires.

The fire adapted grasslands historically experienced "replacement severity" fire on order of every 10 to 35 years. Though grass stalks are typically completely consumed, rapid reproduction and growth from seeds and rhizomes (underground stems) facilitate robust

post-fire recovery. The absence of fire or fire occurrence during the wrong season can compromise grassland rejuvenation and create openings for invasive non-native species.

3.5 Water Resources

Golden has an excellent municipal water supply system which has received the top rating from the Insurance Service Organization. The system has a twelve-million gallon water capacity, and even the lowest pressure hydrants in the system provide a minimum of 50 pounds per square inch (psi) of pressure. Structures throughout the community are typically within 500 feet of a hydrant. In the event of power loss, water supply remains patent through gravity feed or back-up generators.

There are numerous static water sources within a 3-mile radius of the center of town, which are potentially appropriate for helicopter operations. It is recommended that these water sources be examined by qualified engine and helicopter personnel. Access to those sights found suitable for use should be secured through standing agreements with the landowners. Sites approved for use should be inspected annually by qualified personnel.

3.6 Fire Department

The Golden Fire Department maintains 11 pieces of apparatus out of four stations. The apparatus, discussed in more detail in Section 6, include a type-3 wildland engine and type-6 wildland engine. The 9 square mile jurisdiction is divided into two response districts, with Station 1 responding in the area north of 19th Street and the closest of the other three stations responding in the southern area. Of the 48 volunteer firefighters, all have received training in wildland firefighting and 24 are on the wildland team. These dedicated volunteers respond to an average of over 1,100 calls and 20 wildland fires per annum.

An Intergovernmental Agreement for Mutual Aid between fire departments exists between the City of Golden and the other fire departments in Jefferson County to provide coverage for very large incidents with many participants (like wildfire or flood). In the case of large-scale incidents, all of the fire departments in Jefferson County, the CSFS, and USFS participate in the Annual Operating Plan for wildfire.

3.7 Values at Risk

Life safety and protection of private property are the top concerns for fire agencies operating in the WUI. There are intrinsic wildfire risks in Golden's WUI that cannot be abated, such as climate, topography, and the proximity of open space. Other risk factors can be addressed, such as inadequate defensible space, the buildup of hazardous fuels in proximity to some structures, and construction characteristics in some cases. These issues are evaluated and discussed in detail in Section 4.

Ecological values are central to the community's interests and esthetics, for residents and visitors alike. Wildfire is a natural part of ecology, and normally occurring fire is

necessary to maintain many desirable attributes such as wildlife habitat and forage. Under a normally occurring fire regime, many ecological values will recover within a few years of fire. Air quality should recover within days after a fire but wildlife habitat may take years. However, severe or unseasonable wildfire may compromise ecosystem health producing conditions conducive to the spread of noxious and invasive weeds. Ecological values at risk to wildfire in this area include:

- Wildlife and aquatic habitat
- Nearby forests
- Viewsheds
- Soil stability
- Natural vegetation communities
- Air quality

4 WILDFIRE HAZARD AND RISK ASSESSMENTS

4.1 Approach to the Wildfire Hazard/Risk Assessment

To identify the wildfire hazard and risk for the Golden area terrain, fire season weather, potential fire behavior, and history of fire occurrence were are all evaluated. A detailed community hazard/risk assessment was then performed for Golden's WUI areas. The City of Golden's WUI was identified as those neighborhoods bordering open space on the northern, western, and eastern sides of the city. For assessment and planning purposes this WUI was divided into three assessment areas based on location (Map 5).

Fire hazard refers to vegetation or wildland fuel in terms of its contribution to problem fire behavior and its resistance to control when combined with terrain and weather features. Risk is the wildland fuels' probability of ignition. Values-at-risk include infrastructure, buildings, improvements, and natural resources that are likely to suffer long-term damage from the direct impacts of a wildfire.

As part of the assessment, a concerted effort was made to solicit and include input from the public and local experts in fire and natural resource issues. Public meetings were convened on February 8 and April 5, 2007 at 7:00 p.m. in the Golden Community Center. The meetings were announced through the Golden *Informer* newsletter, county and city websites, the posting of more than 100 fliers, and direct contact outreach to homeowner's associations. The purpose of the first meeting was to explain the wildfire risk assessment, present the findings of the risk assessment, and provide an opportunity for the public to participate in the process, and comment on proposed mitigation possibilities such as hazardous fuels management and non-fuel projects. The purpose of the second meeting was to present the findings of the CWPP to the public.

Questionnaires were distributed at meetings and mailed to all residences to obtain information on public opinion and the level of wildfire risk in Golden, evaluate values at risk, and assess mitigation practices needed to reduce risk (Appendices C and D). WUI safety pamphlets and brochures that explain CSFS and Firewise home construction and landscaping practices were also handed out at the meetings (Appendix F). A draft report of the CWPP was posted on the County's emergency website to encourage public review and comment.

4.2 Fire Behavior Analysis

Fire behavior is defined as the manner in which a fire reacts to the influences of fuel, weather, and topography. Two key measures of this behavior are the rate of spread and the intensity. Rate of spread is often expressed in chains (66 feet) per hour, equal to 1.1 feet per minute. Fireline intensity is reflected by flame length at the flaming front. It does not account for continued burning of fuels once the main fire front has passed.

BehavePlus (Andrews et al. 2005) is software that was used to assess potential fire behavior given the identified FBFMs, local topography and weather conditions. The predicted fire behavior represents surface fire behavior only. Fire moving through the forest canopy and other types of extreme fire behavior are not represented in this analysis.

4.3 Terrain

The City of Golden is located between 5,600 and 6,200 feet in elevation. The surrounding terrain rises steeply to mesas and peaks between 6,200 and 7,500 feet. These slopes typically exceed 17 percent and regularly exceed 35 percent. For fire behavior modeling, a 30 percent slope was used for grass and brush while forest fuels were modeled at 45 percent, representative of the steep north facing slopes that it favors. Grass was also modeled at 10 percent to represent conditions on mesa tops.

4.4 Fire Weather

Average and severe case weather and fuel moisture conditions were determined using records from local remote access weather stations (RAWS) during the summer wildfire season. The Corral Creek, Bailey, and Sugarloaf stations were selected based on proximity, elevation, and available data (Table 8). There are closer weather stations that were not used due to their lack of historical data (see Section 4.6). Experimentation with fire behavior modeling using individual station data and a variety of time periods from the last twenty years had minimal effect on predicted fire behavior outputs.

Table 8. Remote Access Weather Stations Utilized

Station Name	Elevation	Location Relative to Golden	Years of Data
Corral Creek	7,844 feet	15 mi. west-southwest	1970-1985, 2001-2006
Bailey	7,982 feet	25 mi. southwest	1970-1992, 2000-2006
Sugarloaf	6,733 feet	20 mi. northwest	1977-1992, 1994-2006

Fiftieth percentile conditions represent average case, and 90th percentile conditions represent severe case conditions where only 10 percent of the days were hotter and drier. Percentile weather was calculated for the typical summer fire season of June through August based on data from 1970 through 2006 (Table 9). Mid-flame wind speeds of 8 miles per hour (mph) and 4 mph were used for the modeling of 90th and 50th percentile conditions respectively.

Table 9. Average and Severe Case Fire Weather and Fuel Moisture Conditions for June – August, 1970 – 2006

	Max Temp	Relative Humidity	1 hr Fuel Moisture	10 hr Fuel Moisture	100 hr Fuel Moisture	Herbaceous Fuel Moisture	Woody Fuel Moisture
50th Percentile	79 F	35%	7%	9%	12%	95%	123%
90th Percentile	87 F	16%	3%	4%	7%	31%	80%

4.5 Potential Fire Behavior

Two key measures of fire behavior are the rate of spread and the intensity. Rate of spread is here expressed in feet per minute, rather than chains per hour as commonly used in the wildland fire profession. Fireline intensity is reflected by flame length at the flaming front.

Fire behavior simulations were conducted using the afore mentioned inputs for weather (Table 9) and slope (Section 4.3). BehavePlus (Andrews et al. 2005) software was used to generally illustrate the potential surface fire behavior given the prevailing fuel types, local topography, and local weather conditions (Table 10). While any number of variables and assumptions will affect the modeled outputs, there are several significant general principles to focus on:

- The differences in fire behavior under 50th and 90th percentile conditions (drier fuels, windier conditions) are most pronounced in brush and grass fuels.
- This increase in fire behavior is approximately two-fold for flame length and five-fold for rate of spread.
- Fire behavior for most fuel types under 90th percentile conditions exceeds the 4-foot flame lengths generally considered appropriate for direct line construction with hand crews.
- If FBFM 8 converts into the denser FBFM 10, the increase in fire behavior is pronounced and conducive to the initiation of crown fire.

Table 10. BehavePlus Predictions of Fire Behavior

Fire Behavior Fuel Model	Slope	Flame Length, (ft) Average Conditions	Rate of Spread (feet/min)[1] Average Conditions	Flame Length, (ft) Severe Conditions	Rate of Spread (feet/min)[1] Severe Conditions
1 Short Grass	10%	4	59	8	309
1 Short Grass	30%	4	72	9	327
6 Brush, <6 ft	30%	6	28	10	90
8 Short-Needle Timber Litter	45%	1	2	2	6
10 Timber with Heavy Understory	45%	5	8	9	26

[1] Approximated from chains/hr

4.6 Wildfire Occurrence

Within just the past two fire seasons, several significant wildfires have occurred in close proximity to homes in the grass and brush lands of Jefferson County's lower elevations (Appendix L): North Table Mountain (300 acres), Plainview (2,000 acres), Rocky Flats (1,200 acres), Ralston Creek (26 acres). Within the county at large, the last decade has

seen hundreds of thousands of acres burned in the forests near this community, including the Buffalo Creek fire (1996), Hi Meadow fire (2000), the Snaking fire (2002), the Schoonover fire (2002) and the Hayman fire (2002). Though these occurred in areas substantially different than Golden, they illustrate a trend in increasing fire size and severity along the Colorado Front Range.

The Golden Fire Department provided records for wildland fire occurrence by month from 2000 through 2006. Fire cause and latitude/longitude were not available, but several patterns seem apparent. While no data for fire cause were provided anecdotal evidence and population density suggest that human caused fires should be a concern.

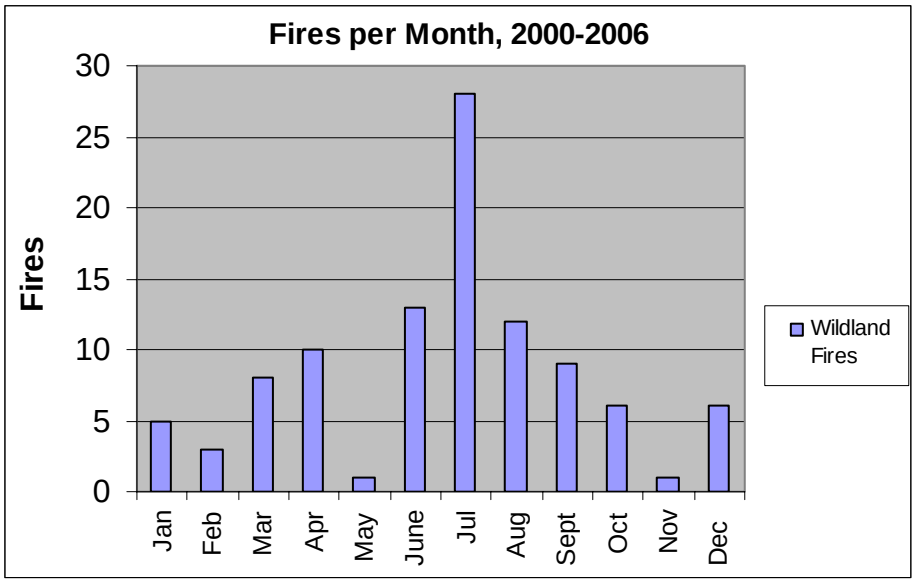
The average number of wildland fires recorded by the Golden Fire Department is approximately 17 per annum. While less than 2 percent of the average-call volume for the system, this comprises 20 percent of the fire calls. The synopsis of fires by fuel class (Table 11) indicates a frequency of timber fires disproportionate to the occurrence of this fuel class within the jurisdiction, possibly due to mutual aid calls.

Table 11. Wildfires by Fuel Class, 2000-2006

Fuel Class	Number of Fires
Grass	37
Shrub	46
Timber	28
Other vegetation	32

In examining grass fire occurrence by month (Figure 5), a strong summer fire season is apparent, with a distinct peak in July. A spring fire season in March and April is also evident. This pattern corresponds to the availability of light fuels for combustion after snow melt but prior to green-up and then again as they cure in late-summer.

Figure 5. Grass Fire Occurrence by Month



4.7 Jefferson County Fire Danger Rating System and Local Weather Information

The Jefferson County Fire Danger Rating System (JFDRS) is based on the National Fire Danger Rating System (NFDRS) implemented in 1978. It uses both RAWS and independent weather stations that are monitored with the data available from the internet. Jefferson County limits the Fire Danger Rating to NFDRS fuel model C (Pine-Grass Savanna) and G (Short-Needle [Heavy Dead]). These NFDRS fuel models are used to identify vegetation in broader fire danger terms than the FBFMs, which are used to more specifically quantify inputs for fire behavior calculations.

The RAWS stations supply all necessary data used for fire danger rating; however, the independent stations require manual inputs to calculate fire danger such as state of the weather and calculation of 1-hour fuel moisture. After the weather data is collected, the fire danger is calculated with an NFDRS calculator provided in the Fire Family Plus (Bradshaw and Brittain 2004) software. The energy release component (ERC) is then compared to the rating chart developed for Jefferson County and an adjective fire danger value (Extreme, Very High, High, Moderate, Low) is assigned. Evergreen Fire Dispatch faxes completed forms for the RAWS and independent weather stations to the county Office of Emergency Management, CSFS, and local fire agencies for distribution. The completed form with various components of the NFDRS is used for responders and an adjective fire danger for the public.

Additional weather resources include:

- Waterton North RAWS, in service July 20, 2002
  ID: WTTC2 NAME: WATERTON NORTH
  LATITUDE: 39.4672 LONGITUDE: -105.2097
  ELEVATION: 8,714 ft MNET: RAWS
- Current station conditions may be found at: http://raws.wrh.noaa.gov/cgi-bin/roman/meso_base.cgi?stn=WTTC2
- National Fire Weather Page: http://fire.boi.noaa.gov/
- Real-Time Observation Monitor and Analysis Network (ROMAN): http://fire.boi.noaa.gov/
- Current Weather Summary for Rocky Mountain Geographic Coordinating Area: http://raws.wrh.noaa.gov/cgibin/roman/raws_ca_monitor.cgi?state=RMCC&rawsflag=2

4.8 Community Hazard and Risk Assessments

Community assessments were conducted during February 2007 to determine wildfire hazards, risks, and mitigation opportunities. The WUI lies in an elongated horseshoe shaped belt where relatively dense concentrations of suburban homes abut preserved open space on the west, north, and east sides of the city (Map 5). Working with the Golden Fire Department, three separate community assessment areas were established (Table 12). These areas were grouped geographically with the North Area wrapping around the community north of Highway 58, the Southwest Area consisting of

subdivisions to the southwest or U.S. Highway 6, and the Southeast Area wrapping around the western flank of South Table Mountain. The center of Golden, which was not considered WUI, is characterized by urban/suburban development running into the City of Lakewood to the southeast.

Table 12. Community Assessment Areas Summary Information

Community Assessment Areas	Location	Surrounding Fuels
North Area	Subdivisions bordering open space north of highway 58	Grass with pockets of brush in drainages and some green strips between homes
Southwest Area	Subdivisions bordering open space southwest of US 6	Grass with areas of brush in proximity to homes on a more frequent basis than the other two assessment areas
Southeast Area	Subdivisions bordering open space northeast of S. Golden Rd/East St, south of West 32nd Ave	Grass with pockets of brush in proximity to homes in a few cases Unkempt brush along fence rows and drainages near some homes

Compared with most other fire department jurisdictions in Jefferson County, Golden has dense concentrations of structures. This can prove beneficial during a wildfire by allowing resources assigned to structure protection to remain more consolidated and able to support and communicate with one another. These resources will also be generally closer to escape routes and safety zones, compared to areas with dispersed housing patterns.

The density of structures can also be detrimental when multiple structures are simultaneously threatened or when structures present exposure problems to one another. There are similar benefits and liabilities to this housing pattern when considering mitigation efforts. In areas with small lots, the defensible space efforts of one home can support the efforts of the neighboring structure. Conversely, a lack of Firewise efforts by one resident can pose a hazard to several neighbors.

The urban center of Golden is not WUI, but has several related fire issues typical of most cities. These issues include un-irrigated parks as well as drainage and trail corridors where brush and grass have been allowed to buildup. However, fire risks for many of these areas may decrease as they are developed or irrigated.

The open space in the assessment area is characterized by light fuels and vegetation communities in generally good health. As noted, fire in these areas can pose a significant threat (Section 4.4) and fire exclusion has had an impact on the ecosystem. Access limitations in this steep terrain can render suppression action by ground forces difficult or impracticable.

The NFPA Wildland Fire Risk and Hazard Severity Assessment Form 1144 (Appendix B) was used to rate communities based on such things as access, adjacent vegetation (fuels), defensible space, topography, roof and building characteristics, available fire protection, and placement of utilities. Because the NFPA 1144 form is designed to be used for individual structures as well as communities, specific criteria were adopted for

its use. Where a range of conditions was found within and assessment area, a corresponding value was adopted. Scores are assigned to each element and then totaled to determine the community's relative risk. Low, moderate, high, and extreme hazard ratings may be assigned based on the total community score. The three Golden communities received a moderate hazard score (Table 13). Appendix C provides specific community details on methodology and results.

Table 13. Community Hazard Rating and Contributing Factors

Community Assessment Area	Hazard Rating	Contributing Factors
North Area	Moderate	▪ (+) Generally light fuels ▪ (-) Clusters of homes with wood shake roofs and combustible building materials ▪ (+) Excellent fire department response, water and street systems ▪ (-) Cul-de-sacs in excess of 300 feet ▪ (-) Steep slopes in proximity to homes ▪ (-) Most homes would benefit from improved defensible space
Southwest Area	Moderate	▪ (+/-) Generally light fuels with some pockets of brush close to homes ▪ (+/-) Combustible building materials, but generally non-combustible roofs ▪ (+) Excellent fire department response, water and street systems ▪ (-) Cul-de-sacs in excess of 300 feet ▪ (-) Steep slopes in proximity to homes ▪ (-) Most homes would benefit from improved defensible space
Southeast Area	Moderate	▪ (+) Generally light fuels ▪ (+/-) Combustible building materials, but generally non-combustible roofs ▪ (-) Above ground utilities ▪ (+) Excellent fire department response, water and street systems ▪ (-) Cul-de-sacs in excess of 300 feet ▪ (-) Steep slopes in proximity to homes ▪ (-) Most homes would benefit from improved defensible space
Urban Areas	NA	▪ (+) Much of the occluded open space is being developed or becoming irrigated for parks and golf courses ▪ (-) Some park areas are remaining in undeveloped state and are more susceptible to fire ▪ (-) Drainage and trail corridors are prone to brush build-up, often in proximity to homes ▪ (+/-) Issues of weed problems typical of urban areas ▪ (+) Wildfire is of a low and diminishing concern, though some unkempt areas merit attention

5 WILDFIRE MITIGATION PLAN

5.1 Approach to Mitigation Planning

Wildfire mitigation is defined as reducing the probability of wildfire occurrence and the negative impacts resulting from wildfire. This can be accomplished through wildland fuels management, non-fuels mitigation measures, and public outreach. Results are often most effective when these three approaches are pursued by governmental entities, citizen groups, and individuals working in concert. The key to success and the primary value of this document lie with the implementation of action items.

Hazardous fuels and non-fuels mitigation projects were identified based on the findings of field surveys, interviews with county and district fire suppression experts, and through a community questionnaire. Fuels mitigation projects were identified and prioritized based on expressed priorities of stakeholders and the Golden Fire Department, demonstrated efficacy of protecting the primary community values from wildfire, and practicality of implementation. As a result, defensible space and public education/outreach received priority. Improvement of construction features was secondary and prescribed fire and large-scale fuel treatments were a relatively low priority for the community.

