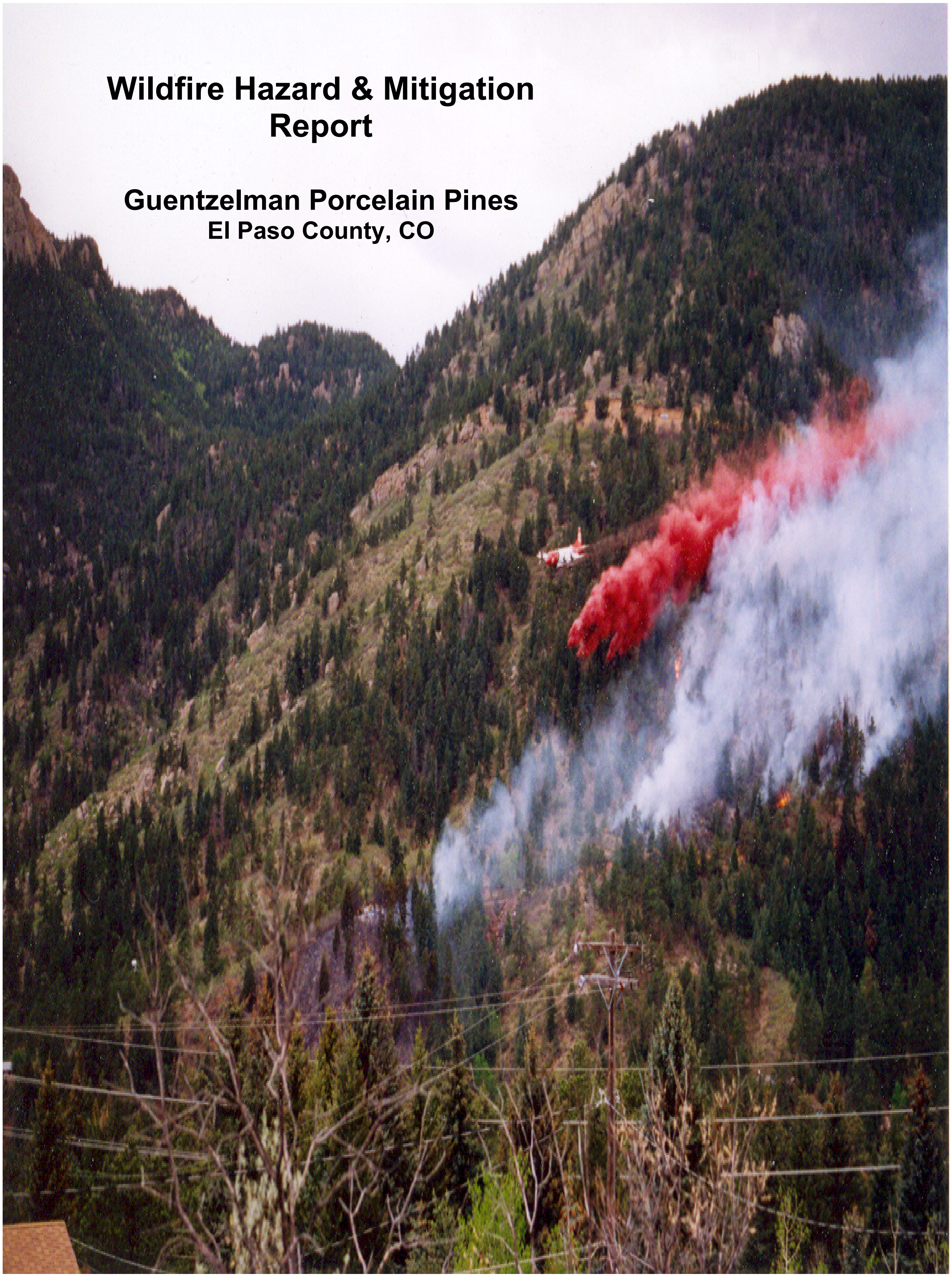
Wildfire Hazard & Mitigation Report

Guentzelman Porcelain Pines
El Paso County, CO



Wildfire Hazard Evaluation Report

For the

Guentzelman Porcelain Pines Subdivision

El Paso County, CO

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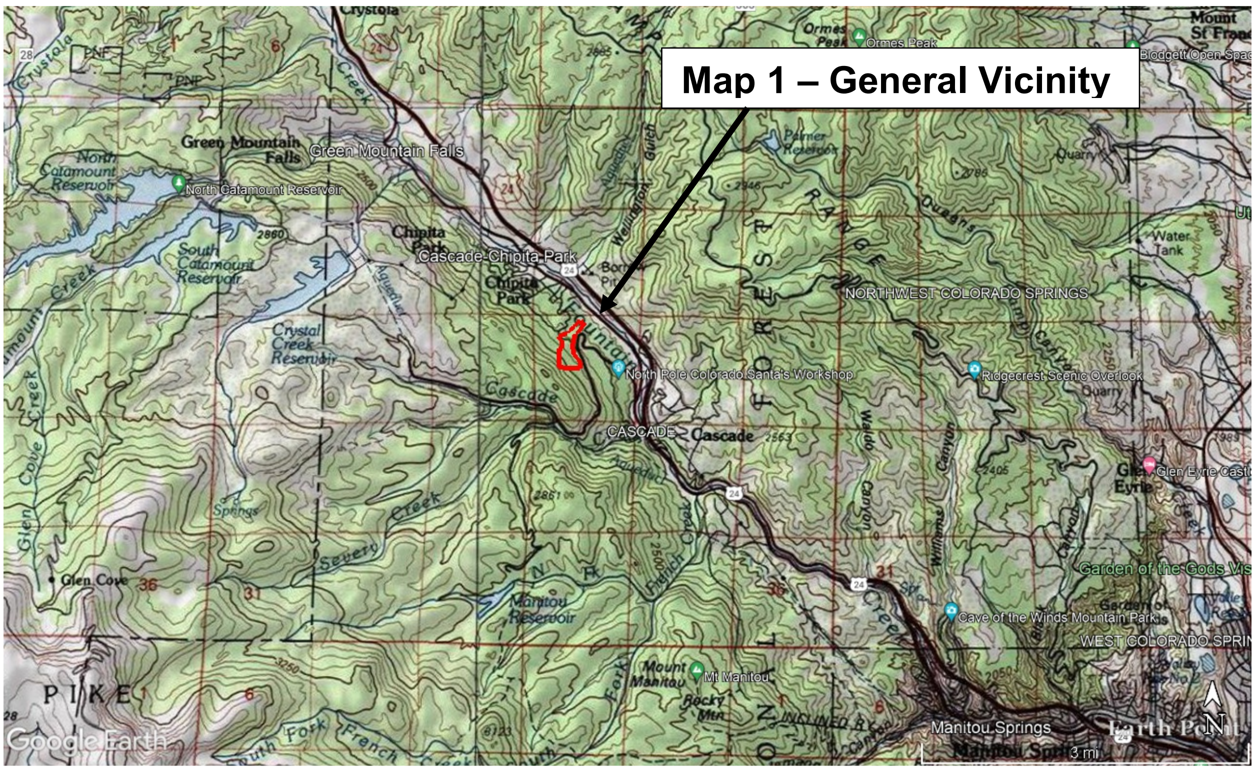
Warning and Disclaimer: The degree of protection from wildfire hazards intended to be provided by this plan is considered reasonable for planning purposes. It is based on accepted forestry and fire science methodology. This plan is intended to aid the Guentzelman Porcelain Pines subdivision in minimizing the dangers and impacts from wildfire hazards. Fire is a natural force and an historical part of the ponderosa pine and native grassland ecosystems. Therefore, unforeseen or unknown wildfire conditions, natural or man-made changes in conditions such as climate, vegetation, fire breaks, fuel materials, fire suppression or protection devices, and ignition sources may contribute to future damages to structures and land uses even though properly permitted within designated wildfire hazard areas.

December 16, 2022

General Description

The Guentzelman Porcelain Pines ('GPP') is a private residential development planned for the Cascade area in unincorporated western El Paso County, Colorado. The development plan proposes the subdivision of approximately 35.1 acres into 4 lots. The lots range in size from 5.06 up to 12.49 acres.

The property is located along the Pikes Peak Highway (see Map 1 below). The property can be accessed via Mountain Road from Picabo Road. A second access is from Kulsa Road via Ute Road. The parcels included under this report are identified with the El Paso County Assessor's Schedule Numbers, 8322200017 and 8322200018.



Map 1 – General Vicinity

The Ute Pass Summer Homes subdivision borders the property on the north and the west. The Pikes Peak Mountain Estate and Pikes Peak Highway toll booth is situated on the east side. In addition, there are unplatted properties to the east as well.