5.2 Suggested Actions to Achieve Desired Results

Recommended action items are divided into a number of fuels mitigation and non-fuels related categories. Hazardous fuels reductions categories include: defensible space and potential neighborhood projects (Table 14, Map 5). Non-fuels related actions include: education and outreach, Firewise building upgrades, and fire department preparedness. While some of these projects require the support and coordination of the fire department or other governmental entities as well as substantial planning and funds, those actions most essential to the preservation of homes during a wildfire rest in the hands of the individual owner or neighborhood groups.

Table 14. Recommended Mitigation Projects by Category

Project	Actions
Outreach/Public Education	▪ Annual neighborhood outreach/organization ▪ Fire department public education program ▪ Coordinate with existing programs (e.g. Golden Pride Week) as appropriate
Defensible Space	▪ Basic yard clean-up ▪ Property line clean-up ▪ Coordination with open space ▪ Debris disposal ▪ Public education regarding disposal through the Golden Forestry Division ▪ Maintenance
Firewise Building Improvements	▪ Replace shake roofs ▪ Enclose exposed decks and gables

Project	Actions
	▪ Screen vents and chimneys ▪ Other actions as needed
Area Treatments	▪ Support efforts of neighboring jurisdictions ▪ Explore opportunities for prescribed fire
Supporting Actions	▪ Funding and grants ▪ Revisions to county/local statutes
Fire Department Preparedness	▪ Continue firefighter training ▪ Continue improvement of firefighter equipment and fire apparatus ▪ Tactical pre-suppression planning

Table 15 proposes a wildfire mitigation project schedule, that when implemented would reduce the hazards and risks of wildfire throughout the assessment area.

Table 15. Recommended Wildfire Mitigation Projects and Schedule

Year	Project	Actions
1	Annual spring outreach	▪ Contact and/or organize homeowners
	Annual spring mitigation (Defensible Space)	▪ Basic yard clean-up and disposal ▪ Clean roofs and gutters ▪ Trim limbs/bushes within 3-5 feet of home ▪ Rake yard ▪ Help a neighbor ▪ Organize debris disposal
2	Annual spring outreach	▪ Contact and/or organize homeowners
	Annual spring mitigation (Defensible Space)	▪ Brush clean-up along property lines ▪ Repeat basic yard clean-up ▪ Organize debris disposal
3	Annual spring outreach	▪ Contact and/or organize homeowners ▪ Advise individual home owners on needed improvements to construction features
	Annual spring mitigation (Defensible Space)	▪ If necessary, coordinate defensible space efforts between homeowner groups who have created defensible space, and adjacent open space land managers.
4	Annual spring outreach	▪ Contact and/or organize homeowners ▪ Follow-up on construction feature recommendations
	Annual spring mitigation (Defensible Space)	▪ Complete any outstanding projects from previous years ▪ Begin maintenance phase ▪ Initiate construction feature improvements

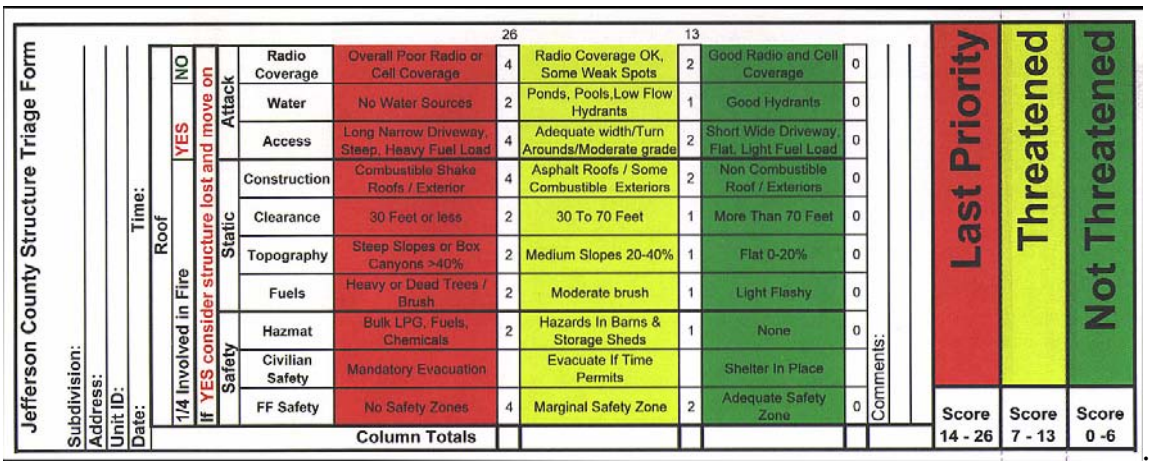
Outreach and Public Education: The most effective form of mitigation can be education and outreach. The purpose of a community-wide education program is to: 1) educate the public to the risks of wildfire to property and life; 2) motivate property owners to take responsibility in reducing the risk of wildfire and to create defensible space around their structures; 3) teach the benefits of different types of fire resistant building materials; and 4) educate the public as to the historic role of fire. Education makes other mitigation programs possible.

Action Item: Annual fire department outreach efforts, such as individual home assessments or neighborhood meetings, may substantially increase citizen interest in subsequent defensible space initiatives. Coordinating this effort with the annual Golden Pride Week may be a good option. Firewise materials and postings should be made available to the public at the community center, fire stations, post offices, and schools every year. A coordinated disposal method for yard waste may spur individual action. This may be greatly enhanced by public education regarding slash disposal through the Golden Forestry Division.

Defensible Space: An action that can be taken immediately to improve community hazard ratings is the implementation of defensible space around individual homes. It is recommended that the creation of defensible space follow the CSFS guidelines as set forth in *Creating Defensible Space Zones, Bulletin No.6.302* (Dennis 2003), which is consistent with City of Golden codes for vegetation management (Appendices G and M). The focus of *Creating Defensible Space Zones, Bulletin No.6.302* is on forested WUI interface communities. However, the principles of defensible it presents are also applicable to grassland WUI communities. A recommendation is that grass height should be mowed between 4 to 6 inches. Areas where grasses are mowed to height of less than 4 inches could be susceptible to weedy plant colonization. Weed abatement may be useful in some areas currently dominated with weeds and these areas could be improved with the reseeding of native grasses. Appendix L provides information on appropriate grass seed mixtures and seeding rates.

Action Item: This is the primary recommendation for hazard fuels mitigation within the Golden area. It is suggested that the above outreach efforts be used to coordinate and spur implementation and debris disposal at the neighborhood level. The homes with the highest needs for defensible space are situated adjacent to city or county open space. These homeowners may wish to coordinate defensible space actions with vegetation management on public land. The City of Golden Department of Parks and Recreation and Jefferson County Open Space may wish to consider formalizing a procedure whereby a group of homeowners who has established defensible space on their own land may petition for fuels management on adjacent open space.

When this principal of defensible space is combined with fire resistant construction and some common sense, the risk of structure loss is greatly reduced. When these principals are consistently applied across a neighborhood, everybody benefits. Additionally, in the event of a wildfire, homes and neighborhoods with Firewise defensible space and construction are much more likely to be assigned structure defense crews than those without. Jefferson County has developed a structure triage system that helps determine the ability for a fire department to defend homes during a wildfire incident (Figure 6).



Jefferson County Structure Triage Form																	
Subdivision:									26			13					
Address:								Radio Coverage	Overall Poor Radio or Cell Coverage	4	Radio Coverage OK, Some Weak Spots	2	Good Radio and Cell Coverage	0		Last Priority	
Unit ID:						Attack		Water	No Water Sources	2	Ponds, Pools,Low Flow Hydrants	1	Good Hydrants	0		Threatened	
Time:								Access	Long Narrow Driveway, Steep, Heavy Fuel Load	4	Adequate width/Turn Arounds/Moderate grade	2	Short Wide Driveway, Flat, Light Fuel Load	0		Not Threatened	
Date:	Roof	NO	If YES consider structure lost and move on	Static	Construction	Combustible Shake Roofs / Exterior	4	Asphalt Roofs / Some Combustible Exteriors	2	Non Combustible Roof / Exteriors	0	Comments:					
		YES			Clearance	30 Feet or less	2	30 To 70 Feet	1	More Than 70 Feet	0						
	1/4 Involved in Fire				Topography	Steep Slopes or Box Canyons >40%	2	Medium Slopes 20-40%	1	Flat 0-20%	0						
					Fuels	Heavy or Dead Trees / Brush	2	Moderate brush	1	Light Flashy	0						
				Safety	Hazmat	Bulk LPG, Fuels, Chemicals	2	Hazards In Barns & Storage Sheds	1	None	0						
					Civilian Safety	Mandatory Evacuation		Evacuate If Time Permits		Shelter In Place							
					FF Safety	No Safety Zones	4	Marginal Safety Zone	2	Adequate Safety Zone	0					Score 14 - 26	Score 7 - 13	Score 0 -6
					Column Totals												

Figure 6. Jefferson County Structure Triage Form

Effective defensible space consists of a fuel-free zone adjacent to the home, a treated secondary zone that is thinned and cleaned of surface fuels, and if the parcel is large enough, a transitional 3rd zone that is basically a managed forest area (Figure 7). These components all work together in a proven and predictable manner. Zone 1 keeps fire from burning directly to the home; Zone 2 reduces the adjacent fire intensity and the likelihood of torching, crown fire, and ember production; and Zone 3 does the same at a broader scale, keeping the fire intensity lower by maintaining a more natural, historic condition, which in turn reduces the risk of extreme/catastrophic fire behavior.

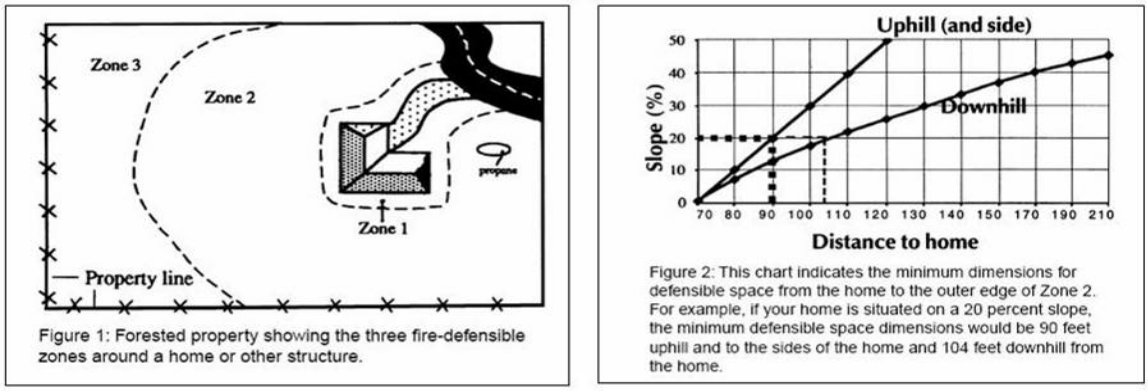


Figure 1: Forested property showing the three fire-defensible zones around a home or other structure.

Figure 2: This chart indicates the minimum dimensions for defensible space from the home to the outer edge of Zone 2. For example, if your home is situated on a 20 percent slope, the minimum defensible space dimensions would be 90 feet uphill and to the sides of the home and 104 feet downhill from the home.

Figure 7. CSFS Defensible Space Standards (Dennis 2003)

Zone 1 (0-15 feet from structure): Within 3-5 feet of the structure, decorative rock or mowed, irrigated grass is recommended (Appendix G). Well-spaced and pruned low flammability plants are acceptable if the structure has noncombustible siding. In the remainder of Zone 1, trees braches should be pruned 5-10 feet above the ground (not to exceed ⅓ of the tree height). Dead wood, tall grass, and ladder fuels (low limbs, small trees, and shrubs that may carry fire into tree crowns) should be removed from this area. Leaves and overhanging branches should be removed from the roof and gutters.

Vegetation in this area should be irrigated as needed to ensure plant health and reduce flammability. Woodpiles should be removed and stored in Zone 2.

Zone 2 (15 to at least 75 feet from structure or to the property line): The size of this zone is dependent upon slope. Treatment of fuels and ladder fuels is generally the same as Zone 1. Trees (or small groups of trees) and shrubs should be thinned to provide 10 feet of clearance between crowns. Grass should be mowed as it dries in late summer.

Zone 3 (beyond Zone 2 to property line): This area outside of Zone 2 should be managed for the appropriate land use objectives, such as forest health, aesthetics, recreation, and wildlife habitat.

Defensible Space efforts can be encouraged and coordinated annually through neighborhood meetings, and most of this work can be done by the homeowner with little more than hand tools. A phased approach will make this effort less daunting (refer to Table 15). It should be emphasized that defensible space can be created in an esthetically pleasing manner that maintains privacy and the natural character of the community (Figure 8). Defensible space should also be created around outbuildings. Assisting neighbors may be essential in many cases. For example: assisting the elderly, sharing ladders for gutter cleaning, and assisting neighbors with larger needs.

Figure 8. Defensible space and privacy can be compatible

Building Improvements: Improving the Firewise characteristics of structures goes hand-in-hand with the construction of defensible space. Extensive recommendations may be found in CSFS publications available at http://csfs.colostate.edu/library.htm. The most significant improvement that can be made to some of the homes in the assessment areas, is replacing wood shake roofs with noncombustible Class A roofing material, as required for all new roofs in Jefferson County's WUI. All homeowners, and especially those with wood roofs, should keep roofs and gutters clear of leaves and pine needles. Embers can travel surprising distances (over 1 mile) and ignite receptive pockets of fuel far from the main fire. Gutters and roof vents should be screened, and enclosing the underside of exposed decks should be considered.

Action Item: Individual home assessments or less detailed general recommendations may be incorporated as part of an outreach initiative. It is suggested that construction feature recommendations and improvements be a part of the wildfire mitigation project schedule.

Fuel breaks: Access roads may be maintained as fuel breaks where possible. Reducing the amount of vegetation along access roads provides strategic fuel breaks along likely evacuation and incident access routes. Herbaceous vegation along roads may be mowed to a height of 4 to 6 inches approximately 10 feet on each side to create fuel breaks. This creates a safer emergency ingress/egress scenario while greatly aiding potential tactical suppression efforts. There are several roads and trails in the Apex Park, North Table Mountain, and South Table Mountain areas that may be considered for this purpose. Though no fuel breaks are recommended in forested areas, Appendix F is included as a reference. The guidelines presented in Appendix F are also applicable to grassland situations. Since many weeds are highly flammable, some areas that are dominated by weeds may benefit from an appropriate weed abatement treatment followed by the seeding of native grasses (Appendix K).

Area Treatments of Hazardous Fuel: Wildfires frequently burn across jurisdictional boundaries. As such, large scale hazardous fuels management must be coordinated across jurisdictions and ownership boundaries. The objectives of these vegetative treatments are to reduce buildup of hazardous fuels to reduce fire intensity and rates of spread. These efforts can increase the efficacy of fire suppression efforts as well as return ecosystems to a healthier and less combustible status.

Large-scale fuel treatments are subject to a number of hurdles, including funding, lack of public understanding, environmental impact, and ownership issues. While no specific large-scale area treatment projects are proposed or scheduled within the Golden Fire Department's jurisdiction, participation in future projects on adjoining lands should be considered. Much of the open space surrounding Golden is Jefferson County Open Space land. The county is engaged in a number of projects in areas of poor ecosystem health, which do not currently include the areas adjacent to Golden.

Dense concentrations of brush fuels should be examined for possible future thinning or prescribed fire. Thinning projects may be used to breakup the continuity of these fuel beds. Under the right conditions, prescribed fire can convert areas of mountain mahogany brush to grass. Either of these practices will require maintenance and possibly combinations of treatments. Any such projects will require further study and specific prescriptions. Some areas could benefit from the seeding of native grasses to reduce fuel flammability and provide erosion control. Appendix K provides information on appropriate seeding mixes.

Action Item: The Golden Fire Department, City of Golden Parks and Recreation, Jefferson County Open Space, and Jefferson County Office of Emergency Management should investigate opportunities for prescribed fire that combine the benefits of ecosystem maintenance, wildland fire training, and wildland fuels management.

Weeds: Invasive and noxious weedy vegetation also contribute to fuel hazards. Integrated weed management programs will reduce this fuel hazard around and within

communities and improve the health of plant communities. The seeding of native grasses and forbs on highly disturbed sites would reduce fuel hazard.

Access: With paved roads in excess of 25 feet wide, the road system in the Golden WUI is in excellent condition. Several areas where the road grade exceeded 5 percent or cul-de-sacs exceeded 300 feet were noted, but turnarounds for apparatus are provided. No actions are proposed for access within the communities.

While the access within the communities is quite good, access to the surrounding open space is generally very limited. This is in keeping with the land management objectives of these areas and no action items beyond normal maintenance of trails and current roads are proposed. This issue of limited access does need to be recognized in any suppression response plans, strategies, and tactics for this area. As previously mentioned, road and trail systems can be utilized as a basis for fuel breaks.

5.3 Treatment Options

While no specific, large-scale treatment projects are proposed for the Golden area, this brief synopsis of treatment options and cost estimates is provided for general knowledge or potential future actions. Cost estimates for treatments should be considered as general guidelines (Table 16). Costs can vary tremendously, but generally run $300 to $1,200 per acre depending upon:

- Diameter of materials
- Acreage of project
- Steepness of slope
- Density of fuels
- Proximity to structures
- Fuel costs
- Area accessibility

Table 16. Treatment Options Typical of Colorado Front Range

Treatment	Estimated Cost	Comments
Machine Mowing	$90 - $200/acre	▪ Appropriate for large, flat grassy areas on relatively flat terrain
Prescribed Fire	$100 - $125/acre	▪ Can be very cost effective ▪ Ecologically beneficial ▪ Can be used as training opportunities for firefighters ▪ Obtain permit from JeffCo Environmental Health Services ▪ May require manual or mechanical pre-treatment ▪ Carries risk of escape which may be unacceptable in some WUI areas ▪ Unreliable scheduling due to weather and smoke management constraints
Brush Mastication	$300 - $500/acre	▪ Brush species (Gamble oak in particular) tend to resprout vigorously after mechanical treatment ▪ Follow-on treatment with herbicides, fire, grazing, or further mechanical treatments are typically necessary ▪ Mastication tends to be less expensive than manual (chain saw) treatment and eliminates disposal issues
Timber Mastication*	$300 - $1,200/acre	▪ Materials up to 10” in diameter and slopes up to 30 percent can be treated

Treatment	Estimated Cost	Comments
		▪ Eliminates disposal issues ▪ Environmental impact of residue being left on-site are still under study
Manual Treatment with Chipping or Pile Burning*	$300 - $1,200/acre	▪ Allows for removal of merchantable materials or firewood in timber ▪ Requires chipping, hauling, and pile burning of slash ▪ Must comply with CAPCD smoke management policy
Feller Buncher*	$750 and up/acre	▪ Mechanical treatment on slopes over 30 percent or of materials over 10" in diameter may require a feller-buncher rather than a masticator ▪ Costs tend to be considerably higher than masticator ▪ May allow for removal of merchantable material

*Treatments not applicable for fuels found within Golden Fire Department jurisdiction).

It is imperative that implementers plan for the long-term monitoring and maintenance of all treatments. Post-treatment rehabilitation including seeding with native plants and erosion control may be necessary.

5.4 Supporting Projects

Outreach and defensible space initiatives accompanied by construction feature improvements are the central focus of the mitigation efforts. Prescribed fire and other fuel treatments are possible future actions that may occur on the adjacent open space. All of these initiatives will benefit from one or more of the following supporting projects.

Funding and Grants: Grant support may be able to accelerate treatment on larger private holdings and along roads as well as disposal. In addition to close coordination with the Jefferson County Office of Emergency Management, an excellent resource for finding grants is www.rockymountainwildlandfire.info.

Public Land Planning: Denver Mountain Parks and Jefferson County Open Space along with local parks departments manage a significant portion of the wildlands in western Jefferson County. The management focus on these lands is understandably on environmental and recreational issues rather than community protection. Fire management projects are a natural nexus for these concerns. Once the CWPPs are completed throughout the county, it may be advisable for the heads of these agencies to meet with Jefferson County Emergency Management (EM) and determine if there is a need to adjust any projects or planning efforts to support any CWPPs.

Regulatory Actions: One of the major issues confronting defensible space and hazardous fuels mitigation is the need for maintenance. While county statutes require defensible space for new construction, there is no requirement for maintenance and no retroactive regulation for existing structures. For defensible space to be consistently successful some regulatory impetus may be necessary. Jefferson County should examine the options for requiring the maintenance of defensible space. This could be associated with the sale of a home or based on time since initial treatment. Those communities with local statutes or covenants should consider similar regulation as an interim step and to

help drive the initiative from the bottom up. This is a public safety issue where failure to maintain one's property can create a hazard for firefighters, adjacent properties, and the community.

5.5 Need for Action

Wildfire occurrence in Jefferson County is common. Ignition usually results from natural causes, although human-caused fire potential is high. Steep terrain, large areas of continuous fuels, and frequent high fire danger weather conditions make wildfire a significant concern in this area, as substantiated by recent large fires.

Both general and specific actions are needed to mitigate wildfire risk, improve forest and open space health, and enhance vegetative diversity. Mitigation of hazardous conditions, prevention of unwanted fires, and effective response to fires once ignited must all be addressed to ensure safety of the community. To this end, the Core Team should identify an Implementation Team to move forward on the recommendations of this plan.

6 EMERGENCY OPERATIONS

6.1 Wildfire Response Capability and Recommendations

Response

The Golden Fire Department maintains 11 pieces of apparatus out of four stations. Of the 48 volunteer firefighters, all have received training in wildland firefighting and 24 are on the wildland team. With these dedicated volunteer resources, they respond to an average of over 1,100 calls and 20 wildland fires per annum. The City of Golden fleet includes:

- 2 Heavy Rescues
- 1 Tower Ladder Truck
- 6 Type-1(2) Engines
- 1 Type-6 AWD Brush Engine
- 1 Type-3 AWD WUI Engine

For illustration purposes, Table 17 compares initial attack capabilities for an average engine crew as determined from the "Line Production Rates for Initial Action by Engine Crews" charts (National Wildfire Coordinating Group 2004) with predicted fire spread under 50th percentile weather conditions. These are very generalized figures provided to illustrate the potential gap between potential fire behavior and available suppression resources. This highlights the importance of mutual aid and aerial support.

Table 17. Wildland Fire Production Rates

Wildland Fire Production Rates Per Hour Using Type-6 Engine (3 firefighters)		
Anderson Fire Behavior Fuel Model	**Fireline Production Rate Chains/hr***	**Predicted Fire Spread Under Average Conditions in Chains/hr***
1 Short Grass, 10% slope	24	59
1 Short grass, 30% slope	15	72
6 Shrubs under 6 ft. tall – Brush	12	28
8 Closed timber litter	15	2
10 Closed timber with heavy dead and down woody debris	12	8
Wildland Fire Production Rates Per Hour Using Type-6 Engine (5+ firefighters)		
1 Short Grass	40	59
2 Short grass with scattered shrubs or open timber	25	72
6 Shrubs under 6 ft. tall – Brush	20	28
8 Closed timber litter	24	2
10 Closed timber with heavy dead and down woody debris	20	8

* Chains/hr is roughly equivalent to feet/minute.

The structure protection table (Table 18) is based on the time a crew can prepare a structure for a wildland fire using a Type-1 engine. The accepted standard is 20 minutes for a four-firefighter crew and 30 minutes for a three-firefighter crew.

Table 18. Structural Protection Rates

Structural Protection Rates Per Hour Using Type-I Engines		
Firefighters	**Rates**	**Total per hour**
3	30 minutes/structure	2
4	20 minutes/structure	3

Mutual Aid

The district participates in the Jefferson County Resource Groups. These groups are pre-organized task forces used for structure protection or a squad for a hand crew. There is also a county wide mutual aid agreement among fire protection districts. All Incident Commanders (IC) and District Chiefs are authorized to request Mutual Aid from participating agency. Additional support for wildfires may be provided by the local CSFS or USFS districts. Major incidents will receive assistance from the Jefferson County Type 3 Incident Management Team (IMT) and a broader pool of cooperators as needed.

Recommendations

Initial Attack: Table 17 illustrates the potential for fire behavior to exceed the suppression capability of initial attack crews. This is especially true in the Golden area where so much of the surrounding terrain is extremely difficult to access. This department is well trained and well equipped for wildland firefighting. Maintaining and enhancing initial attack capability is essential for the Golden Fire Department. This includes the ability to respond with qualified wildland firefighters and supervisors.

Appropriate Management Response: The Golden Fire Department, in coordination with its cooperators, may wish to develop pre-incident plans to help guide strategy and tactics in specific areas including an "appropriate management response" matrix in some cases. While all incidents should, of course, have an appropriate response, fire agencies have historically selected an offensive, direct attack as the first choice. A pre-defined method, whereby a risk-benefit analysis would be performed, may increase firefighter safety, reduce suppression costs, and reduce environmental damage. For example, it might be determined that given certain fire behavior, values at risk, difficulty of access, and available resources, a fire on top of South Table Mountain would be managed with a confine and contain strategy. Educating the public as to the principles and needs for a confine and contain strategy may relieve public anxiety and avoid unwarranted criticism.

6.2 Emergency Procedures and Evacuation Routes

In the event that the County Sheriff orders a community to evacuate because of threatening wildfire, residents should leave in an orderly manner. The Sheriff would proclaim the preferred evacuation routes and safe sites. However, the need for evacuation can occur without notice when conditions for wildfire are favorable. Homeowners should be prepared to evacuate without formal notice.

Before residents leave, they should take every precaution to reduce the chance of structure loss as time allows. Human safety is the number one concern in an evacuation. Action could include thoroughly irrigating the defensible space, watering down the roof, and removing all debris from rain gutters. Remove all flammable materials 30 feet or more from the house such as woodpiles, leaves, debris, and patio furniture. Windows and doors should be closed but not locked. Other openings should be covered. A ladder should be placed for roof access by firefighters. A fully charged hose that reaches around the house should also be available for firefighter use. Porch lights should be left on to allow firefighters to find homes at night.

Families should have meeting locations in place and phone numbers to call in case family members are separated. Families should take with them important papers, documents, pets, food, water, and other essential items. The exterior of the house should be monitored for smoke for several days after return. Embers may lodge in small cracks and crevices and smolder for several days before flaming.

7 CWPP MONITORING AND EVALUATION

7.1 CWPP Plan Adoption

Public meetings and a public comment period where incorporated into this CWPP process to provide the opportunity for wide-spread participation and input. Comments and input were solicited from stakeholders. The final draft of the CWPP was formally adopted by the Core Team, comprised of representatives from the Golden Fire Department, Jefferson County, CSFS, Jefferson County Open Space, and Denver Water Board.

The HFRA authorities for CWPP require adoption of this plan, as does the FEMA Disaster – Mitigation Act of 2000. With formal adoption of this plan by the Core Team, the City of Golden, Jefferson County, and CSFS will be competitive for hazardous fuels and non-fuels mitigation funding that may assist with plan implementation. Furthermore, adoption of this plan highlights the partnerships among fire stations, local government, community-based organizations, and public agencies.

7.2 Sustaining CWPP Efforts

The City of Golden CWPP provides the foundation and resources for understanding wildfire risk and presents opportunities to reduce potential losses from wildfire. However, the CWPP is worthless without implementation. While much of this is the responsibility of the individual citizen and homeowner, leadership from public officials is crucial for success.

The success of any CWPP hinges on effective and long-term implementation of identified mitigation practices. It is highly recommend that the Core Team identify an Implementation Team to coordinate the recommendations of the CWPP. The magnitude of the wildfire risks and hazards facing the Golden Fire Department is significant and any effective reduction requires on-going commitment and collaboration to implement the treatments recommended in this CWPP.

The City of Golden Fire Department is committed to supporting fire protection and emergency services within the district and surrounding areas. It is important that the district continue to provide support in maintaining risk assessment information and emergency management coordination. Stakeholders should implement recommended actions by working with fire authorities, community organizations, private landowners, and public agencies to coordinate hazardous fuels management and other mitigation projects.

7.3 CWPP Oversight, Monitoring, and Evaluation

Monitoring is an extremely difficult component of the CWPP process to maintain. It is crucial to determining which methods and initiatives are successful. For monitoring

defensible space, a simple series of annual photographs from designated photo points may prove helpful. If larger treatments are undertaken, a more formal protocol of pre-treatment and post-treatment measurements should be adopted. All projects should be recorded and records kept in a single designated location, such as with the fire department.

In addition to coordinating the recommended actions in the CWPP, the Implementation Team should coordinate the monitoring efforts to evaluate the efficacy of treatments. Specific monitoring duties can be delegated by the Implementation Team. The CWPP should be reexamined on an annual or regular basis to ensure its relevance. This may be accomplished through meetings which include the fire department, homeowner groups, and other stakeholders.

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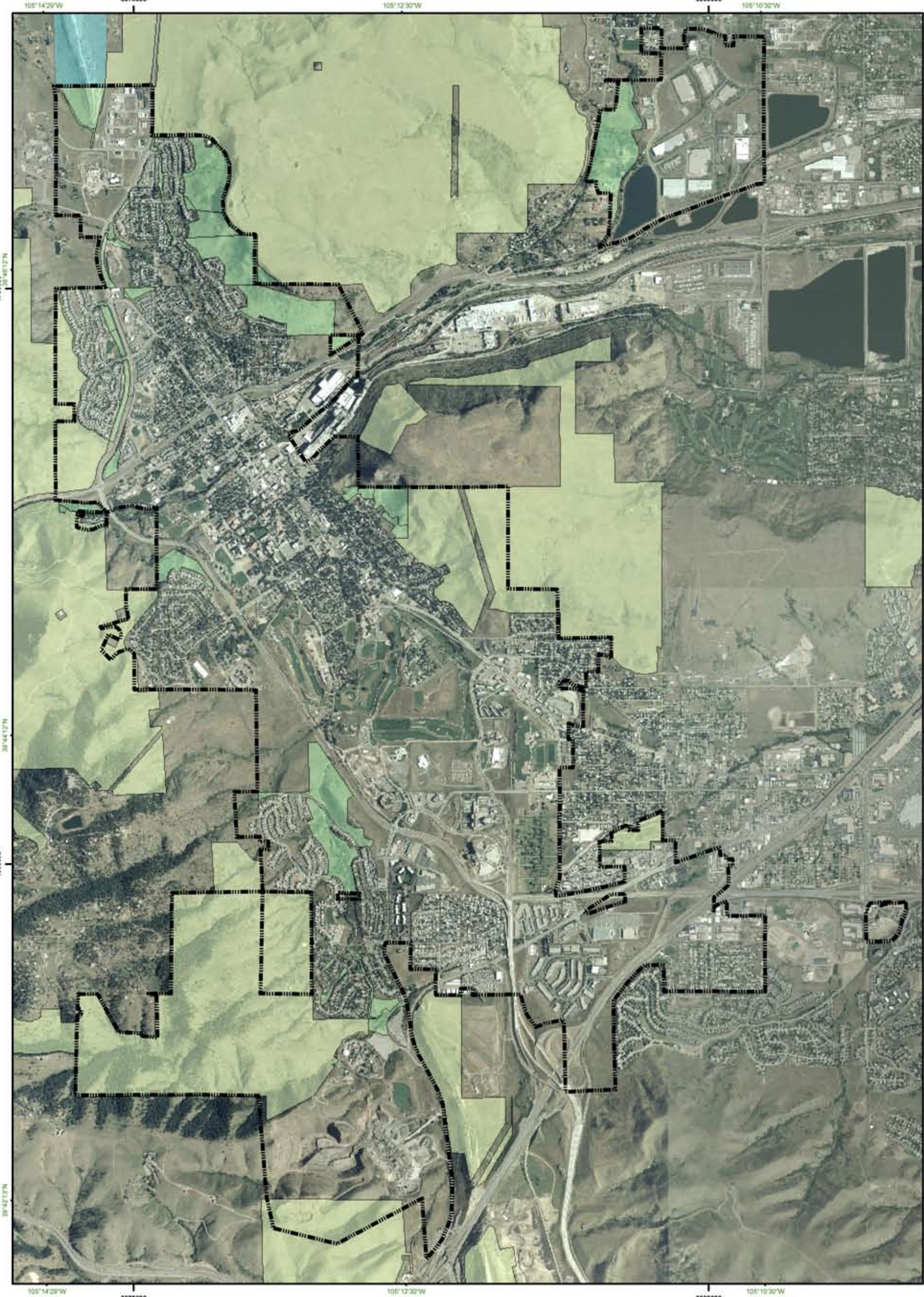
APPENDIX A
PROJECT MAPS



City of Golden
Jefferson County, Colorado

- City of Golden
- City of Golden
- Denver Water Board
- Jefferson County
- State of Colorado

0 0.25 0.5 1
Miles

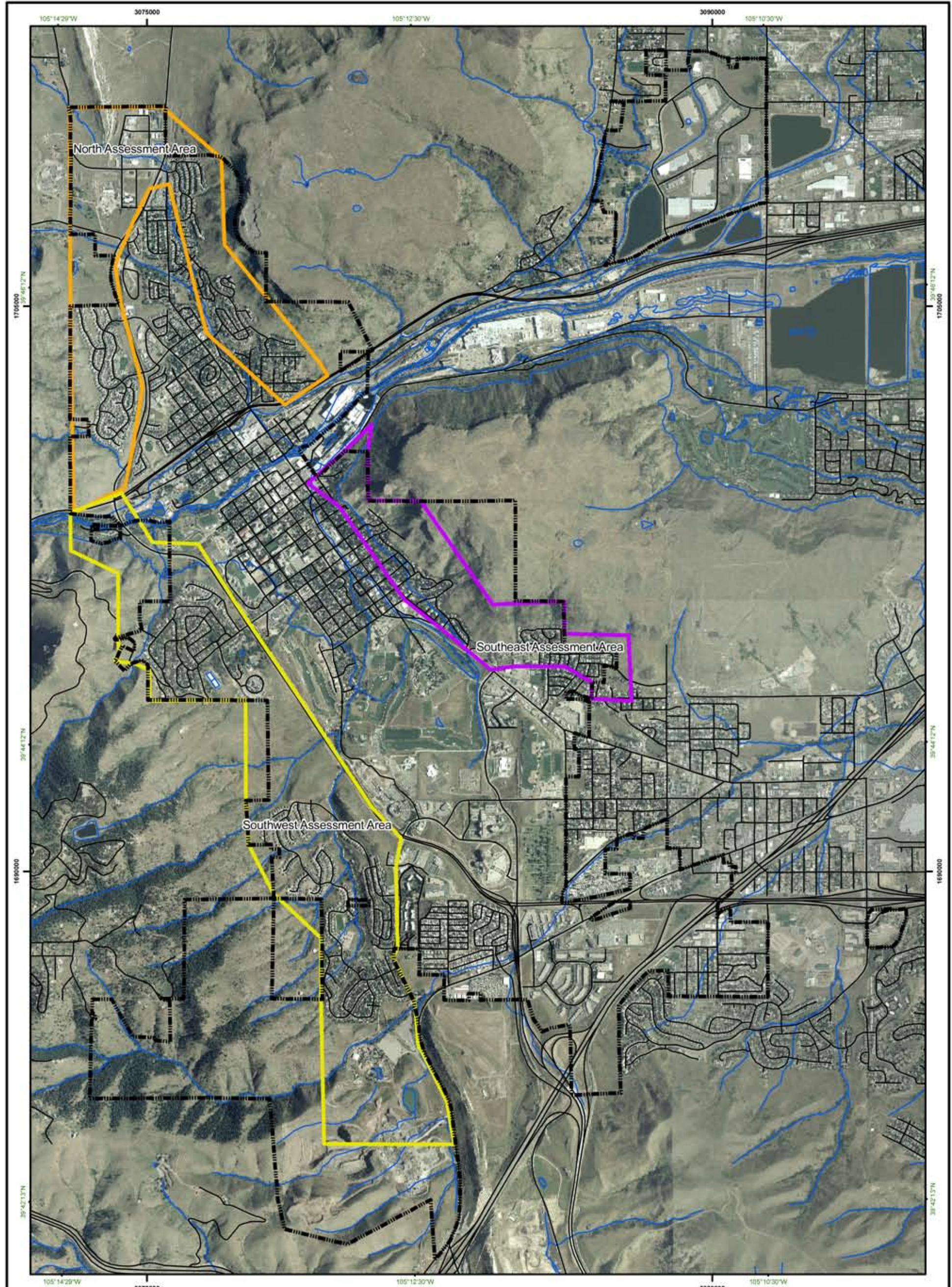
Colorado State Plane
Central NAD 1983

μ

Walsh
an ecology and environment company

Map 1
Assessment Area

Proj # 7404	Date: 3/2007



City of Golden
Jefferson County, Colorado

Legend

- Streams
- Roads

Communities

- North Assessment Area
- Southeast Assessment Area
- Southwest Assessment Area

0 0.25 0.5 1
Miles

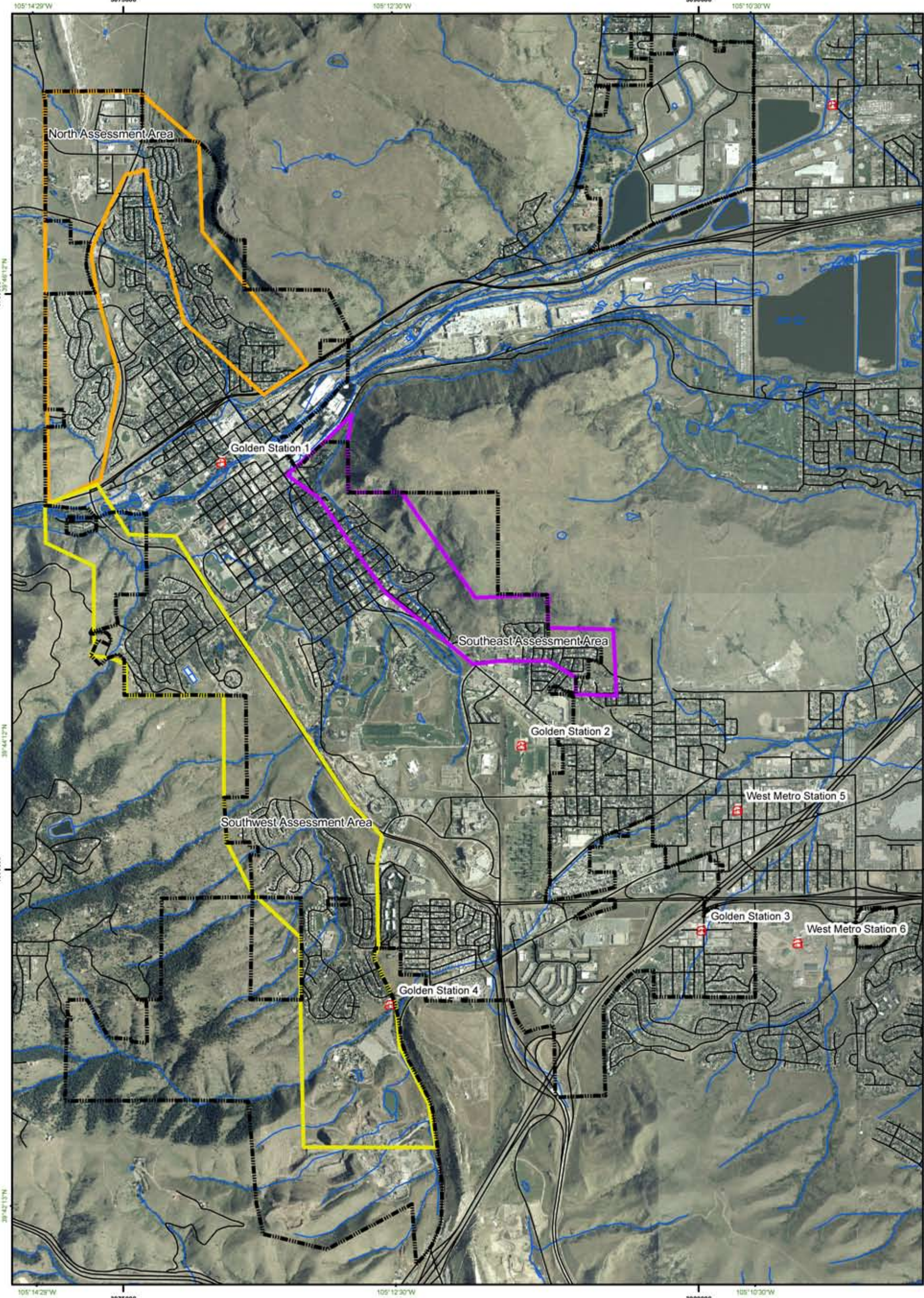
Colorado State Plane
Central NAD 1983

μ

Walsh
an ecology and environment company

Map 2
Community Map

Proj # 7404	Date: 3/2007



City of Golden
Jefferson County, Colorado

Legend

- City of Golden
- a Fire Station
- Roads
- Streams

0 0.25 0.5 1
Miles

Colorado State Plane
Central NAD 1983

μ

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Map 3
Fire Service Infrastructure