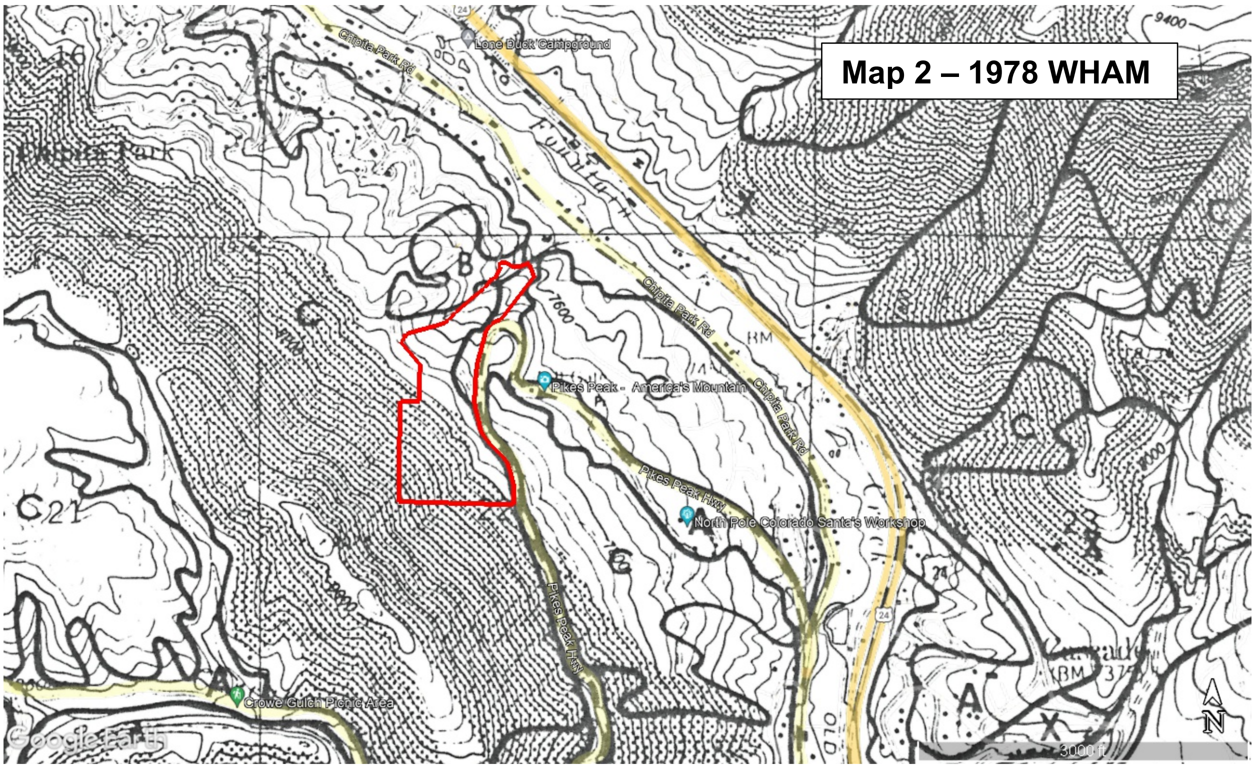
The western portion of El Paso County area does have a wildfire history. Most notably, the Waldo Canyon Fire burned in June of 2012. It was the most destructive wildfire in Colorado's history at that time. Over 18,000 acres burned, and 346 structures were destroyed.

Prior to the Hayman Fire in 2002, a small wildfire ignited along Chipita Park Road in Cascade and burned uphill towards the Pikes Peak Highway. This incident occurred approximately one-half mile southeast of the subject property. While small in importance, fire weather conditions dictated the use of an air tanker to aid in the fire's suppression. The cover photo is from that incident.

On July 17, 2022, a lightning strike ignited a single dead tree below the Pikes Peak Highway in proximity to the proposed development. While this incident was quickly extinguished, it provides insight to the random risk of a wildfire occurrence.

Wildfire Hazard

Based upon the Wildfire Hazard Area Map (WHAM) developed by the Colorado State Forest Service (CSFS) in 1978, the site of the proposed development of 'GPP' subdivision contains a high hazard for trees (see Map 2).



Legend: A= Low Hazard (Trees/Grass)   B= Medium Hazard (Trees)   C= High Hazard (Trees)

Since the publication of this hazard map series, the CSFS developed a wildfire risk assessment tool in 2012 referred to as the Colorado Wildfire Risk Assessment Web Portal (CO-WRAP). This assessment was recently updated to include events up to 2017. A copy is attached to this report.

Within the assessment report, the wildfire risk to the property is classified as high to highest (see Map 3). Wildfire risk is a composite rating which identifies the probability of loss or harm from a wildfire.

The Burn Probability is the annual probability of any location becoming subjected to a wildfire event. The assessment gives the proposed development a moderately high to high ranking in this regard. This is not unexpected due to the number of ignitions locally on private and Federal lands, the Waldo Canyon Fire in particular.

One distinction that can be drawn from the assessment is the selection of the fuel models used in determining the wildfire hazard. The WHAM (Map 2) uses a simplistic approach and delineates between grass, shrub and tree fuel beds.

The CO-WRAP assessment uses a distinct timber fuel model. This is a more dynamic approach, but it does not delineate between fuel beds but considers them uniform across large areas. So even though there may be clusters of shrubs or grasses present, the timber fuel will dominate wildfire spread.

A field inspection was performed on June 14, 2022, and again on December 13, 2022, to determine if any change should be made to the original wildfire hazard conclusions or the CO-WRAP assessment. Based upon the field inspection, **the wildfire risk was confirmed as high**.

There has been no appreciable forest management activity conducted on the property. Due to a dwarf mistletoe infection in both ponderosa pine and Douglas-fir, many trees have subsequently perished and fallen over. This has contributed to higher than anticipated quantity of dead fuel on the forest floor. Due to the infection of the younger Douglas-fir with dwarf mistletoe, these small trees will act as ladder fuels which will probably ignite the canopy of the overstory fir (see Photo 1).