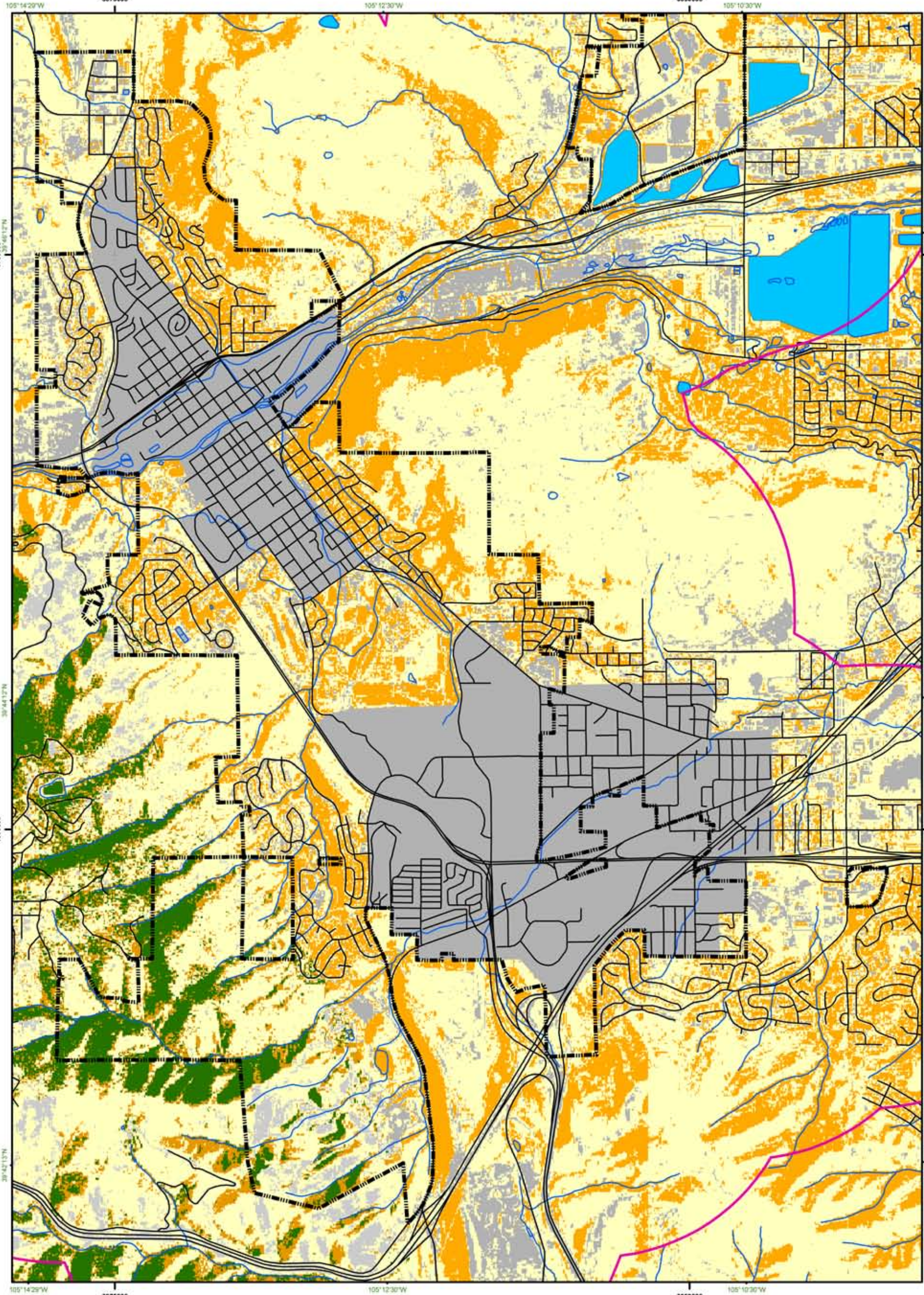
Proj # 7404	Date: 3/2007

105°14'29"W 3075000 105°12'30"W 3090000 105°10'30"W

1705000 39°46'12"N

1690000 39°44'12"N

39°42'13"N



105°14'29"W 3075000 105°12'30"W 3090000 105°10'30"W

City of Golden
Jefferson County, Colorado

Existing Vegetation

- City of Golden
- Roads
- Streams
- Medium Density Timber (FBFM 8)
- Shrubs (FBFM 6)
- Shrubs, Grass, Low Cover (FBFM 1)
- Urban or Sparse Vegetation

0 0.25 0.5 1
Miles

Colorado State Plane
Central NAD 1983

μ

Walsh
an ecology and environment company

Map 4
Existing Vegetation and Fire Behavior Fuel Model

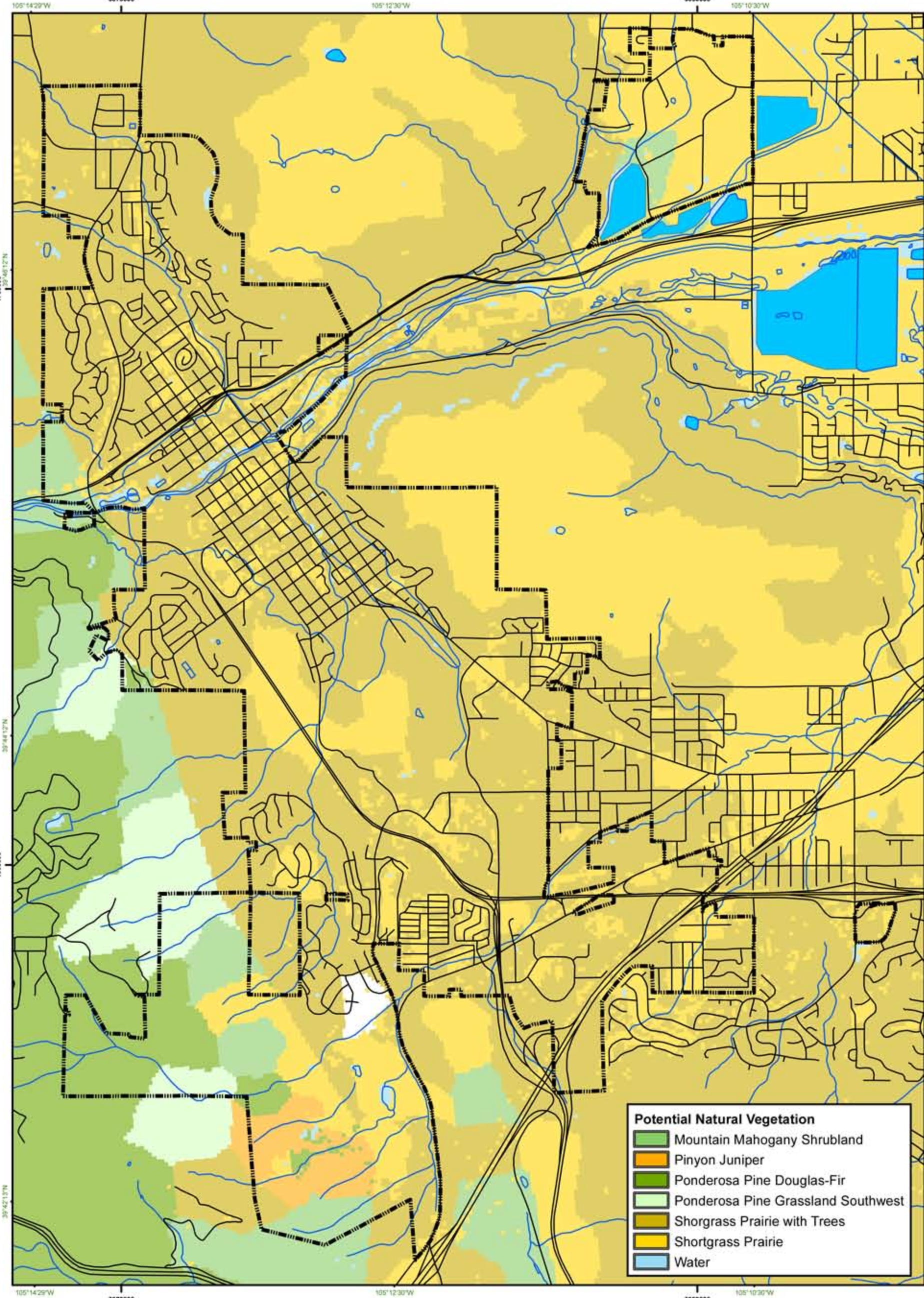
Proj # 7404	Date: 3/2007

105°14'29"W 3075000 105°12'30"W 3090000 105°10'30"W

39°46'12"N 1705000

39°44'12"N 1690000

39°42'13"N



105°14'29"W 3075000 105°12'30"W 3090000 105°10'30"W

City of Golden
Jefferson County, Colorado

Legend

- City of Golden
- Roads
- Streams

0 0.25 0.5 1
Miles

Colorado State Plane
Central NAD 1983

μ

Walsh
an ecology and environment company

Map 5
Potential Natural Vegetation

Proj # 7404	Date: 3/2007

105°14'29"W 3075000 105°12'30"W 3090000 105°10'30"W

1705000 39°46'12"N

1690000

39°44'12"N

39°42'13"N

Historical Fire Regimes

- '0-35 year frequency; low and mixed severity'
- '0-35 year frequency; replacement severity'
- '200+ year frequency; replacement severity'
- '35-200 year frequency; low and mixed severity'
- '35-200 year frequency; replacement severity'
- 'Water'

City of Golden
Jefferson County, Colorado

Legend

- City of Golden
- Roads
- Streams

0 0.25 0.5 1
Miles

Colorado State Plane
Central NAD 1983

μ

Walsh
an ecology and environment company

Map 6
Historical Fire Regimes

Proj # 7404	Date: 3/2007

105°14'29"W 3075000 105°12'30"W 3090000 105°10'30"W

1705000 39°46'12"N

1690000 39°44'12"N

39°42'13"N

City of Golden
Jefferson County, Colorado

Legend

- City Boundary
- Roads
- Streams

Fire Regime Condition Class

- Class 1
- Class 2
- Class 3

0 0.25 0.5 1
Miles

Colorado State Plane
Central NAD 1983

μ

Walsh
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Map 7
Fire Regime Conditon Class

Proj # 7404	Date: 3/2007

105°14'29"W 3075000 105°12'30"W 3090000 105°10'30"W

North Assessment Area

Southeast Assessment Area

Southwest Assessment Area

1705000 39°45'12"N

1690000 39°44'12"N

39°43'13"N

105°14'29"W 3075000 105°12'30"W 3090000 105°10'30"W

City of Golden
Jefferson County, Colorado

Legend

- City of Golden
- Communities
- Roads
- Streams
- Defensible Space Treatment Zones
- Potential Future Forest Management Projects
- Potential Future Prescribed Fire

0 0.25 0.5 1
Miles

Colorado State Plane
Central NAD 1983

μ

Walsh
an ecology and environment company

Map 8
Fuel Treatment

Proj # 7404	Date: 3/2007

APPENDIX B

NFPA WILDLAND FIRE RISK AND HAZARD SEVERITY ASSESSMENT FORM 1144

WILDLAND FIRE RISK AND HAZARD SEVERITY ASSESSMENT FORM

Assign a value to the most appropriate element in each category and place the number of points in the column on the right.

Element	Points	
A. Means of Access		
1. Ingress and egress		
a. Two or more roads in/out	0	_____
b. One road in/out	7	_____
2. Road width		
a. ≥7.3 m (24 ft)	0	_____
b. ≥6.1 m (20 ft) and <7.3 m (24 ft)	2	_____
c. <6.1 m (20 ft)	4	_____
3. All-season road condition		
a. Surfaced road, grade <5%	0	_____
b. Surfaced road, grade >5%	2	_____
c. Non-surfaced road, grade <5%	2	_____
d. Non-surfaced road, grade >5%	5	_____
e. Other than all-season	7	_____
4. Fire Service Access		
a. ≤91.4 m (300 ft) with turnaround	0	_____
b. >91.4 m (300 ft) with turnaround	2	_____
c. <91.4 m (300 ft) with no turnaround	4	_____
d. ≥91.4 m (300 ft) with no turnaround	5	_____
5. Street signs		
a. Present [10.2 cm (4 in.) in size and reflectorized]	0	_____
b. Not present	5	_____
B. Vegetation (Fuel Models)		
1. Characteristics of predominate vegetation within 91.4 m (300 ft)		
a. Light (e.g., grasses, forbs, sawgrasses, and tundra) NFDRS Fuel Models A, C, L, N, S, and T	5	_____
b. Medium (e.g., light brush and small trees) NFDRS Fuel Models D, E, F, H, P, Q, and U	10	_____
c. Heavy (e.g., dense brush, timber, and hardwoods) NFDRS Fuel Models B, G, and O	20	_____
d. Slash (e.g., timber harvesting residue) NFDRS Fuel Models J, K, and L	25	_____
2. Defensible space		
a. More than 30.48 m (100 ft) of vegetation treatment from the structure(s)	1	_____
b. 21.6 m to 30.48 m (71 ft to 100 ft) of vegetation treatment from the structure(s)	3	_____
c. 9.14 m to 21.3 m (30 ft to 70 ft) of vegetation treatment from the structure(s)	10	_____
d. <9.14 m (30 ft) of vegetation treatment from the structure(s)	25	_____
C. Topography Within 91.4 m (300 ft) of Structure(s)		
1. Slope <9%	1	_____
2. Slope 10% to 20%	4	_____
3. Slope 21% to 30%	7	_____
4. Slope 31% to 40%	8	_____
5. Slope >41%	10	_____

(NFPA 1144, 1 of 2)

Element	Points	
D. Additional Rating Factors (rate all that apply)		
1. Topographical features that adversely affect wildland fire behavior	0–5	_____
2. Areas with a history of higher fire occurrence than surrounding areas due to special situations (e.g., heavy lightning, railroads, escaped debris burning, and arson)	0–5	_____
3. Areas that are periodically exposed to unusually severe fire weather and strong dry winds	0–5	_____
4. Separation of adjacent structures that can contribute to fire spread	0–5	_____
E. Roofing Assembly		
1. Class A roof	0	_____
2. Class B roof	3	_____
3. Class C roof	15	_____
4. Nonrated	25	_____
F. Building Construction		
1. Materials (predominate)		
a. Noncombustible/fire-resistive siding, eaves, and deck (*see Chapter 8*)	0	_____
b. Noncombustible/fire-resistive siding and combustible deck	5	_____
c. Combustible siding and deck	10	_____
2. Building setback relative to slopes of 30% or more		
a. ≥9.14 m (30 ft) to slope	1	_____
b. <9.14 m (30 ft) to slope	5	_____
G. Available Fire Protection		
1. Water source availability		
a. Pressurized water source availability		
1892.7 L/min (500 gpm) hydrants ≤304.8 m (1000 ft) apart	0	_____
946.4 L/min (250 gpm) hydrants ≤304.8 m (1000 ft) apart	1	_____
b. Nonpressurized water source availability (off site)		
≥946.4 L/min (250 gpm) continuous for 2 hours	3	_____
<946.4 L/min (250 gpm) continuous for 2 hours	5	_____
c. Water unavailable	10	_____
2. Organized response resources		
a. Station ≤8 km (5 mi.) from structure	1	_____
b. Station >8 km (5 mi.) from structure	3	_____
3. Fixed fire protection		
a. NFPA 13, 13R, 13D sprinkler system	0	_____
b. None	5	_____
H. Placement of Gas and Electric Utilities		
1. Both underground	0	_____
2. One underground, one aboveground	3	_____
3. Both aboveground	5	_____
I. Totals for Home or Subdivision (Total of all points)		

Hazard Assessment	Total Points
Low hazard	<40
Moderate hazard	40–69
High hazard	70–112
Extreme hazard	>112

(NFPA 1144, 2 of 2)

APPENDIX C

COMMUNITY/NEIGHBORHOOD/SUBDIVISION HAZARD AND RISK SURVEY

1) The district was divided into assessment areas based on access and similarity of fuel, infrastructure, and construction characteristics.
2) Each assessment area was divided into neighborhoods.
3) Each neighborhood was rated using the NFPA 1144 Wildland Fire Risk and Hazard Severity Assessment Form. The rating assigned represents the average conditions for the neighborhood.
4) Road widths were measured where necessary.
5) Road grades and slopes were determined from GIS maps and field checked.
6) Fuel models were determined by satellite imagery interpretation and field checked. Photographs were used to double check field assessments and provide a baseline record. While the NFPA form refers to NFDRS fuel models the corresponding FBPS fuel models are: _____

Light	1, 2, 3
Medium	5, 6, 7, 8, 9
Heavy	4, 10
Slash	11, 12, 13

7) When fuel or defensible space conditions in a neighborhood were best represented by two different rating classes, an average was used. For example, when a neighborhood was on the boundary between dense forest (20 points) and light brush (10 points), with approximately half of the homes exposed to each condition, a rating of 15 points was assigned.
8) Ratings for individual neighborhoods were totaled and averaged to arrive at the assessment area rating.

North Community Assessment Area

Description: This area consists of the Golden subdivisions that borders open space north of state highway 58, including North Table Mountain, Mesa Meadows, Canyon View, and Canyon Point (The Village at Mountain Ridge). This area is located in the topographically transitional zone between the valley floor and the steep slopes (in excess of 30 percent) of the surrounding open space, with some homes in close proximity to steep drainages. Yards are typically less than 0.5 acres. Roads are well marked and paved. Even though many streets exceed 5 percent slope, they are wide and accessible to fire apparatus. There are a number of dead-end cul-de-sacs that exceed 300 feet. The Golden municipal water supply has an ISO rating of Class 1 for fire protection flow.

Vegetation: The predominant fire carrying fuel is grass, though pockets of brush are found in drainages and some green strips between homes (i.e., west of Deer Springs Lane). The closest timber fuels are over 0.5 miles to the west. Defensible space for homes is generally around 30 feet, though ornamental conifers may compromise this zone in some cases.

Survey Notes: Commercial structures in this area are constructed of fire resistive materials and have parking lots that provide extensive defensible space. Private residences in this area appear to have been constructed within the last 15 years. The majority of homes have combustible siding, and combustible decks are common. Most of the homes with the highest exposure to wildland fuels have composite Class A roofs. There are substantial groupings of homes with wood shake roofs in the Normans and Canyon Points areas, earning the assessment area a roofing assembly rating of 10.

Recommendations: The most effective measures for reducing this area's wildland fire hazard and risk will be phasing out of wood shake roofs and increasing defensible space. Because most yards are less than 0.5 acres in size, increasing defensible space may require a cooperative effort with the adjoining public land managers.

Wildland Fire Risk and Hazard Severity Form NFPA 1144		
Golden		North Area
Means of Access		
Ingress and Egress	Points	
2 or more roads in & out	0	0
One road in & out	7	
Road Width		
> 24 ft	0	0
> 20 ft < 24 ft	2	
< 20 ft	4	
All-Season Road Condition		
Surfaced Road, grade <5%	0	
Surfaced Road, grade >5%	2	
Non-surfaced Road, grade <5%	2	2
Non-surfaced Road, grade >5%	5	
Other than all season	7	
Fire Service Access		
< 300 ft with turnaround	0	
> 300 ft with turnaround	2	2
< 300 ft with no turnaround	4	
> 300 ft with no turnaround	5	
Street Signs (predominant)		
Present - reflective	0	0
Present - non-reflective	2	
Not present	5	
Vegetation (fuel models)		
Characteristics of predominant veg w/in 300 ft		
Light - 1, 2, 3	5	5
Medium - 5, 6, 7, 8, 9	10	
Heavy - 4, 10	20	
Slash - 11, 12, 13	25	
Defensible Space - vegetation treatment around structure		
> 100 ft around structure	1	
> 70 ft < 100 ft around structure	3	
> 30 ft < 70 ft around structure	10	10
< 30 ft around structure	25	
Topography Within 300 ft of Structures		
Slope		
< 9%	1	
10% to 20%	4	
21% to 30%	7	
31% to 40%	8	8
> 41%	10	
Additional Rating Factors (rate all that apply)		
Additional factors		
Topographic features that adversely affect fire behavior	0-5	2
Areas with a history of high fire occurrence - ignition potentia	0-5	0
Severe fire weather potential	0-5	3
Separation of adjacent structures contributing to fire spread	0-5	2

Golden		North Area
Roofing Assembly		
Roofing		
Class A	0	
Class B	3	
Class C	15	10
Unrated	25	
Building construction		
Materials (predominant)		
Non-combustible fire-resistive siding, eaves and deck	0	
Non-combustible siding, eaves and combustible deck	5	
Combustible siding and deck	10	10
Building set-back relative to slope of 30% or more		
> 30 ft to slope	1	
< 30 ft to slope	5	5
Available Fire Protection		
Water source availability		
Hydrants 500 gpm < 1000 ft apart	0	0
Hydrants 250 gpm < 1000 ft apart	1	
Non-pressurized water source > 250 gpm for 2 hours	3	
Non-pressurized water source < 250 gpm for 2 hours	5	
Water unavailable	10	
Organized response resources		
Station < 5 mi from structure	1	1
Station > 5 mi from structure	3	
Fixed fire protection		
NFPA 13, 13R, 13D sprinkler system	0	
None	5	5
Placement of gas and Electric Utilities		
Utilities		
Both underground	0	0
One above, one below	3	
Both above ground	5	
Totals for home or subdivision		**65**

Hazard Rating Scale
< 40 LOW
> 40 MODERATE
> 70 HIGH
> 112 EXTREME

Southwest Community Assessment Area

Description: This area is comprised of the Golden subdivisions that border open space west of county road 93 and west and south of U.S. 6, including Golden West Condominiums, Parfet Estates, Beverly Heights, Eagle Ridge, Tripp Ranch, and the Heritage Square amusement park. This area is located in the topographically transitional zone between the valley floor and the steep slopes (in excess of 30 percent) of the surrounding open space, with some homes in close proximity to steep drainages. Yards are typically less than 0.5 acres. Roads are well marked and paved. Even though many streets exceed 5 percent slope, they are wide and accessible to fire apparatus. There are several cul-de-sacs that exceed 300 feet. The Golden municipal water supply has an ISO rating of Class 1 for fire protection flow.

Vegetation: The predominant fire carrying fuel is grass, with areas of brush in proximity to homes on a more frequent basis than the other two assessment areas, hence the fuel rating of 7. The closest timber fuels are approximately 0.5 miles to the west. Defensible space for homes is generally around 30 feet, though ornamental conifers may compromise this zone in some cases.

Survey Notes: The homes in the Beverly Heights area appear to have been built in the 1970s and 1980s while many of the homes in the Eagle Ridge area were built within the last decade. The majority of homes have combustible siding and decks. Virtually all homes have non-combustible roofs. Combustible construction features are a concern in the Heritage Square amusement park and include wood fences, wood boardwalks, wood shake roofing, and piles of combustible debris.

Recommendations: The most effective measures for reducing this area's wildland fire hazard and risk will be increasing defensible space. Because most yards are less than 0.5 acres in size, increasing defensible space may require a cooperative effort with the adjoining public land managers. Cleaning up areas of decadent brush close to structures should be considered, particularly northwest of Mount Zion Drive, in the drainage north of Heritage Square, and throughout the Eagle Ridge/Tripp Ranch area.

Wildland Fire Risk and Hazard Severity Form NFPA 1144		
Golden		**Southwest Area**
Means of Access		
Ingress and Egress	Points	
2 or more roads in & out	0	0
One road in & out	7	
Road Width		
> 24 ft	0	0
> 20 ft < 24 ft	2	
< 20 ft	4	
All-Season Road Condition		
Surfaced Road, grade <5%	0	
Surfaced Road, grade >5%	2	
Non-surfaced Road, grade <5%	2	2
Non-surfaced Road, grade >5%	5	
Other than all season	7	
Fire Service Access		
< 300 ft with turnaround	0	
> 300 ft with turnaround	2	2
< 300 ft with no turnaround	4	
> 300 ft with no turnaround	5	
Street Signs (predominant)		
Present - reflective	0	0
Present - non-reflective	2	
Not present	5	
Vegetation (fuel models)		
Characteristics of predominant veg w/in 300 ft		
Light - 1, 2, 3	5	7
Medium - 5, 6, 7, 8, 9	10	
Heavy - 4, 10	20	
Slash - 11, 12, 13	25	
Defensible Space - vegetation treatment around structure		
> 100 ft around structure	1	
> 70 ft < 100 ft around structure	3	
> 30 ft < 70 ft around structure	10	10
< 30 ft around structure	25	
Topography Within 300 ft of Structures		
Slope		
< 9%	1	
10% to 20%	4	
21% to 30%	7	
31% to 40%	8	8
> 41%	10	
Additional Rating Factors (rate all that apply)		
Additional factors		
Topographic features that adversely affect fire behavior	0-5	2
Areas with a history of high fire occurrence - ignition potentia	0-5	0
Severe fire weather potential	0-5	3
Separation of adjacent structures contributing to fire spread	0-5	2

Golden		**Southwest Area**
Roofing Assembly		
Roofing		
Class A	0	0
Class B	3	
Class C	15	
Unrated	25	
Building construction		
Materials (predominant)		
Non-combustible fire-resistive siding, eaves and deck	0	
Non-combustible siding, eaves and combustible deck	5	
Combustible siding and deck	10	10
Building set-back relative to slope of 30% or more		
> 30 ft to slope	1	1
< 30 ft to slope	5	
Available Fire Protection		
Water source availability		
Hydrants 500 gpm < 1000 ft apart	0	0
Hydrants 250 gpm < 1000 ft apart	1	
Non-pressurized water source > 250 gpm for 2 hours	3	
Non-pressurized water source < 250 gpm for 2 hours	5	
Water unavailable	10	
Organized response resources		
Station < 5 mi from structure	1	1
Station > 5 mi from structure	3	
Fixed fire protection		
NFPA 13, 13R, 13D sprinkler system	0	
None	5	5
Placement of gas and Electric Utilities		
Utilities		
Both underground	0	0
One above, one below	3	
Both above ground	5	
Totals for home or subdivision		53

Hazard Rating Scale
< 40 LOW
> 40 MODERATE
> 70 HIGH
> 112 EXTREME

Southeast Community Assessment Area

Description: This area is comprised of the Golden subdivisions that border open space northeast of South Golden Road/East Street, south of West 32nd Avenue. This area is located in the topographically transitional zone between the valley floor and the steep slopes (in excess of 30 percent) of the surrounding open space. Yards are typically less than 0.5 acres. Roads are well marked and paved. Even though many streets exceed 5 percent slope, they are wide and accessible to fire apparatus. There are several cul-de-sacs that exceed 300 feet. The Golden municipal water supply has an ISO rating of Class 1 for fire protection flow.

Vegetation: The predominant fire carrying fuel is grass, with pockets of brush in proximity to homes in a few cases. Defensible space for homes is generally around 30 feet, though ornamental conifers and decadent deciduous vegetation along fence lines and drainage ditches may compromise this zone in some cases.

Survey Notes: Construction in this area is of mixed age with homes built from the 1970s to present. The majority of homes have combustible siding. Combustible decks are, while present, less common than in the other two assessment areas. As a result, the building construction materials rating was dropped to a 7. Virtually all homes have non-combustible roofs. Unlike the other assessment areas, above-ground utility lines are common, presenting a possible source of ignition while also being more susceptible to fire damage.

Recommendations: The most effective measures for reducing this area's wildland fire hazard and risk will be increasing defensible space. Because most yards are less than 0.5 acres in size, increasing defensible space may require a cooperative effort with the adjoining public land managers. Cleaning up areas of decadent brush along property lines should be undertaken, for example north of West 16th Place and northeast of Table Drive. As utility lines are moved from above to under ground, this will further lower the hazard/risk.

Wildland Fire Risk and Hazard Severity Form NFPA 1144		
Golden		Southeast Area
Means of Access		
Ingress and Egress	Points	
2 or more roads in & out	0	0
One road in & out	7	
Road Width		
> 24 ft	0	0
> 20 ft < 24 ft	2	
< 20 ft	4	
All-Season Road Condition		
Surfaced Road, grade <5%	0	
Surfaced Road, grade >5%	2	
Non-surfaced Road, grade <5%	2	2
Non-surfaced Road, grade >5%	5	
Other than all season	7	
Fire Service Access		
< 300 ft with turnaround	0	
> 300 ft with turnaround	2	2
< 300 ft with no turnaround	4	
> 300 ft with no turnaround	5	
Street Signs (predominant)		
Present - reflective	0	0
Present - non-reflective	2	
Not present	5	
Vegetation (fuel models)		
Characteristics of predominant veg w/in 300 ft		
Light - 1, 2, 3	5	5
Medium - 5, 6, 7, 8, 9	10	
Heavy - 4, 10	20	
Slash - 11, 12, 13	25	
Defensible Space - vegetation treatment around structure		
> 100 ft around structure	1	
> 70 ft < 100 ft around structure	3	
> 30 ft < 70 ft around structure	10	10
< 30 ft around structure	25	
Topography Within 300 ft of Structures		
Slope		
< 9%	1	
10% to 20%	4	
21% to 30%	7	
31% to 40%	8	8
> 41%	10	
Additional Rating Factors (rate all that apply)		
Additional factors		
Topographic features that adversely affect fire behavior	0-5	2
Areas with a history of high fire occurrence - ignition potentia	0-5	0
Severe fire weather potential	0-5	3
Separation of adjacent structures contributing to fire spread	0-5	2

Golden		Southeast Area
Roofing Assembly		
Roofing		
Class A	0	0
Class B	3	
Class C	15	
Unrated	25	
Building construction		
Materials (predominant)		
Non-combustible fire-resistive siding, eaves and deck	0	
Non-combustible siding, eaves and combustible deck	5	7
Combustible siding and deck	10	
Building set-back relative to slope of 30% or more		
> 30 ft to slope	1	1
< 30 ft to slope	5	
Available Fire Protection		
Water source availability		
Hydrants 500 gpm < 1000 ft apart	0	0
Hydrants 250 gpm < 1000 ft apart	1	
Non-pressurized water source > 250 gpm for 2 hours	3	
Non-pressurized water source < 250 gpm for 2 hours	5	
Water unavailable	10	
Organized response resources		
Station < 5 mi from structure	1	1
Station > 5 mi from structure	3	
Fixed fire protection		
NFPA 13, 13R, 13D sprinkler system	0	
None	5	5
Placement of gas and Electric Utilities		
Utilities		
Both underground	0	
One above, one below	3	3
Both above ground	5	
Totals for home or subdivision		51
Hazard Rating Scale		
< 40 LOW		
> 40 MODERATE		
> 70 HIGH		
> 112 EXTREME		

APPENDIX D
CITY OF GOLDEN SURVEY QUESTIONNAIRE

Questionnaire
Community Wildfire Protection Plan (CWPP)
Jefferson County

Walsh Environmental Scientists and Engineers LLC—under contract with Jefferson County Emergency Management and in collaboration with Colorado State Forest Service and US Forest Service—is developing CWPPs for nine fire protection districts, which have significant wild-land urban interface lands. You can help by providing information and suggestions on your perceptions of wildland fire and potential mitigation projects by responding to the following question:

1. What **community** do you live in or are closest to? (please write in)	
2. How great of **risk** does wildfire pose to your community?	□ Extreme Risk □ Moderate Risk □ Low Risk □ No Risk
3. What areas are at **extreme fire hazard** and pose a risk to homes or property?	□ Forestlands □ Grasslands □ Shrublands □ Juniper Stands □ Other Areas: _____ **Location:**
4. What is the best way to **mitigate or reduce** wildfire hazards?	□ Increase number of fire department personnel □ Reduce vegetation (grasses, trees, etc.) on public lands by controlled burns. □ Reduce vegetation (grasses, trees, etc.) on public lands by mechanical treatments. □ Increase firefighting equipment (more trucks, water tenders, etc.) □ Increase water availability □ Encourage private landowners to reduce fuels and develop defensible spaces around structures.
5. What **recent actions** have been taken to reduce the risk of wildfire to your community?	□ None that I am aware of □ If you know of actions that have been taken,

	please explain:
6. What **fire education programs** have occurred in your community?	□ None that I am aware of □ If you know of programs that have occurred, please explain:
7. Is the community **prepared** to combat wildfire?	□ No, if not, why: □ Yes, if so, how come: □ I do not know
8. What **actions** do you think need to be taken to reduce the risk of wildland fire?	
Additional Comments:	

Please provide **contact information** in case we have further questions:

Name	
Address	
Phone	

Please fill out this survey and mail, fax, or email your response to:

Walsh Environmental Jerry Barker 303-443-0367 (fax) 4888 Pearl E. Circle, Suite 108 Boulder, CO 80301-2475 jbarker@walshenv.com	Jeffco Emergency Management Rocco Snart 303-271-4905 (fax) 800 Jefferson County Parkway Golden, CO 80419 rsnart@jeffco.us

APPENDIX E

CITY OF GOLDEN QUESTIONNAIRE FEEDBACK SUMMARY

Questionnaires were provided at public meetings convened on February 8 and April 5, 2007 at the City of Golden Community Center. Participants of the meetings were asked to respond to the questionnaire while at the meeting or mail responses at a latter time. Also, the questionnaire was mailed to all Golden residents by the City of Golden in the March mailing of the *Informer*. Seven questionnaires have been received as of April 20, 2007. The following tables summarize the responses of the eight questionnaires that were received.

Table 1 Questionnaire Summary

Question		Number of Response
2. How great of risk do wildfires pose to your property and community?	Extreme	2
	Moderate	4
	Low	2
	No	
3. What areas do you think are at extreme fire hazard and pose a risk to homes or property?	Forestlands	0
	Grasslands	7
	Shrublands	4
	Juniper	1
	Other	0
4. What do you think would be the best way to mitigate or reduce these hazardous?	Reduce Vegetation	7
	Increase Equipment	2
	Increase Volunteers	1
	Develop Defensible Space	6
	Firewise Education	7
	Evacuation Routes	2
	Increase available water	3
5. Do you know of recent actions taken to reduce the risk of wildfires or to protect residents from wildfire spreading from public lands onto private lands or visa versa?	No	7
	Yes	1
6. Have there been recent fire education programs in your community?	No	6
	Yes	2
7. Do you think that the community in which you live is prepared to combat wildfire? (See Table 2 for responses)	No	2
	Yes	1
	I do not know	5
8. What actions do you think need to be taken to reduce wildfire risk?	See Table 3 for responses.	

Table 2 Written Responses to Question 7

Comment Number	Number Received	Comment
1	4	Reduce hazardous fuels in gulches and ditches
2	2	Improve public education
3	1	Prevent neighbors from lighting fireworks
4	1	Golden Parks needs to develop an action plan
5	2	Willing to participate on CWPP Implementation team

Table 3 Summary of Responses to Question Number 8

Comment	Number Received	Comment
1	6	Develop fuels mitigation mandates
2	1	Help senior citizens develop defensible space
3	1	Proactive fire department
4	1	Reduce hazardous fuels

APPENDIX F

FUELBREAK GUIDELINES FOR FORESTED SUBDIVISIONS AND COMMUNITIES

Fuelbreak Guidelines for Forested Subdivisions & Communities

By

Frank C. Dennis

Colorado State Forest Service
Knowledge to Go Places

This publication was developed for use by foresters, planners, developers, homeowners' associations and others. Implementation of these measures cannot *guarantee* safety from all wildfires, but will greatly increase the probability of containing them at more manageable levels.

Inadequate fire planning can result in loss of life or property and costly suppression activities.

Colorado's forested lands are experiencing severe impacts from continuing population increases and peoples' desire to escape urban pressures. Subdivisions and developments are opening new areas for homesite construction at an alarming rate, especially along the Front Range and around recreational areas such as Dillon, Vail, and Steamboat Springs.

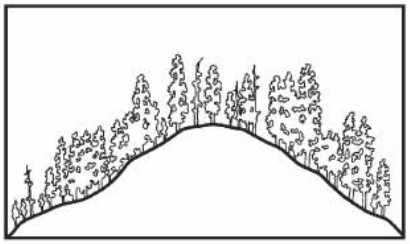
But with development inevitably comes a higher risk of wildfire as well as an ever-increasing potential for loss of life and property. Methods of fire suppression, pre-suppression needs, and homeowner and fire crew safety must all be considered in the planning and review of new developments as well as for the "retrofitting" of existing, older subdivisions.

Fuelbreaks should be considered in fire management planning for subdivisions and developments; however, the following are guidelines **only**. They should be customized to local areas by professional foresters experienced in Rocky Mountain wildfire behavior and suppression tactics.

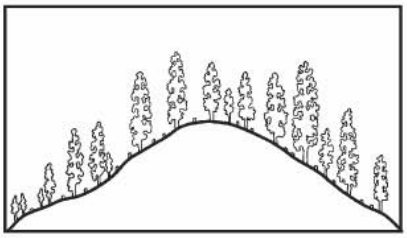
Fuelbreak vs Firebreak

Although the term fuelbreak is widely used in Colorado, it is often confused with firebreak. The two are entirely separate, and aesthetically different, forms of forest fuel modification and treatment.

• A firebreak is strip of land, 20 to 30 feet wide (or more), in which all vegetation is removed down to bare, mineral soil each year prior to fire season.



Above, cross section of mixed conifer stand before fuelbreak modification. Below, after modification.



• A fuelbreak (or shaded fuelbreak) is an easily accessible strip of land of varying width (depending on fuel and terrain), in which fuel density is reduced, thus improving fire control opportunities. The stand is thinned, and remaining trees are pruned to remove ladder fuels. Brush, heavy ground fuels, snags, and dead trees are disposed of and an open, park-like appearance is established.

The following is a discussion of the uses, limitations, and specifications of fuelbreaks in wildfire control and fuels management.

Fuelbreak Limitations

Fuelbreaks provide quick access for wildfire suppression. Control activities can be conducted more safely due to low fuel volumes. Strategically located, they break up large, continuous tracts of dense timber, thus limiting uncontrolled spread of wildfire.

Fuelbreaks can aid firefighters greatly by slowing fire spread under normal burning conditions. However, under extreme conditions, even the best fuelbreaks stand little chance of arresting a large

Before and after photos of a forest stand thinned to reduce fuel loads.

fire, regardless of firefighting efforts. Such fires, in a phenomenon called "spotting," can drop firebrands 1/8-mile or more ahead of the main fire, causing very rapid fire spread. These types of large fires may continue until there is a major change in weather conditions, topography, or fuel type.

It is critical to understand: A fuelbreak is the line of defense. The area (including any homes and developments) between it and the fire may remain vulnerable.

In spite of these somewhat gloomy limitations, fuelbreaks have proven themselves effective in Colorado. During the 1980 Crystal Lakes Subdivision Fire near Fort Collins, crown fires were stopped in areas with fuelbreak thinnings, while other areas of dense lodgepole pine burned completely. A fire at O'Fallon Park in Jefferson County was successfully stopped and controlled at a fuelbreak. The Buffalo Creek Fire in Jefferson County (1996) and the High Meadow Fire in Park and Jefferson Counties (2000) slowed dramatically wherever intense forest thinnings had been completed. During the 2002 Hayman Fire, Denver Water's entire complex of offices, shops and caretakers' homes at Cheesman Reservoir were saved by a fuelbreak with no firefighting intervention by a fuelbreak.

Burned area near Cheesman Reservoir as a result of the Hayman Fire. Note the unburned green trees in the middle right of the photo, a treated fuelbreak.

The Need For A Fuelbreak

Several factors determine the need for fuelbreaks in forested subdivisions, including: (1) potential problem indicators; (2) wildfire hazard areas; (3) slope; (4) topography; (5) crowning potential; and (6) ignition sources.

Potential Problem Indicator

The table below explains potential problem indicators for various hazards and characteristics common to Colorado's forest types. All major forest types, except aspen, indicate a high potential for wildfire hazard.