Photo 1. View of dwarf mistletoe infection in Douglas-fir and downed fuels.

Wildfire Behavior

This rating considers the role of the three major components that affect wildfire behavior: fuels, topography and weather. These three components will be examined in relation to ‘GPP’ development plan.

Fuels

The area was field checked, and the results of the WHAM were confirmed based upon the observed fuel models on the property. The USDA – Forest Service Intermountain Forest and Range Experiment Station in Ogden, Utah, developed these fuel model descriptions. They are used as aids in estimating fire behavior (see Appendix A).

The criteria for choosing a fuel model reflects that a wildfire will burn in that fuel type which best supports that fire. There may be more than one fuel model represented on any given area of land. In addition, current and expected weather conditions will influence the condition of these fuels.

The forest can best be described under Fuel Model 10 (see Appendix A). “The fires burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead-down fuels include greater quantities of 3-inch or larger limb wood resulting from over maturity or natural events… Any forest type may be considered if heavy down material is present; examples are insect- or disease- ridden stands…”

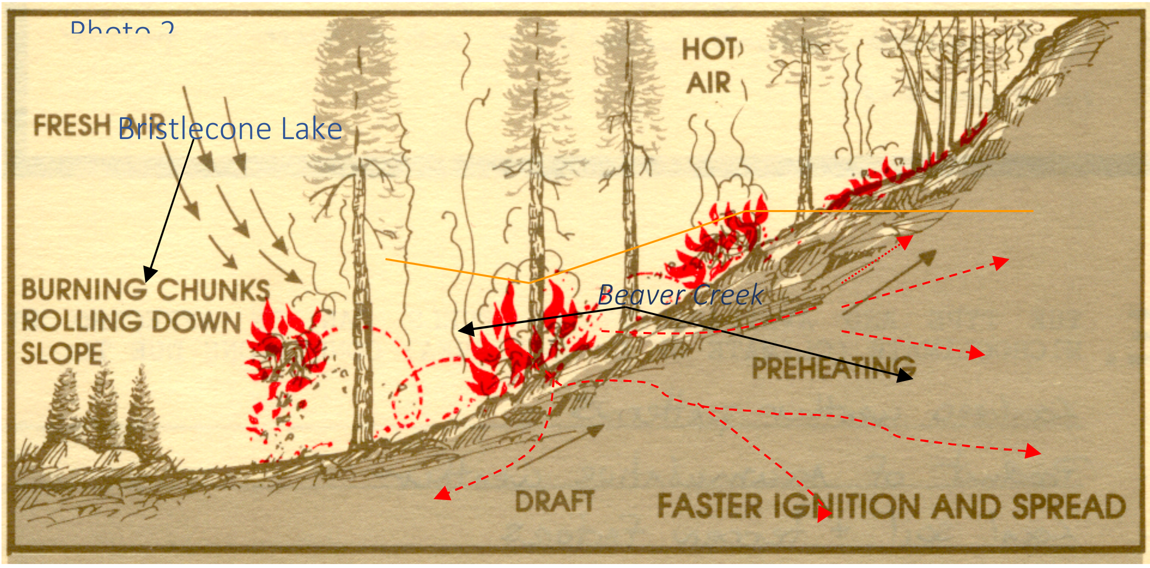
Fuel Model 10 can be further refined to TU5, Very High Load, Dry Climate Timber-Shrub (see Appendix A). This fuel model was developed by Scott & Brogan in 2005. The primary carrier of a fire is heavy forest litter with a shrub or small tree understory. This fuel type encompasses over 80% of the total area. TL8, Long-Needle Litter contains five acres but is relatively insignificant regarding wildfire spread.

Topography

The topography of the site is one of the main factors that will influence a fire spread. The aspect or compass direction that any slope faces influence the fuel type that exists and the amount of preheating these fuels receive by the sun. Aspect can also influence the effects of diurnal winds, as they move upslope during the daylight hours and down slope during the evening and early morning hours.

In this instance, one of the most important attributes of topography is the percent of slope on which the development is proposed. As the percent of slope increases, the rate of fire spread by convection increases. In other words, wildfires burn faster moving uphill (see Figure 1).

Figure 1. Slope Affects Fire Spread



The specific topography of the property is steep. Slopes more than 25% are considered extreme slopes in their effect on wildfire behavior (see Map 3).

Slope Projections: Blue Line= 45% Green Line= 54% Yellow Line=29% Pink Line=19%

The lowest slope is approximately 19%. This covers mostly Lots 1 and 2. Lots 3 and 4 are all in the extreme slope location. However, it is assumed that any structure built will be close to the hammerhead turn around and not at the utmost limits of those lots.