Fuel Type	Characteristics			Hazards			
	Aesthetics	Wildlife	Soil	**Wildfire**	Avalanche	Flood	Climate
Aspen	2	3	3	**2**	4	3	2
Douglas-fir	2	2	3	**5**	2	2	3
Greasewood-Saltbrush	4	2	2	**2**	1	3	3
Limber-Bristlecone Pine	3	2	4	**3**	4	2	5
Lodgepole Pine	2	2	3	**5**	4	2	4
Meadow	5	4	4	**2**	3	4	3
Mixed Conifer	2	1	1	**5**	3	1	3
Mountain Grassland	5	3	4	**3**	3	2	4
Mountain Shrub	3	5	4	**4**	2	2	3
Piñon-Juniper	2	3	4	**4**	2	3	2
Ponderosa Pine	2	3	1	**5**	2	2	3
Sagebrush	4	4	3	**3**	3	2	3
Spruce-Fir	2	3	3	**4**	5	**3**	4

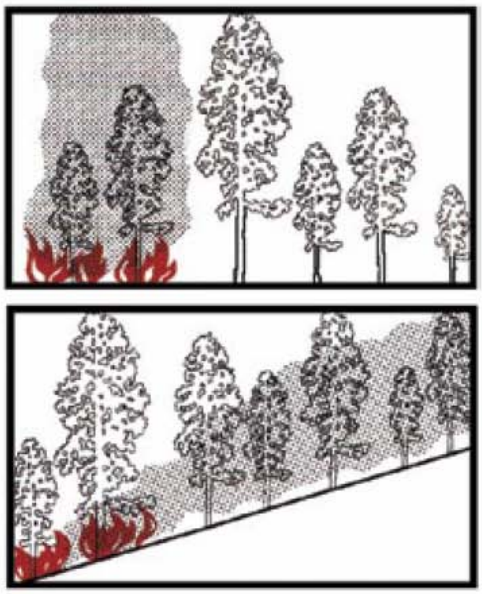
Legend: 5 – Problem may be crucial; 4 – Problem very likely;
3 – Exercise caution; 2 – Problem usually limited;
1 – No rating possible

Wildfire Hazard Maps

The Colorado State Forest Service (CSFS), numerous counties and some National Forests have completed wildfire hazard mapping for many areas within Colorado, particularly along the Front Range. These maps typically consider areas with 30 percent or greater slope; hazardous fuel types; and hazardous topographic features such as fire chimneys. Wildfire Hazard Ratings may be depicted in several ways. Whatever system is used, areas rated moderate or higher should be considered for fuel modification work.

Slope

Rate of fire spread increases as the slope of the land increases. Fuels are preheated by the rising smoke column or they may even come into contact with the flames themselves.



Fire effects, flat vs steep terrain. Note preheating of fuels on steep ground from passage of smoke column.

At 30 percent slope, rate of fire spread doubles compared to rates at level ground, drastically reducing firefighting effectiveness. **Areas near 30 percent or greater slopes are critical and must be reviewed carefully.**

Topography

Certain topographic features influence fire spread and should be evaluated. Included are fire chimneys, saddles, and V-shaped canyons. They are usually recognized by reviewing standard U.S.G.S. quad maps.

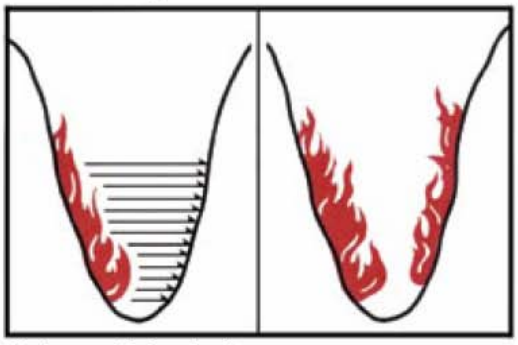
• Chimneys are densely vegetated drainages on slopes greater than 30 percent. Wind, as well as air pre-heated by a fire, tends to funnel up these drainages, rapidly spreading fire upslope.

Chimney.

• Saddles are low points along a main ridge or between two high points. Like chimneys, they also funnel winds to create a natural fire path during a fire's uphill run. Saddles act as corridors to spread fire into adjacent valleys or drainages.

Saddle.

• Narrow, V-shaped valleys or canyons can ignite easily due to heat radiating from one side to the other. For example, a fire burning on one side of a narrow valley dries and preheats fuels on the opposite side until the fire "flashes over." The natural effect of slope on fire then takes over and fire spreads rapidly up drainage and uphill along both sides of the valley.



Flashover in V-shaped valley.

Crowning Potential

An on-site visit is required to accurately assess crowning potential. A key, below, helps determine this rating. Fuel modification is usually unnecessary if an area has a rating of 3 or less.

Crowning Potential Key

	Rating
A. Foliage present, trees living or dead — B	
B. Foliage living — C	
C. Leaves deciduous or, if evergreen, usually soft, pliant, and moist; never oily, waxy, or resinous.	0
CC. Leaves evergreen, not as above — D	
D. Foliage resinous, waxy, or oily — E	
E. Foliage dense — F	
F. Ladder fuels plentiful — G	
G. Crown closure > 75 percent	9
GG. Crown closure < 75 percent	7
FF. Ladder fuels sparse or absent — H	
H. Crown closure > 75 percent	7
HH. Crown closure < 75 percent	5
EE. Foliage open — I	
I. Ladder fuel plentiful	4
II. Ladder fuel sparse or absent	2
DD. Foliage not resinous, waxy, or oily — J	
J. Foliage dense — K	
K. Ladder fuels plentiful — L	
L. Crown closure > 75 percent	7
LL. Crown closure < 75 percent	4
KK. Ladder fuels sparse or absent — M	
M. Crown closure > 75 percent	5
MM. Crown closure < 75 percent	3
JJ. Foliage open — N	
N. Ladder fuels plentiful	3
NN. Ladder fuels sparse or absent	1
BB. Foliage dead	0

The majority of dead trees within the fuelbreak should be removed. Occasionally, large, dead trees (14 inches or larger in diameter at 4 1/2 feet above ground level) may be retained as wildlife trees. If retained, all ladder fuels must be cleared from around the tree's trunk.

Ignition Sources

Possible ignition sources, which may threaten planned or existing developments, must be investigated thoroughly. Included are other developments and homes, major roads, recreation sites, railroads, and other possible sources. These might be distant from the proposed development, yet still able to channel fire into the area due to slope, continuous fuels, or other topographic features.

Fuelbreak Locations

In fire suppression, an effective fire line is connected, or "anchored," to natural or artificial fire barriers. Such anchor points might be rivers, creeks, large rock outcrops, wet meadows, or a less flammable timber type such as aspen. Similarly, properly designed and constructed fuelbreaks take advantage of these same barriers to eliminate "fuel bridges." (Fire often escapes control because of fuel bridges that carry the fire across control lines.)

Since fuelbreaks should normally provide quick, safer access to defensive positions, they are necessarily linked with road systems. Connected with county-specified roads within subdivisions, they provide good access and defensive positions for firefighting equipment and support vehicles. Cut-and fill slopes of roads are an integral part of a fuelbreak as they add to the effective width of modified fuels.

Fuelbreaks without an associated road system, such as those located along strategic ridge lines, are still useful in fire suppression. Here, they are often strengthened and held using aerial retardant drops until fire crews can walk in or be ferried in by helicopter.

Preferably, fuelbreaks are located along ridge tops to help arrest fires at the end of their runs. However, due to homesite locations and resource values, they can also be effective when established at the base of slopes. Mid-slope fuelbreaks are least desirable, but under certain circumstances and with modifications, these too, may be valuable.

Fuelbreaks are located so that the area under management is broken into small, manageable units. Thus, when a wildfire reaches modified fuels, defensive action is more easily taken, helping to keep the fire small. For example, a plan for a subdivision might recommend that fuelbreaks break up continuous forest fuels into units of 10 acres or less. This is an excellent plan, especially if defensible space thinnings are completed around homes and structures, and thinning for forest management and forest health are combined with the fuelbreak.

When located along ridge tops, continuous length as well as width are critical elements. Extensive long-range planning is essential in positioning these types of fuelbreaks.

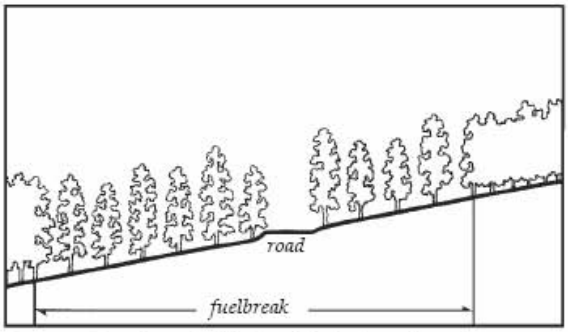
Aesthetics

Improperly planned fuelbreaks can adversely impact an area's aesthetic qualities. Careful construction is necessary when combining mid-slope fuelbreaks with roads involving excessive cut-and-fill.

These photos, far- and near- views of the same site, illustrate that forest can be thinned without impacting aesthetics.

Care must also be taken in areas that are not thinned throughout for fuel hazard reduction. In such cases the fuelbreak visually sticks out like a "sore thumb" due to contrasting thinned and unthinned portions of the forest. (Especially noticeable are those portions of the fuelbreak above road cuts).

These guidelines are designed to minimize aesthetic impacts. However, some situations may require extensive thinning and, thus, result in a major visual change to an area. Additional thinning beyond the fuelbreak may be necessary to create an irregular edge and to "feather," or blend, the fuelbreak thinning into the unthinned portions of the forest. Any thinning beyond the fuelbreak improves its effectiveness and is highly recommended.



Cross-section of a typical fuelbreak built in conjunction with a road.

Constructing the Fuelbreak

Fuelbreak Width and Slope Adjustments

Note: Since road systems are so important to fuelbreak construction, the following measurements are from the toe of the fill for downslope distances, and above the edge of the cut for uphill distances.

The minimum recommended fuelbreak width is approximately 300 feet for level ground. Since fire activity intensifies as slope increases, the overall fuelbreak width must also increase. However, to minimize aesthetic impacts and to maximize fire crew safety, the majority of the increases should be made at the bottom of the fuelbreak, below the road cut.

Widths are also increased when severe topographic conditions are encountered. Guidelines for fuelbreak widths on slopes are given below:

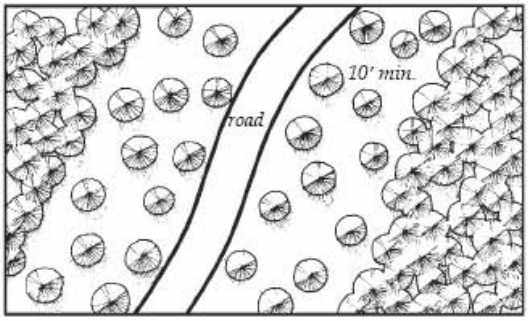
Fuelbreak Width/Slope

Percent Slope (%)	Minimum Uphill Distance (ft)	Minimum Downhill Distance (ft)	Total Width of Modified fuels (ft)*
0	150	150	300
10	140	165	303
20	130	180	310
30	120	195	315
40	110	210	320
50	100	225	325
60	100	240	340

*As slope increases, total distance for cut-and-fill for road construction rapidly increases, improving fuelbreak effective width.

Stand Densities

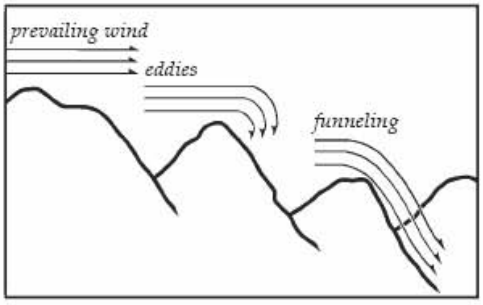
Crown separation is a more critical factor for fuelbreaks than a fixed tree density level. A *minimum* 10-foot spacing between the edges of tree crowns is recommended on level ground. As slope increases, crown spacing should also increase. However, small, isolated groups of trees may be retained for visual diversity. Increase crown spacing around any groups of trees left for aesthetic reasons and to reduce fire intensities and torching potential.



Plan view of fuelbreak showing minimum distance between tree crowns.

In technical terms, a fuelbreak thinning is classified as a heavy "sanitation and improvement cut, from below." Within fuelbreaks, trees that are suppressed, diseased, deformed, damaged, or of low vigor are removed along with all ladder fuels. Remaining trees are the largest, healthiest, most wind-firm trees from the dominant and co-dominant species of the stand.

Because such a thinning is quite heavy for an initial entry into a stand, prevailing winds, eddy effects, and wind funneling must be carefully evaluated to minimize the possibility of windthrow. It may be necessary to develop the fuelbreak over several years to allow the timber stand to "firm-up" — this especially applies to lodgepole pine and Engelmann spruce stands.



Topography affects wind behavior – an important consideration during fuelbreak construction.

Area-wide forest thinnings are recommended for any subdivisions. Such thinning is not as severe as a fuelbreak thinning, but generally should be completed to fuelbreak specifications along the roads (as outlined on page 6.) In addition, "defensible space thinnings" are highly recommended around all structures (see CSU Coop. Extension Fact sheet 6.302, *Creating Wildfire-Defensible Zones*).

Debris Removal

Limbs and branches left from thinning (slash) can add significant volumes of fuel to the forest floor, especially in lodgepole pine, mixed-conifer, or spruce/fir timber types. These materials can accumulate and serve as ladder fuels, or can become "jackpots," increasing the difficulty of defending the fuelbreak during a wildfire. **Slash decomposes very slowly in Colorado and proper disposal is essential.** Proper treatment reduces fire hazard, improves access for humans and livestock, encourages establishment of grasses and other vegetation, and improves aesthetics.

Three treatment methods are commonly used. These are lopping-and-scattering, piling and burning, and chipping. Mulching of small trees and slash using equipment similar to Hydro-axes or Timbcos equipped with mulching heads are becoming a popular method of treatment. Size, amount, and location of slash dictates the method used, in addition to cost and the final desired appearance. The method chosen will also depend on how soon an effective fuelbreak is needed prior to construction in new developments.

Lop and scatter: slash should be no deeper than 12" above ground surface.

Chipping is the most desirable, but also the most expensive method of slash disposal.

Piled slash can be burned but only during certain conditions, such as after a snowfall.

Fuelbreak Maintenance

Following initial thinning, trees continue to grow (usually at a faster rate). The increased light on the forest floor encourages heavy grass and brush growth where, in many cases, where little grew before. The site disturbance and exposed mineral soil created during fuelbreak development is a perfect seed bed for new trees that, in turn, create new ladder fuels. Thus, in the absence of maintenance, fuelbreak effectiveness will decrease over time.

Fuelbreak maintenance is essential. Ingrowth, shown above, will minimize the effectiveness of this fuelbreak within a few years.

Fuelbreak maintenance problems are most often the result of time and neglect. Misplaced records, lack of follow-up and funding, and apathy caused by a lack of fire events are some of the major obstacles. In addition, the responsibility for fuelbreak maintenance projects is often unclear. For example, control of a fuelbreak completed by a developer passes to a homeowner's association, usually with limited funds and authority to maintain fuelbreaks.

If fuelbreak maintenance is not planned and completed as scheduled, consider carefully whether the fuelbreak should be constructed. An un-maintained fuelbreak may lead to a false sense of security among residents and fire suppression personnel.

Conclusion

An image of well-designed communities for Colorado includes:

- Forested subdivisions where the total forest cover is well-managed through carefully planned, designed, and maintained thinnings. This contributes to reduced wildfire hazards and a much healthier forest — one that is more resistant to insects and disease.

- A system of roads and driveways with their associated fuelbreaks that break up the continuity of the forest cover and fuels. These help keep fires small, while also providing safer locations from which to mount fire suppression activities. In addition to allowing fire personnel in, they will allow residents to evacuate if necessary.

- Individual homes that all have defensible space around them, making them much easier to defend and protect from wildfire, while also protecting the surrounding forest from structure fires.

Creation of such communities is entirely feasible if recognition of the fire risks, a spirit of cooperation, an attitude of shared responsibility, and the political will exists.

Colorado's mountains comprise diverse slopes, fuel types, aspects, and topographic features. This variety makes it impossible to develop general fuelbreak prescriptions for all locations. ***The previous recommendations are guidelines only.*** *A professional forester with fire suppression expertise should be consulted to "customize" fuelbreaks for particular areas.*

APPENDIX G
CREATING WILDFIRE DEFENSIBLE ZONES

NATURAL RESOURCES SERIES

FORESTRY

Creating Wildfire-Defensible Zones no. 6.302

by F.C. Dennis [1]

Quick Facts...

Wildfire will find the weakest links in the defense measures you have taken on your property.

The primary determinants of a home's ability to survive wildfire are its roofing material and the quality of the "defensible space" surrounding it.

Even small steps to protect your home and property will make them more able to withstand fire.

Consider these measures for all areas of your property, not just the immediate vicinity of the house.

Fire is capricious. It can find the weak link in your home's fire protection scheme and gain the upper hand because of a small, overlooked or seemingly inconsequential factor. While you may not be able to accomplish all measures below (and there are no guarantees), each will increase your home's, and possibly your family's, safety and survival during a wildfire.

Start with the easiest and least expensive actions. Begin your work closest to your house and move outward. Keep working on the more difficult items until you have completed your entire project.

Defensible Space

Two factors have emerged as the primary determinants of a home's ability to survive wildfire. These are the home's roofing material and the quality of the "defensible space" surrounding it.

Use fire-resistive materials (Class C or better rating), not wood or shake shingles, to roof homes in or near forests and grasslands. When your roof needs significant repairs or replacement, do so with a fire-resistant roofing material. Check with your county building department. Some counties now restrict wood roofs or require specific classifications of roofing material.

Defensible space is an area around a structure where fuels and vegetation are treated, cleared or reduced to slow the spread of wildfire towards the structure. It also reduces the chance of a structure fire moving from the building to the surrounding forest. Defensible space provides *room for firefighters to do their jobs.* Your house is more likely to withstand a wildfire if grasses, brush, trees and other common forest fuels are managed to reduce a fire's intensity.

The measure of fuel hazard refers to its continuity, both horizontal (across the ground) and vertical (from the ground up into the vegetation crown). Fuels with a high degree of both vertical and horizontal continuity are the most hazardous, particularly when they occur on slopes. Heavier fuels (brush and trees) are more hazardous (i.e. produce a more intense fire) than light fuels such as grass.

Mitigation of wildfire hazards focuses on breaking up the continuity of horizontal and vertical fuels. Additional distance between fuels is required on slopes.

Creating an effective defensible space involves developing a series of management zones in which different treatment techniques are used. See Figure 1 for a general view of the relationships among these management zones. Develop defensible space around each building on your property. Include detached garages, storage buildings, barns and other structures in your plan.

The actual design and development of your defensible space depends on several factors: size and shape of buildings, materials used in their construction, the slope of the ground on which the structures are built, surrounding topography,

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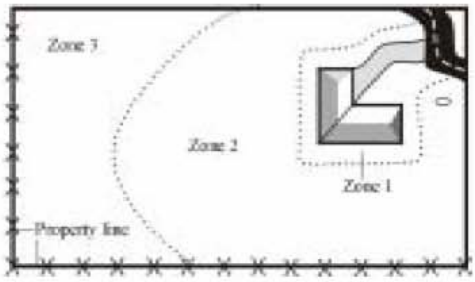

Figure 1: Forested property showing the three fire-defensible zones around a home or other structure.

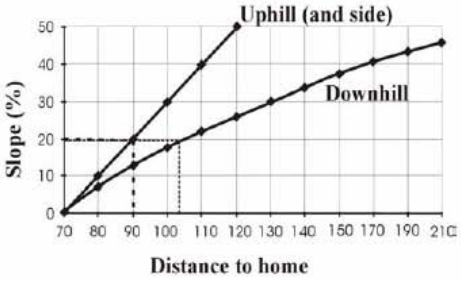

Figure 2: This chart indicates the *minimum recommended* dimensions for defensible space from the home to the outer edge of Zone 2. For example, if your home is situated on a 20 percent slope, the minimum defensible space dimensions would be 90 feet uphill and to the sides of the home and 104 feet downhill from the home.

and sizes and types of vegetation on your property. These factors all affect your design. You may want to request additional guidance from your local Colorado State Forest Service (CSFS) forester or fire department. (See the Special Recommendations section of this fact sheet for shrubs, lodgepole pine, Engelmann spruce, and aspen.)

Defensible Space Management Zones

Zone 1 is the area of maximum modification and treatment. It consists of an area of 15 feet around the structure in which all flammable vegetation is removed. This 15 feet is measured from the outside edge of the home's eaves and any attached structures, such as decks.