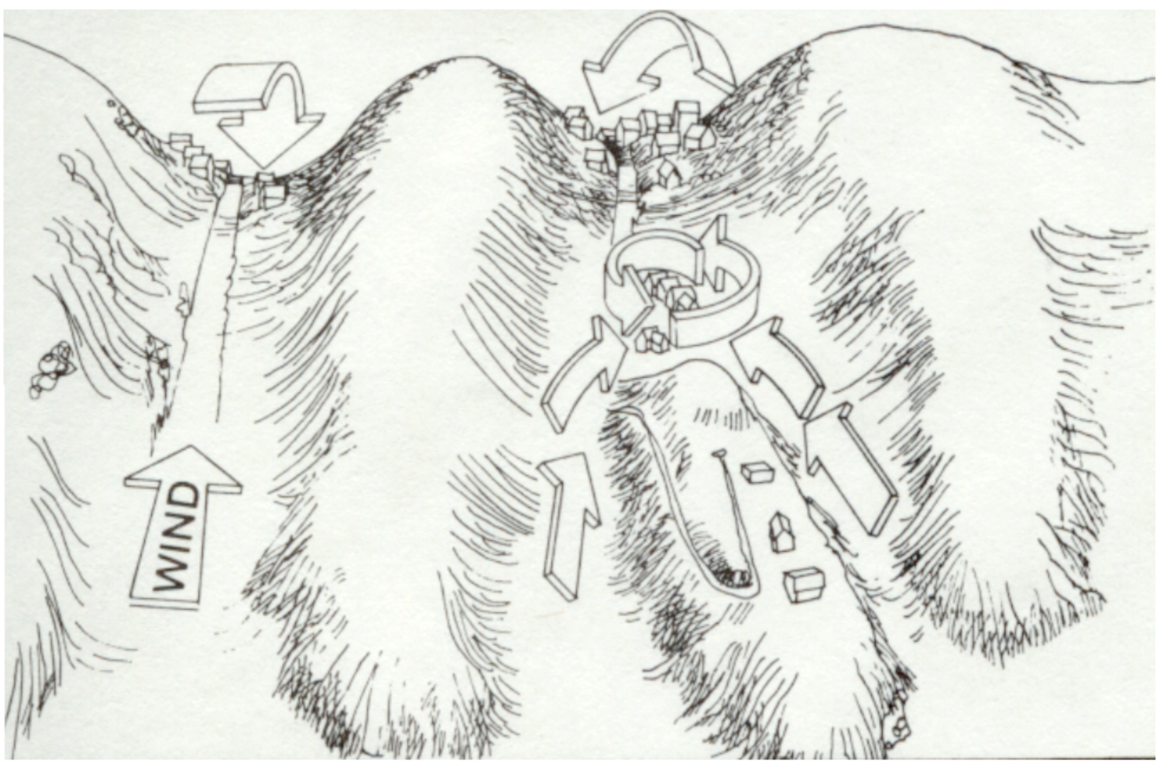
Figure 2 depicts the effect the drainages or box canyons have on a fire. These topography features tend to funnel a wildfire uphill within a narrow profile and the preheating effect tends to ignite the side slopes of the drainage. Structures placed at the mouth of the drainage are most at risk from a wildfire.

There is a drainage that runs along the northern boundary of the property. It can be found at the terminus of Ute Road. During the inventory process, this drainage was wet but was not flowing at any substantial volume.

There is also a drainage along the south boundary below the Pikes Peak Highway Toll Road. This drainage appears to flood during heavy precipitation events. This is evidenced by the erosion from runoff from the highway.

Due to the heavy load of dead material, these drainages will pose a threat to wildfire suppression forces.

Figure 2. Drainages Tend to Draw in Fire



Graphic Courtesy of Colorado Springs Fire Department

Weather

Weather is the most variable of all the factors. The accumulative effects of weather over time can influence vegetation curing and fuel moisture content.

Grasses, for example, are described as being one-hour time lag fuels. Time lag is a measure of the rate at which a given dead fuel gains or loses moisture. Hence grasses tend to be influenced by the weather conditions on an hourly basis. Wood fuels that are three inches in diameter or larger are considered 1,000-hour time lag fuels. This type of fuel requires a long period of time of dry or wet weather to affect its combustibility.

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The effect of wind on a fire were on display most dramatically this past winter (December - 2021) during the Marshall Fire in Boulder County. This fire grew to over 6,200 acres and destroyed 1,084 homes. The fuel bed consisted of grassland. High winds carried embers across a railway bed and several county roads. The wind gusts up to 115 miles per hour where reported. The wildfire reached the town of Superior, three miles away, in just one hour.

It should be noted that this level of high wind activity is not uncommon along the foothills where the proposed subdivision is located.

While the weather may contribute greatly to a wildfire event, it is immune to outside influences.

Predicted Fire Behavior

Based upon history, one can expect that if an ignition occurs, a wildfire will spread rapidly and quickly uphill towards or through the proposed development. Using the USDA – Forest Service Fire Behavior Fuel Model, the following predictions can be made based upon an 80-degree temperature day with a relative humidity of 18% with little cloud cover at 1:00 p.m. in the month of July. The point of origin used in this example is at the lowest end of Lots 1 and 2, where they meet Ute Road.

The fire will spread quickly, at a rate more than 8,646 feet per hour, or 144 feet per minute. Flame lengths will range from 7 to 7 ½ feet. The probability of fuels igniting in advance of the fire front is 100%. In the fifteen minutes that it may take for the fire to be noticed, reported to the fire department's dispatch office and for the arrival of the initial attack force, the fire could have traveled over 2,160 feet. At that distance, the wildfire would exit the property and continue onto USDA - Forest Service land.

It is predicted that local suppression forces will not be able to contain the initial fire outbreak with mobile engines and hand constructed control lines.

It should be noted that these predictions are based upon normal weather conditions prevailing over the course of a year. Weather conditions that were exhibited from the winter of 2022 through the present date are outside of normal conditions resulting in the catastrophic losses experienced throughout the western United States this past fire season. Again, the Marshall Fire provides an insight in what fire behavior might occur even in the winter season.

If such conditions are present on or in the vicinity of the proposed development site, any wildfire event can be predicted to be more severe and resistant to initial control efforts.

The normal diurnal winds will accelerate the wildfire incident. If the normal diurnal wind patterns are present, a wildfire will move quickly uphill from the east. The drainages will draw fire upslope by increasing wind velocity. This convective heat current will accelerate the pre-heating of available fuel upslope of the fire. It is expected that the fire will move upslope rapidly with high heat intensity.

Finally, it should not be assumed that the main periods of fire danger would be in the summer months. As history has shown, out of season fire events are much more common than might be expected by the public.

Wildfire Mitigation

It should be noted here that the occurrence of a wildland fire on this property and any subsequent spread of a wildfire to adjacent land could never be eliminated. In the Spaatz Fire, suppression forces were able to arrive on scene in approximately four minutes after the fire was reported. Even with this rapid response, the wildfire reached a size of 67 acres before it was controlled.

The potential for loss can be reduced and the odds can be improved that initial response forces can be successful in keeping a wildfire to the smallest size possible and structure loss to a minimum. But even with the best efforts of suppression forces, there will always exist a level of risk of loss to a wildfire.

The only way to reduce the risk of loss from a wildfire is to modify the factors that influence fire behavior. Of the three factors discussed previously, the only factor that could be modified prior to a wildland fire is the fuels. The efforts in modifying fuels can be targeted to their arrangement, continuity and availability.

- **Arrangement**

The arrangement of fuel considers the size, shape and compactness of the fuel itself. Smaller fuel sizes have a greater surface area exposure for preheating. If these smaller sized fuels are only lightly compacted in spacing this results in easier ignition and increased combustion.

Fuels that are tightly compacted and larger in size have lower surface areas. This reduces the ease of ignition and combustion.

One technique in reducing the readily ignitable fuel level would be to remove fuels, such as dead leaves, fallen limbs and other small organic debris, from the proposed development. However, it is not practical to remove these types of fuels from the entire property.

During the construction phase of any residential structure, the most likely source of ignition will come from personnel and activities. These sources of ignition may come from flammable chemicals, improperly discarded cigarettes, shorts in electrical equipment, and other means.

It is suggested here that the reduction of the most ignitable fuel be done in areas that are within fifty feet of the pad of any proposed residential structures. This will reduce the amount of small, flashy fuel in proximity to the structure. It will also retard the spread of a fire towards adjacent property and provide suppression forces additional time to contain a fire quickly.

Once a residential structure is built, a wildfire safety zone should be established. Wildfire safety zones are intended to slow a fire down so that it may be controlled and extinguished. There are three zones that comprise a wildfire safety zone.

The first zone is the one that contains the most opportunity for modification. The minimum width recommended is thirty feet and is divided into three segments.

As these zones may be unique for each lot that is developed, it is difficult to make specific recommendations here. However, it is recommended that each lot be treated prior to completion of the structure and the issuance of the occupancy certificate.

Specific information on the development of wildfire safety zones is available through the Colorado State Forest Service in the Quick Guide Series Fire 2012-1, *Creating Wildfire-Defensible Zones* at the following link:
https://static.colostate.edu/client-files/csfs/pdfs/FIRE2012_1_DspaceQuickGuide.pdf

There is a large quantity of dead trees in various states of decay. Of concern is a large number are scattered like ‘jackstraws. This represents a loose arrangement of fuels.

Photo 2. This photo is taken adjacent to wet drainage on the east boundary. Note the dead trees that have fallen over and are suspended in the air to some degree.

The dead trees would preferably be removed. But where this may not be feasible, the dead trees should be limbed, so they are in direct contact with the forest floor. This will accelerate decay and the dead trees will be less able to burn than if left to air-dry.