Zone 2 is an area of fuel reduction. It is a transitional area between Zones 1 and 3. The size of Zone 2 depends on the slope of the ground where the structure is built. Typically, the defensible space should extend *at least* 75 to 125 feet from the structure. See Figure 2 for the appropriate distance for your home's defensible space. Within this zone, the continuity and arrangement of vegetation is modified. Remove stressed, diseased, dead or dying trees and shrubs. Thin and prune the remaining larger trees and shrubs. Be sure to extend thinning along either side of your driveway all the way to your main access road. These actions help eliminate the continuous fuel surrounding a structure while enhancing homesite safety and the aesthetics of the property.

Zone 3 is an area of traditional forest management and is of no particular size. It extends from the edge of your defensible space to your property boundaries.

Prescriptions

Zone 1

The size of Zone 1 is 15 feet, measured from the edges of the structure. Within this zone, several specific treatments are recommended.

Plant nothing within 3 to 5 feet of the structure, particularly if the building is sided with wood, logs or other flammable materials. Decorative rock, for example, creates an attractive, easily maintained, nonflammable ground cover.

If the house has noncombustible siding, widely spaced foundation plantings of low growing shrubs or other "fire wise" plants are acceptable. Do not plant directly beneath windows or next to foundation vents. Be sure there are no areas of continuous grass adjacent to plantings in this area.

Frequently prune and maintain plants in this zone to ensure vigorous growth and a low growth habit. Remove dead branches, stems and leaves.

Do not store firewood or other combustible materials in this area. Enclose or screen decks with metal screening. Extend the gravel coverage under the decks. Do not use areas under decks for storage.

Ideally, remove all trees from Zone 1 to reduce fire hazards. If you do keep a tree, consider it part of the structure and extend the distance of the entire defensible space accordingly. Isolate the tree from any other surrounding trees. Prune it to at least 10 feet above the ground. Remove any branches that interfere with the roof or are within 10 feet of the chimney. Remove all "ladder fuels" from beneath the tree. Ladder fuels are vegetation with vertical continuity that allows fire to burn from ground level up into the branches and crowns of trees. Ladder fuels are potentially very hazardous but are easy to mitigate. No ladder fuels can be allowed under tree canopies. In all other areas, prune all branches of shrubs or trees up to a height of 10 feet above ground (or 1/2 the height, whichever is the least).

Zone 2

Zone 2 is an area of fuel reduction designed to reduce the intensity of any fire approaching your home. Follow these recommended management steps.

Thin trees and large shrubs so there is at least 10 feet between crowns. Crown separation is measured from the furthest branch of one tree to the nearest branch on the next tree (Figure 3). On steep slopes, allow more space between tree crowns. (See Figure 4 for *minimum recommended* spacing for trees on steep slopes.) Remove all ladder fuels from under these remaining trees. Carefully prune trees to a height of at least 10 feet.

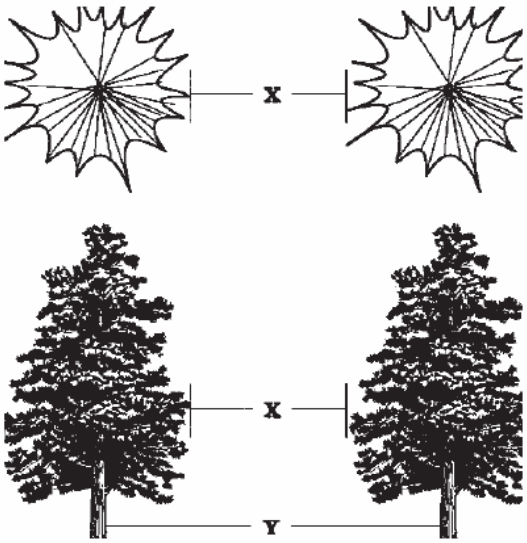

Figure 3: X = crown spacing; Y = stem spacing. Do not measure between stems for crown — measure between the edges of tree crowns.

Small clumps of 2 to 3 trees may be occasionally left in Zone 2. Leave more space between the crowns of these clumps and surrounding trees.

Because Zone 2 forms an aesthetic buffer and provides a transition between zones, it is necessary to blend the requirements for Zones 1 and 3. Thin the portions of Zone 3 adjacent to Zone 2 more heavily than the outer portions.

Isolated shrubs may remain, provided they are not under tree crowns. Prune and maintain these plants periodically to maintain vigorous growth. Remove dead stems from trees and shrubs annually. Where shrubs are the primary fuel in Zone 2, refer to the Special Recommendations section of this fact sheet.

Limit the number of dead trees (snags) retained in this area. Wildlife needs only one or two snags per acre. Be sure any snags left for wildlife cannot fall onto the house or block access roads or driveways.

Mow grasses (or remove them with a weed trimmer) as needed through the growing season to keep them low, a maximum of 6 to 8 inches. This is extremely critical in the fall when grasses dry out and cure or in the spring after the snow is gone but before the plants green up.

Stack firewood and woodpiles uphill or on the same elevation as the structure but at least 30 feet away. Clear and keep away flammable vegetation within 10 feet of these woodpiles. Do not stack wood against your house or on or under your deck, even in winter. Many homes have burned from a woodpile that ignited as the fire passed. Wildfires can burn at almost any time in Colorado.

Locate propane tanks at least 30 feet from any structures, preferably on the same elevation as the house. You don't want the LP container below your house — if it ignites, the fire would tend to burn uphill. On the other hand, if the tank is above your house and it develops a leak, LP gas will flow downhill into your home. Clear and keep away flammable vegetation within 10 feet of these tanks. Do not screen propane tanks with shrubs or vegetation.

Dispose of slash (limbs, branches and other woody debris) from your trees and shrubs through chipping or by piling and burning. Contact your local CSFS office or county sheriff's office for information about burning slash piles. If neither of these alternatives is possible, lop and scatter slash by cutting it into very small pieces and distributing it over the ground. Avoid heavy accumulations

% slope	Tree Crown Spacing	Brush and Shrub Clump Spacing
0 -10 %	10´	2 1/2 x shrub height
11 - 20%	15´	3 x shrub height
21 - 40%	20´	4 x shrub height
> 40%	30´	6 x shrub height

Figure 4: Minimum tree crown and shrub clump spacing.

Grasses

Keep dead, dry or curing grasses mowed to less than 6 inches. Defensible space size where grass is the predominant fuel can be reduced (Figure 5) when applying this practice.

Windthrow

In Colorado, certain locations and tree species, including lodgepole pine and Engelmann spruce, are especially susceptible to damage and uprooting by high winds (windthrow). If you see evidence of this problem in or near your forest, or have these tree species, consider the following adjustments to the defensible space guidelines. It is highly recommended that you contact a professional forester to help design your defensible space.

Adjustments: If your trees or homesite are susceptible to windthrow and the trees have never been thinned, use a stem spacing of diameter plus five instead of the guides listed in the Zone 3 section. Over time (every 3 to 5 years) *gradually* remove additional trees. The time between cutting cycles allows trees to "firm up" by expanding their root systems. Continue this periodic thinning until the desired spacing is reached.

Also consider leaving small clumps of trees and creating small openings on their lee side (opposite of the predominant wind direction). Again, a professional forester can help you design the best situation for your specific homesite and tree species. Remember, with species such as lodgepole pine and Engelmann spruce, the likelihood of a wildfire running through the tree tops or crowns (crowning) is closely related to the overabundance of fuels on the forest floor. Be sure to remove downed logs, branches and *excess* brush and needle buildup.

% slope	D-space size (uphill, downhill, sidehill)
0 - 20 %	30'
21 - 40%	50'
> 40%	70'

Figure 6: Minimum defensible space size for grass fuels.

Maintaining Your Defensible Space

Your home is located in a forest that is dynamic, always changing. Trees and shrubs continue to grow, plants die or are damaged, new plants begin to grow, and plants drop their leaves and needles. Like other parts of your home, defensible space requires maintenance. Use the following checklist each year to determine if additional work or maintenance is necessary.

Defensible Space and FireWise Annual Checklist

- ☐ Trees and shrubs are properly thinned and pruned within the defensible space. Slash from the thinning is disposed of.
- ☐ Roof and gutters are clear of debris.
- ☐ Branches overhanging the roof and chimney are removed.
- ☐ Chimney screens are in place and in good condition.
- ☐ Grass and weeds are mowed to a low height.
- ☐ An outdoor water supply is available, complete with a hose and nozzle that can reach all parts of the house.
- ☐ Fire extinguishers are checked and in working condition.
- ☐ The driveway is wide enough. The clearance of trees and branches is adequate for fire and emergency equipment. (Check with your local fire department.)
- ☐ Road signs and your name and house number are posted and easily visible.
- ☐ There is an easily accessible tool storage area with rakes, hoes, axes and shovels for use in case of fire.
- ☐ You have practiced family fire drills and your fire evacuation plan.
- ☐ Your escape routes, meeting points and other details are known and understood by all family members.
- ☐ Attic, roof, eaves and foundation vents are screened and in good condition.

FIREWISE is a multi-agency program that encourages the development of defensible space and the prevention of catastrophic wildfire.

Stilt foundations and decks are enclosed, screened or walled up.

- ☐ Trash and debris accumulations are removed from the defensible space.
- ☐ A checklist for fire safety needs inside the home also has been completed. This is available from your local fire department.

References

Colorado State Forest Service, Colorado State University, Fort Collins, CO 80523-5060; (970) 491-6303:

- *FireWise Construction — Design and Materials*
- Home Fire Protection in the Wildland Urban Interface
- Wildfire Protection in the Wildland Urban Interface
- *Landowner Guide to Thinning*

Colorado State University Cooperative Extension, 115 General Services Bldg., Fort Collins, CO 80523-4061; (970) 491-6198; E-mail: resourcecenter@ucm.colostate.edu:

- 6.303, *Fire-Resistant Landscaping*
- 6.304, *Forest Home Fire Safety*
- 6.305, *FireWise Plant Materials*
- 6.306, *Grass Seed Mixes to Reduce Wildfire Hazard*
- 7.205, *Pruning Evergreens*
- 7.206, *Pruning Shrubs*
- 7.207, *Pruning Deciduous Trees*

Colorado State Forest Service

This fact sheet was produced in cooperation with the Colorado State Forest Service.

[1]*Wildfire Hazard Mitigation Coordinator, Colorado State Forest Service.*

APPENDIX H

PRESCRIBED PILE BURNING GUIDELINES

Colorado State FOREST SERVICE

GOLDEN DISTRICT

This handout is designed to be used by forest landowners, land managers, and fire department personnel in planning and conducting safe and effective burning of piled forest debris ("slash") called "pile burns." These guidelines cannot guarantee safety against accidents, unforeseen circumstances, changing burning conditions, or negligent actions of the individuals conducting the prescribed fire. By following the intent of these guidelines and using common sense, the landowner or forest manager can reduce slash accumulations, improve the appearance of their forest land, and reduce wildfire risk on their property. The reader should contact a local office of the Colorado State Forest Service (CSFS) or their local fire authority for updated versions of this publication and current requirements about the use of open fires.

DEFINITIONS:

Slash: The accumulation of vegetative materials such as tops, limbs, branches, brush, and miscellaneous residue resulting from forest management activities such as thinning, pruning, timber harvesting, and wildfire hazard mitigation.

Pile Burning: The treatment of slash by arranging limbs and tops into manageable piles. Piles are burned during safe burning conditions, generally during the winter following cutting.

Chunking-In: The process of moving unburned materials from the outside perimeter into the center of the still burning piles. This is done after the pile has initially burned down and is safe to approach, but before the hot coals in the center have cooled. Chunking-in allows greater consumption of the piled slash.

Mop-up: The final check of the fire to identify and extinguish any still-burning embers or materials. This is accomplished by mixing snow, water, or soil with the burning materials.

MATERIALS TO BE INCLUDED IN PILES:

All limbs, tops, brush, and miscellaneous materials recently cut in the area, no greater than 3 inches in diameter and from 1 to 8 feet in length. Older branches can be used as long as they still have needles/foliage attached or have not started decaying. Materials greater than 3 inches in diameter do not significantly help a fire spread rapidly, will generally burn longer and require more chunking-in or mopping-up than is cost-effective, produce greater amounts of smoke, and should be used for sawtimber, posts and poles, firewood, or left for wildlife habitat. **Do not place garbage or debris in the piles**.

LOCATION OF PILES:

Piles should be located in forest openings or between remaining trees, in unused logging roads and landings, meadows, and rock outcrops. Piles should be preferably at least 10 feet from the trunk of any overhead trees. In denser stands of trees, piles can be located closer to the trees and even under the overhanging branches, but these piles should be smaller in size and burned when snow or moisture is present in the tree crowns. Piles should NOT be located on active road surfaces, in ditches, near structures or poles, under or around power lines, or on top of logs or stumps that may catch fire and continue smoldering.

CONSTRUCTION OF PILES:

Piles should be constructed by hand whenever possible, but if constructed by machine they should clean of dirt and debris. Piles should be started with a core of kindling-like materials such as needles, small branches, or paper in the bottom of the pile. Pile slash soon after cutting (while still green) and before winter snowfall. Do not include wood products such as firewood and logs. Pile branches and tops with the butt ends towards the outside of the pile, and with the branches overlapping so as to form a series of dense layers piled upon each other. The piles should be compact, packed down during construction, and with no long branches that will not burn from sticking out into the surrounding snow. Piles should be up to 8 feet in diameter, and at least 4 to 6 feet high. These measures prevent snow and moisture from filtering down into the piles and extinguishing the fire before it gets going. If the fuels do not have sufficient needles or fine fuels to carry the fire or kept moisture out (such as oak brush or very old conifer branches), then you should cover the piles with 6 mil plastic to keep them dry until the day of the burn, and then remove it.

PLANNING YOUR BURNING EFFORT:

Individuals should check with the local CSFS office or fire authority for the current requirements on open fires. Generally, you must complete one or more of the following steps before burning slash:

1. Complete and have an approved open burning permit from the local (county) Health Department.
2. Obtain authorization from the legally constituted fire authority for your area. This may be part of the health department's permit process.
3. Land management agencies must complete and have approval of an open burning permit from the Colorado Department of Health - Air Pollution Control Division.

Copies of all permits should be available on-site during the burning operation. Burning activities should also include plans for safety, supplemental water sources, and extra assistance from the local fire authority or the landowner. The individual(s) planning the burning operation should notify the following entities on the day of a burn: the local fire authority, county sheriff's department, and adjacent landowners who may be affected by smoke. Notification should include the date, times, and exact location of the burn.

Pile burning must be conducted under suitable weather conditions. Periods of snow or light rain, with steady, light winds (for smoke dispersal), and sufficiently snow cover (6-12 inch depths) are ideal. Do not burn during periods of high winds, low humidity or drying conditions, temperature inversions (especially "Red Air Quality" days in metropolitan areas), with a lack of snow cover or these conditions are expected to develop after starting the burn. Persons burning slash piles should have the following: leather gloves; shovels; suitable footwear; masks for covering the mouth and nose; and proper eye protection.

BURNING SLASH PILES:

Piles may be ignited by several means. If the needles and fine fuels within the pile have dried though the summer, ignition can be easily started with matches and a large ball of newspaper placed within the bottom of the pile. If fuels are still partially green, or the pile is wet from rain or melting snow, then a hotter and longer burning source may be necessary. Drip torches (a specially designed gas can used by foresters for igniting fires) or sawdust soaked with diesel fuel can be used to ignite the pile. Flares used for highway emergencies can also be utilized to ignite the piles. **Do not use gasoline for this purpose.**

One test pile should be ignited to see if it burns and at what rate, prior to igniting other piles. If suitable burning conditions exist, then additional piles may be started. Ignite only those piles that can be controlled by the available manpower and resources until they have burned down. You can slow the rate of burning (and possible scorching of adjacent trees) by shoveling snow or spraying water into the pile and cooling the fire down. Depending upon weather conditions, pile size, and moisture content of the fuels, piles should burn down in 30-60 minutes. As a general rule, one person can manage three to six closely situated piles.

After the piles have burned down, chunk-in any unburned slash and wood into the hot coals in the center of the pile. As much as 95 percent of the original slash can be consumed by aggressive chunking-in. Do not start any new piles on fire after 2:00 pm, as they may continue burning into the evening, and will not burn as completely due to lower temperatures and higher relative humidity. Smoke inversions may be a problem for piles still burning after sunset. At all times, piles may need to be actively mopped-up if the weather conditions will not extinguish the fire, or if the fires could escape. If high winds or melting snow increases this risk, then all burning materials must be mopped-up.

ADDITIONAL ASSISTANCE:

If landowners have questions about burning slash, they should contact a local CSFS office (http://csfs.colostate.edu/). CSFS can assist landowners with planning or conducting prescribed fire activities such as pile burning or broadcast (area) burning. Local, state, and fire department authorities may require a burn plan, smoke management plan, and weather monitoring for complex burning operations.

APPENDIX I
WEB REFERENCE GLOSSARY

Resource	Web Site
City of Golden	http://www.ci.golden.co.us
Colorado State Forest Service	http://csfs.colostate.edu/
Colorado State Forest Service Library	http://csfs.colostate.edu/library.htm
Fire Regime Condition Class	http://www.frcc.gov/index.html
FireWise	http://www. Firewise.org.
Jefferson County CWPP project site	http://www.co.jefferson.co.us/emerg/index.htm
Jefferson County Emergency Management	http://www.co.jefferson.co.us/emerg/
Jefferson County Emergency Operating Plan	http://www.co.jefferson.co.us/ca/chap06016.htm#P6_19
Jefferson County, Environmental Health Services, Open Burning Permit	www.co.jefferson.co.us/health/health_T111_R38.htm
Jefferson County Policies and Procedures	http://www.co.jefferson.co.us/ca/ca_T148_R2.htm
Landfire Geospatial Data	http://www.landfire.gov/products_overview.php
Rocky Mtn Geographic Science Center – Wildfire Support	http://wildfire.cr.usgs.gov
Searchable Grants Database	http://www.rockymountainwildlandfire.info/

APPENDIX J
LIST OF PREPARERS

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Fred Groth, Director of Geospatial Technologies	Walsh Environmental Scientists and Engineers, LLC
Kelly Close, Fire Behavior Analyst	Independent Contractor
Scott Wells, CPP, CFE, ALCM	Paradigm Risk Management Associated, LLC
Jerry Stricker, Fire Marshal	City of Golden

APPENDIX K

GRASS SEEDING MIXTURES TO REDUCE WILDFIRE HAZARD

NATURAL RESOURCES SERIES

FORESTRY

Grass Seed Mixes to Reduce Wildfire Hazard **no. 6.306**

by F.C. Dennis[1]

Quick Facts...

Plant "FireWise" grass species to reduce the risk of wildfire damage.

"FireWise" grass mixes may contain only native species or a combination of native and non-native species.

Sow half the seed north to south and the other half east to west.

Rake the seed into the soil.

Mulch erosion-prone areas.

If possible, water often and lightly.

Maintain the area properly.

During much of the year, grasses ignite easily and burn rapidly. Tall grass will quickly carry fire to your house. Plant "FireWise" grasses in the defensible space around your home. Defensible space is an area around a structure where fuels and vegetation are treated, cleared or reduced to slow the spread of wildfire. See fact sheet 6.302, *Creating Wildfire-Defensible Zones*.

Seed Mixes for Colorado

Grass seed mixes developed for Colorado use native or a combination of native and non-native grass species. While the basic mixes (Tables 1 and 3) work reasonably well on all sites, they were modified for moist sites and/or those with northern exposures (Tables 2 and 4).

Grasses included in these mixes have the following characteristics:

- They are lower growing.
- They need less maintenance.
- Seed is readily available and relatively inexpensive.

Grass seed mixes made up entirely of native seed may take longer to establish — up to three years — than those with a percentage of non-native seed.

Planting

Use either a drop or a cyclone seeder to seed your defensible space.

A drop seeder is more accurate in placing seed, especially if wind is a problem. However, if the ground is rough or rocky, the cyclone seeder will be easier to use.

Seed at the rates shown in the tables below. Divide seed into two equal parts. Sow half of the seed by crossing the area north to south and the other half by crossing east to west.

Rake seed into the soil as soon as possible after sowing to reduce the chances of it blowing or washing out. Soil cover also helps to protect the young seedlings from drying out. When sowing on slopes prone to erosion, cover the seeded area with mulch. Recommended mulches include **clean** straw (straw with no seeds in it), netting or matting of some kind.

If you have water from a central community system or a well permit that allows outside irrigation, water the newly seeded areas frequently and lightly. Water enough to keep the soil moist but not so heavily as to cause soil washing and loss of the grass seed.

Maintenance

Even "FireWise" grasses need proper maintenance. See 6.303, *Fire-Resistant Landscaping*, for tips on proper mowing and other maintenance and landscaping suggestions.

Colorado State University Cooperative Extension

Putting Knowledge to Work

FIREWISE is a multi-agency program that encourages the development of defensible space and the prevention of catastrophic wildfire.

Native Grass "Fire Mixes"

Table 1: All exposures.

Species	Variety	Percent of Mix	Broadcast Rate PLS* Lbs/Acre
Arizona fescue	Redondo	20	9.0 x .20 = 1.80
Western wheatgrass	Barton/Rosana	20	32.0 x .20 = 6.40
Streambank wheatgrass	Sodar	20	22.0 x .20 = 4.40
Indian ricegrass	Nezpar	20	25.0 x .20 = 5.00
Blue grama	Lovington	20	6.0 x .20 = 1.20
	TOTALS	100%	18.80

Table 2: Northerly exposures and/or moist sites.

Species	Variety	Percent of Mix	Broadcast Rate PLS* Lbs/Acre
Arizona fescue	Redondo	25	9.0 x .25 = 2.25
Western wheatgrass	Barton/Rosana	25	32.0 x .25 = 8.00
Streambank wheatgrass	Sodar	25	22.0 x .25 = 5.50
Indian ricegrass	Nezpar	25	25.0 x .25 = 6.25
	TOTALS	100%	22.00

Non-Native/Native Grass "Fire Mixes"

Table 3: All exposures.

Species	Variety	Percent of Mix	Broadcast Rate PLS* Lbs/Acre
Canada bluegrass	Reubens	10	2.0 x .10 = 0.20
Western wheatgrass	Barton/Rosana	20	32.0 x .20 = 6.40
Streambank wheatgrass	Sodar	15	22.0 x .15 = 3.30
Indian ricegrass	Nezpar	15	25.0 x .15 = 3.75
Sheep fescue	Covar	20	8.0 x .20 = 1.60
Blue grama	Lovington	20	6.0 x .20 = 1.20
	TOTALS	100%	16.45

Table 4: Northerly exposures and/or moist sites.

Species	Variety	Percent of Mix	Broadcast Rate PLS* Lbs/Acre
Canada bluegrass	Reubens	15	2.0 x .15 = 0.30
Western wheatgrass	Barton/Rosana	20	32.0 x .20 = 6.40
Streambank wheatgrass	Sodar	20	22.0 x .20 = 4.40
Indian ricegrass	Nezpar	15	25.0 x .15 = 3.75
Sheep fescue	Covar	30	8.0 x .30 = 2.40
	TOTALS	100%	17.25

*Pure Live Seed.

References

For additional information on protecting your homesite, see:

- 6.302, *Creating Wildfire-Defensible Zones*
- 6.303, *Fire-Resistant Landscaping*
- 6.304, *Forest Home Fire Safety*
- 6.305, *FireWise Plant Materials*

Colorado State FOREST SERVICE

This fact sheet was produced in cooperation with the Colorado State Forest Service.

[1]*Wildfire Hazard Mitigation Coordinator, Colorado State Forest Service.*

APPENDIX L

SIGNIFICANT WILDFIRE HISTORY within Wildland Urban Interface – CSFS Golden District and Immediate Vicinity

(Prepared by Allen Gallamore, Colorado State Forest Service, 3/21/07 – subject to revision/correction)

FIRE NAME	LOCATION	SIZE	DATES	ADDN INFO
Murphy Gulch	Jefferson County: Inter-Canyon FPD & West Metro (Lakewood-Bancroft) FPD; along foothills west of Ken-Caryl Ranch subdivision	Approx 3,300 acres	Sept. 21-24, 1978	First EFF fire in Front Range, several structures lost, subdivisions evacuated, interagency resources ordered to supplement local fire departments' resources. CSFS Type 2 IMT (?) takes over and manages to closeout.
North Table Mtn	Jefferson County: Fairmount FPD. Top, west and east sides of North Table Mountain.	Approx 1300 – 2000 acres	Sept. 7 – 9, 1988	Human caused fire off CO 93 crossed mountain to threaten subdivisions on east side of mountain. Over 250 firefighters from 20 fire departments and National Guard respond as well as a helicopter. Structure protection and evacuations in many areas.
Mt. Falcon	Jefferson County: Indian Hills FPD; primarily on Jefferson County OS (Mt. Falcon park)	Approx 125 acres	April 23 - 24, 1989	Fire within open space property, leading to voluntary fire reimbursement program by county open space agencies to local fire departments to support initial attack.
O'Fallon	Jefferson County: Evergreen FPD. DMP parkland east of Kittredge	Approx 52 acres	March 24 – 25, 1991	Fire within Denver Mountain Parks' open space, leading to 100 firefighters from 5 departments responding. Dry winter conditions, gusty winds, and limited access slowed control efforts.
Elk Creek	Jefferson County: Golden Gate FPD. North of Clear Creek Canyon and east of Centennial Cone, in Michigan Creek and Elk Creek drainages.	Approx 102 acres	May 14 – 15, 1991	Fire in steep terrain with limited access, leading to use of hand crews formed from 80+ firefighters representing 15 fire departments from several counties. Fire managed jointly by FPD and Jefferson County Sheriff's Office's newly formed Incident Management Group (IMG).
Carpenter Peak / Chatfield	Douglas County: USFS & West Metro (then Roxborough FPD). Two fires, one uphill from Roxborough State Park & one across South Platte River from Jefferson County	Approx 45 acres & 23 acres	July 9 – 11, 1994	Dry lightning caused fires during larger fire bust throughout Front Range – multiple initial attacks occurring in all locations with limited availability of air resources. Evacuations of Roxborough Park and structure protection occurred using 300 firefighters and 40 engines from throughout Denver metro area, and National Guard helicopters.
Rooney Rd	Jefferson County: West Metro (Lakewood-Bancroft) FPD; along Dakota Hogback between C-470, I-70, and Alameda Pkwy	Approx 185 acres	Dec. 19, 1994	High winds and faulty electrical transformer outside "normal" fire season; Rates of Spread, flame lengths and limited access had fire threatening to cross several man-made barriers (roads). Fire departments from throughout Denver Metro area responded, and several structures were threatened.
Buffalo Creek	Jefferson County: USFS & North Fork FPD	Approx 10,400 acres	May 18-25, 1996	High winds and human cause, extreme fire behavior, 10 mile run in 6 hours; 10 homes or outbuildings lost; first "large" fire in Front Range WUI. Type 1 IMT takes over on day 2 from local IMT3 and manages until closeout.

FIRE NAME	LOCATION	SIZE	DATES	ADDN INFO
Beartracks	Clear Creek County: USFS lands, within Evergreen FPD and Clear Creek Fire Authority boundaries; immediately southwest of Mt Evans State Wildlife Area	Approx 500 acres	June 27, 1998 – July 5, 1998	Heavy fuel loading in roadless area and human caused fire leads to heavy initial attack and extended attack by local fire agencies along with air resources; fire poses threat to Upper Bear Creek drainage and numerous homes; Type 2 IMT takes over from local IMG on day 3 and manages to closeout.
Lininger Mountain	Jefferson County: Genesee FPD & Foothills FPD; immediately southeast of Genesee community	Approx 35 acres	Feb. 26-28, 1999	Dry conditions outside "normal" fire season leads to wildfire threatening several subdivisions and utilizing local fire resources for several days.
Green Mountain	Jefferson County: West Metro FPD; Green Mountain from C-470 to homes on north and east sides of park	Approx 200 acres	March 8, 1999	Multiple departments responding to human caused fire in grass fuels with high Rates of Spread, high flame lengths and limited access, outside "normal" fire season; homes, communications sites were threatened.
Hi Meadow	Park County & Jefferson County: Platte Canyon FPD, Elk Creek FPD, North Fork FPD; from Burland Ranchettes on west to CO 126 on east, and south to Buffalo Creek fire and town of Pine	Approx 10,800 acres	June 12-25, 2000	Human cause fire under initial attack by local FPD, blows up on same day as 10,000 ac Bobcat fire in Larimer County. 52 homes lost & misc. structures; considered "benchmark" WUI fire for Colorado at the time. Type 1 IMT takes over on day 2 from local IMT3 and manages until closeout.
El Dorado/ Walker Ranch	Boulder County: Cherryvale FPD and Coal Creek FPD; west of El Dorado Canyon State Park, through Walker Ranch park to Gross Reservoir; adjacent to border with Jefferson County.	Approx 1,100 acres	Sept. 16-22, 2000	Heavy fuel loading in steep terrain leads to heavy initial attack and extended attack by local fire agencies from Boulder, Gilpin, and Jefferson Counties along with air resources; fire poses threat to Gross Reservoir and numerous homes in Boulder and Jefferson County; Type 2 IMT takes over from zone Type 3 IMT on day 2 and manages to closeout.
Snaking	Park County: USFS and Platte Canyon FPD; north of US 285 from Platte Canyon HS to Crow Hill.	Approx 3,000 acres	April 22 – May 2, 2002	High winds and human cause outside "normal" fire season; heavy initial attack and extended attack by local fire agencies from Jefferson and Park Counties along with air resources; fire poses threat to numerous homes. Type 1 IMT takes over from local type 3 IMT on day 2 and manages until closeout.
Black Mountain	Park County, Jefferson County, Clear Creek County: USFS, Elk Creek FPD and Evergreen FPD; north of Conifer Mountain and south of Brook Forest	Approx 300 acres	May 5 – 11, 2002	Heavy fuel loading in steep terrain leads to heavy initial attack and extended attack by local fire agencies from Jefferson and Park Counties along with air resources; fire poses threat to multiple subdivisions in Conifer and Evergreen; Type 2 IMT takes over from local Type 3 IMT on day 2 and manages to closeout.
Schoonover	Douglas County: USFS & North Fork FPD (Trumbull VFD in 2002); immediately south across S. Platte River from Jefferson County, from west of Deckers to near Moonridge.	Approx 3,000 acres	May 21 – 31, 2002	Lightning cause fire under initial attack by USFS and local FPDs, blows up on 2nd day and makes 3,000 acre/4 mile run in steep terrain. Fire threatens homes, camps businesses, watershed, regional powerline; approx. cabins & misc. structures lost. Type 1 IMT takes over on day 3 from local IMT3 and manages until closeout.

FIRE NAME	LOCATION	SIZE	DATES	ADDN INFO
Hayman	Park, Douglas, Teller, and Jefferson Counties: USFS, multiple FPDs and county sheriffs (North Fork FPD in Jefferson County); from Lake George in Park County to Deckers/CO 126 in Jefferson County to Schoonover fire area and Manitou Exp. Station in Douglas/Teller Counties.	Approx 138,000+ acres	June 8 to mid-July, 2002	Human cause fire under initial attack and extended attack by USFS and local FPDs under direction of interagency IMT3, blows up on 2nd day for historic 17 mile run and 70,000 acres. Multiple evacuations over two-week period as fire made several additional "runs". Over 150 homes & misc. structures lost; large areas of damage to Cheeseman Reservoir and South Platte Watershed areas; fire is considered of nationally significant WUI fire for Colorado and Rocky Mountain region. Type 1 IMT takes over on day 3 from IMT3; fire is eventually managed by series of Type 1 IMTs under an Area Command team, until closeout.
Fountain Gulch	Clear Creek County and Gilpin County: Clear Creek Fire Authority, Central City FD, Clear Creek and Gilpin County Sheriff's Offices. Along county line immediately north of I-70 at the Hidden Valley exit.	Approx 200 acres	June 29-July 5, 2002	Significant fire activity in steep terrain with poor road access leads to heavy initial attack and extended attack by local fire agencies along with air resources; fire poses threat to I-70 and CO 119 travel corridors, businesses, and distant subdivisions. Interagency handcrews are ordered to replace local fire resources; continued use of air resources; fire is managed by local IMG to closeout.
Blue Mountain	Jefferson County: Coal Creek FPD. Immediately south of CO 72 at mouth of Coal Creek Canyon.	Approx 35 acres	August 14 - 15, 2002	Railroad caused fire in light fuels spreads rapidly due to continued drought conditions into adjacent timber and subdivision, leading to heavy initial attack and extended attack by local fire agencies along with air resources; fire poses threat to CO 72 and Coal Creek Canyon, businesses, and multiple subdivisions. Fire is managed by local IMG to closeout.
Cherokee Ranch	Douglas County: Littleton FPD, South Metro FPD, Louviers FPD. Between US 85 and Daniels Park Road.	Approx 1,200 acres	October 29 – 31, 2003	High winds and downed power line outside "normal" fire season; Rates of Spread, flame lengths and limited access had fire threatening to cross several man-made barriers (roads). Fire occurs in "open space" area on same day as 3,500 ac Overland fire in Boulder County. Multiple subdivisions on all sides of fire are threatened as fire resources from throughout Denver Metro area respond. Fire is managed by local IMG to closeout.
North Table Mtn	Jefferson County: Fairmount FPD. Top of, and east, north, west sides of, North Table Mountain outside Golden, CO.	Approx 300 acres	July 22 – 24, 2005	Human cause fire in steep terrain on open space that escapes initial attack. Heavy use of air resources during transition from initial attack to structure protection on day 1. Multiple subdivisions on all sides of fire are threatened as fire resources from throughout Jefferson County respond. Fire is managed by local IMT3 to closeout.
Plainview	Jefferson County: Coal Creek FPD. Immediately north of CO 72 at mouth of Coal Creek Canyon and east to CO 93, north to approximately Boulder County line.	Approx 2,700 acres	Jan. 9 – 10, 2006	High winds and human cause outside "normal" fire season. Rates of Spread, flame lengths and limited access had fire threatening to cross several man-made barriers (roads) – 60 mph winds at midnight cause 2 mile fire run in under 5 minutes. Heavy initial attack and extended attack by local fire agencies from Jefferson and Boulder Counties; fire poses threat to numerous homes and businesses. Fire is managed by local IMT3 to closeout.

FIRE NAME	LOCATION	SIZE	DATES	ADDN INFO
Rocky Flats	Jefferson, Boulder, Adams, and Broomfield Counties: multiple FPDs. Immediately north of CO 128 onto Rocky Flats NWR and east to Indiana Street.	Approx 1,200 acres	April 2, 2006	High winds and human cause outside "normal" fire season; Fire occurs in "open space" area of Rocky Flats NWR and adjacent lands. Rates of Spread, flame lengths and limited access had fire threatening to cross several man-made barriers (roads). Heavy initial attack and extended attack by local fire agencies from Jefferson, Boulder, Gilpin, and Adams Counties. Winds prevent use of air resources; multiple subdivisions, businesses, and Rocky Mountain Airport are threatened. Difficulties with communications and fire management across multiple jurisdictional boundaries noted.
Pine Valley	Jefferson County: Elk Creek FPD. Immediately northwest of Town of Pine.	Approx 100 acres	May 28-30, 2006	High winds and human cause near homes; heavy initial attack and extended attack by local fire agencies from Jefferson and Park Counties along with air resources, local USFS resources, and interagency handcrews. Fire poses threat to numerous homes, while winds limit use of air resources during initial attack. Fire is managed by local IMT3 to closeout.
Ralston Creek	Jefferson County: No-man's lands adjacent to Fairmount FPD and Golden Gate FPD. North end of White Ranch OS park and adjacent uranium mine (private).	Approx 26 acres	June 17 – 19, 2006	Fire within open space property under initial attack by local FPD, "blows up" and forces resources to retreat to safety zones. Significant fire activity in steep terrain with poor road access leads to heavy use of air resources; fire poses threat to Ralston Reservoir and numerous subdivisions. Interagency handcrews supplement local fire resources and continued use of air resources on day 2; fire is managed by local IMT3 to closeout.
Centennial Cone	Jefferson County: No-man's lands adjacent to Golden Gate FPD. Entirely within Centennial Cone OS park.	Approx 22 acres	July 21 – 23, 2006	Fire within open space property with significant fire activity in steep terrain with no road access during height of 2006 national fire season leads to limited initial attack; fire poses threat to US 6 in Clear Creek Canyon and distant subdivisions. Limited air resources are utilized to slow fire spread, and an interagency "hotshot" handcrew supplements local fire resources on day 2 for direct attack. Fire is controlled by day 3 as summer monsoons also reduce fire danger.

Other smaller wildfires within the WUI that posed high potential for significant impacts to adjacent communities, and had large initial attack response by local fire departments, include:

- Coal Creek fire, September 1988: 14 separate fires for 42 acres from train in Coal Creek Canyon area, resulting in response from multiple fire agencies and Single Engine Air Tanker, & CO Natl Guard Huey – dip site Ralston Res.
- Beaver Brook, 7/20/98-7/21/98: 25 acre fire immediately downhill from Mt Vernon Country Club in Clear Creek Canyon, resulting in air resources and structural protection.
- Red Rocks fire, 3/9/00: 10 acre grass and brush fire with high winds immediately southwest of Red Rocks amphitheatre, resulting in response from multiple fire agencies in Jefferson County.

- Bald Mountain fire, 5/6/00: 5 acre fire in Genesee Park, immediately west of Mt Vernon Country Club.
- Silver Bullet fire, 6/15/00: approx. 20 acre fire on South Table Mountain immediately above Coors plant in Golden, requiring air tanker use to assist local fire departments. Fire occurred during same time that Hi Meadow fire was making significant run in southern Jefferson County.
- Mt Galbraith fire, 8/11/00: 2 acres in three dry lightning fires on top of Mt. Galbraith above City of Golden, threatening subdivisions in town.
- US 6 fire, 4/6/02: 50 acre grass and brush fire west of US 6 and south of 19th street in City of Golden, threatening multiple subdivisions.
- North Spring Gulch fire, 6/6 – 6/7/02: 20 acre fire northwest of Idaho Springs in Clear Creek County requiring significant air tanker use to assist local fire departments.
- Leyden fire, 1/18/05: 300 acre grass fire northwest of Arvada runs 5 miles in 25-30 mph winds, causing minor damage to numerous homes being protected by 60+ firefighters and multiple engines from Arvada, Fairmount, Rocky Flats, and Golden Fire Departments.

APPENDIX M

CITY OF GOLDEN MUNICIPAL CODES RELATED TO VEGETATION MANAGEMENT

Municipal Code (http://ci.golden.co.us/Code.asp)

Updated through Ordinance No. 1764, March, 2007.

5.05.030 Removal required

It is unlawful, and shall constitute a nuisance for any person who is an owner, owner's agent, occupant, or lessee of any occupied or unoccupied lot or any parcel of land in the city, including, without limitation, public and utility easements and drainage ways within such property, to fail to comply with the terms and conditions of any noxious weed management plan adopted by the local advisory board or to permit or maintain on any such parcel of land, or lot, any accumulation, collection, presence or growth of any of the following:

(a) noxious weeds: or

(b) turf grass or weeds over eight (8) inches in height..

(c) Any grasses or other herbaceous plants, over eight (8) inches in height within ten (10) feet of any building on an adjacent property. (Ord. 1727 § 16, 2005; Ord 1542, § 4 2001; Ord. 1383, 1998; Ord. 1143, 1992; Ord. 629 §1, 1970; Ord. 502 §3, 1962).

5.06.010 Pruning, corner clearances

(a) Trees, shrubs, bushes and other vegetation which are dead, broken, diseased, infested by insects or impede the passage of pedestrians or vehicles or obstruct sight-lines of any public street or highway or any official traffic control device so as to endanger the well-being of any other vegetation or constitutes a potential threat or hazard to persons or property shall constitute a nuisance.

(b) It is unlawful for any person to injure, damage, destroy, cut, trim, spray or remove any tree, shrub, bush or other vegetation upon any public right-of-way or other public property unless authorized by the City. (Ord. 1727 § 22, 2005; Ord. 1143, 1992).

SLASH DROP-OFF (http://ci.golden.co.us/Page.asp?NavID=255)

Tree branches, trimmings, grass clippings and leaves may be dropped off from 7 a.m. to 5 p.m. Wednesdays through Sundays from March through October. Call 303-710-9120 for **winter hours**. All materials are recycled. The maximum length of tree limbs accepted is 8-feet and the maximum diameter is 6-inches. **NO STUMPS.** The cost is $3 per cubic yard for residential

customers and $4.50 per cubic yard for commercial operations. Christmas trees are accepted during winter hours for $1 per tree. Cash and checks are accepted.