- **Continuity**

The second factor affecting fuels that can be modified is their continuity. Is the fuel continuous or patchy in nature? Is the fuel layered in such a manner that it can leave the ground and spread into a vegetative canopy?

In this instance, the fuels in the timber fuel model are continuous. They extend from the eastern tip of the property and up the slope to the west.

Dead ground fuels under the canopy coupled with the dwarf mistletoe infected smaller trees are continuous as well. These ground fuels will provide enough heat to cause ignition and torching of the fire into the fir canopy. However, the mature Douglas-fir canopy is not considered continuous. There are many dead trees that would constrict movement of a fire from tree to tree.

The fire behavior prediction indicates that flame lengths could reach upwards of seven feet or more. To protect structures, dead fuels and the smaller dwarf mistletoe infected trees should be removed.

Live, mature Douglas-fir that is left within thirty feet of structures should be thinned adequately enough so that live crowns do not touch. This will reduce the risk of fire moving from tree to tree.

- **Availability**

The final consideration is the availability of the fuel to physically burn. This factor is influenced by the weather on a daily or yearly basis and cannot be readily influenced.

As was mentioned earlier, the availability of this fuel type should be considered a year-round hazard and not limited to the summer months. Drought conditions and early fall frosts may inhibit the normal leaf drop from Gambel oak. This would leave a very flashy aerial fuel in place and available for rapid combustion and subsequent wildfire spread.

The current weather patterns have contributed to a long-term drought situation that has influenced the availability of the fuels to burn. The trend of above average day time temperatures and below normal precipitation levels have allowed fuels to reach a higher state of availability than might normally be the case, particularly during winter months. This may result in wildfire acting in a manner that might be more characteristic of mid to late summer burning conditions.

Other Considerations

Firebrands & Secondary Ignitions

It is becoming more apparent that structure loss is not occurring during the passage of a burning wildfire front but from ignition of the structure by firebrands and secondary ignitions. Firebrands are burning materials or embers that are lifted into the air by convective wind currents. Firebrands can be cast hundreds of feet in advance of the fire front.

Research and case studies in Australia have found that there is a 50% probability of loss of structures that are 100 – 200 feet from the fire front. This would seem to indicate that firebrands are a major contributing factor of structure loss.

In the U.S., studies indicate there is 90% probability that a structure with a non-flammable roof and that is at least 100 feet from the fuel bed will not be lost during a wildfire. However, this statistic may be misleading as the Cedar Fire (CA) in 2003 indicated that 60% -70% of the structures lost were ignited by firebrands. This would also infer that solely relying on 'defensible space' for structure protection may not be adequate.

In a professional paper by Scott (2005), the exposure of a structure to embers and firebrands is discussed. In an inference to fuel mitigation in the 'defensible space' zones, Scott states that "In no case is complete removal of the forest canopy required to mitigate crown fire potential near a structure." This infers that 'defensible space', while a good starting point, may not be the whole solution in preventing structure loss.

Currently, fire-safe construction is the recommended protocol for fire brand risk reduction by the professional wildfire community.

Roads and Driveways

Roads and driveways to individual lots should be constructed in accordance with NFPA 1141, *Fire Protection for Planned Building Groups*. Specifically, road widths should not be less than twenty-four feet to allow for simultaneous access of emergency equipment and evacuation of residents.

Currently, both Mountain Road and Kulsa Road leading up to the proposed development consist of unimproved dirt roads. The width of these roads is approximately fourteen (14) feet. This will impact the response of emergency vehicles and the evacuation of residents.

At a minimum, El Paso County should plan on thinning or removing vegetation within its right-of-way to reduce the threat to emergency responders and fleeing residents (see Photo 3 below).

Photo 3. This shows Mountain Road just south of its intersection with Picabo Road. It is fourteen (14) feet in width at this location. There is a small turnout at the center left of the photo.

Driveways should provide a minimum width of twelve feet and a minimum vertical clearance of fifteen feet. The grade of any driveway should not exceed 12%. The entrance to any driveway from public roads should not exceed a ninety-degree angle. A turnaround should be provided at all structure sites on driveways over three hundred feet in length. These turnarounds should be within fifty feet of any structure.

Dead end roads should not exceed 600 feet in length when the area is classified as having an extreme wildfire hazard. All dead-end roads should have a turnaround at the closed end (cul-de-sac) of at least 100 feet in diameter. The top of a hammerhead/"T" turnaround should have minimum length of 60 feet at the top of the "T". The fire authority having jurisdiction should make the final determination.

Due to the high wildfire risk and steep slopes present, it is suggested that a turnout be constructed along the private driveway. It should be placed at the curve at the west boundary of Lot 4.

From a detailed wildfire hazard assessment performed in a local subdivision, a common discrepancy found was inadequate or poor visibility of individual residential address numbers. Letters and numbers indicating specific street addresses should be a minimum of 4 inches in height with a ½" stroke. The numbers or letters should be strongly contrasting with the background color to readily visible from the main access road.

Landscaping

The vegetation that is used in the landscaping of the structure should be fire resistant. For example, ornamental junipers can be very flammable and easily ignited by aerial firebrands. Planting these shrubs near the exterior walls of any residential structures provide a readily available fuel source that could threaten the structure and divert suppression forces to protect the building instead of controlling the wildfire.

From the historical fire record of the region, the ignition of ornamental junipers around structures is a major contributor of damage and subsequent loss. **It is strongly recommended that the use of junipers and any other lowing growing ornamental conifer in the landscape be prohibited within thirty feet of a structure's foundation.**

It is assumed that the majority of lots built on will have some type of irrigated greenbelt. Irrigated lawns around a structure are very effective fuel breaks and serve as defensible space in the event of a wildfire.

If a native landscape is preferred, the use of periodic irrigation helps keep landscapes lush and green, thereby lowering their ability to ignite. There are many irrigation techniques available that can keep plants less susceptible to burning while still adhering to water conservation principles.

Another alternative to irrigated green space would be to line the footprint of the foundation of the structure with rock. If rock is used, it should be placed at a minimum width of five feet from the foundation. This will prevent flame lengths from reaching the building.

In areas of extreme wildfire hazard or where lots have a slope exceeding 20%, it is strongly recommended that a five-foot width of stone be installed around the structure and that no plant material should be placed within this (or the first five feet of a larger) rock border.

There are many different sizes and types of rock available. It should be noted here that it would be necessary to remove leaves and other litter from within this rock fuel break on an annual basis.

Construction Considerations

As the fuel in this subdivision are needles and other small woody debris, predictable sources of fuel that will burn and allow entry of a wildfire into the structure will be debris that is trapped under or next to the building or accumulation in the roof gutters. Porch, foundation, roof and attic openings should be screened off or enclosed to keep debris from accumulating and burning underneath. This is particularly important where wooden decks are planned at ground level. This was a factor in the loss of structures in the Waldo Canyon Fire. These location concerns were also expressed in a joint publication by Green Builder Media and the NFPA. This recently released e-book, ‘Design with Fire in Mind’, can be downloaded using the link. Go to the Resources tab and click on e-books.

It is strongly recommended that all decks that are planned at ground level be required to be sealed off and enclosed to prevent the accumulation of flammable debris underneath them.

The National Institute of Standards and Technology published results from experiments that examined how fire spread toward a structure is affected by combustible fences and mulch under conditions that may be encountered in a wildland-urban interface fire.

The study found that firebrands capable of igniting spot fires downwind were generated by nearly all combinations of fence and mulch tested. Mulch was placed under the fences to mimic debris that commonly accumulates under or around them. A target mulch bed at the base of a constructed structure tested the ability of firebrands produced by the burning fence and mulch (simulated debris) to ignite spot fires that threatened the structure.

The result was that all wood fences with mulch (simulated debris) at the base caused spot fires in the target mulch bed. In summary, fire spread is more likely with wood and wood-plastic composite fences than with fences made of vinyl or noncombustible materials such as stone, brick, or steel.

More details on this study can be found at Wind-Driven Fire Spread to a Structure from Fences and Mulch (nist.gov)

In a wildfire risk assessment in a local development, a significant entry point for fire into a house was through the eaves, overhangs or sofits. These locations can trap embers and combustible gas or heat, that can ignite the structure.

Based upon recommendations from FEMA, overhangs, if used, should be enclosed with a flat, horizontal sofit with a one-hour fire resistance rating. The fascia should be constructed of non-combustible material.

The combustibility of a roof is the one of the most important factors in determining the risk of a structure to damage or loss from a wildfire. The use of combustible materials such as wood shingles does not necessarily increase their susceptibility to fire. However, as a wood shingle roof ages and is influenced by the weather, individual shingles may start to warp, curl, and lose the tightness that was exhibited upon initial installation.

Siding materials, while not as critical as compared to roof, can help to lower the overall risk of a structure to damage from a wildfire. Where a high wildfire risk exists, such as in this subdivision, the wildfire intensity will ignite combustible siding material

In addition, the slope of the development that increases combustibility due to the preheating effect created by the slopes. These slopes range from as low as 10% upwards to 35%. Slopes more than 15% are considered steep and play a major role in a wildfire spread and intensity.

It is recommended that where slopes exceed 15% in areas where the wildfire hazard is considered high, non-combustible siding materials should be used in the construction of structures.

Water Supply

At the present time, there is no readily available water supply for ground suppression fire resources. The nearest fire hydrant is located at 9140 Mountain Road, over one-third of a mile to the north. Due to narrow width of the road, it will be difficult to refill engines from that location. Also, there are no fire hydrants along Kulsa Road.

There may be a location opposite the entrance to the subdivision on Mountain Road to install a fire hydrant. This could only be accomplished if there was a water line running all the way along Mountain Road. This option should be discussed with the Cascade Fire Protection District.

Otherwise, the local fire department will need to rely on water hauled into the site during a fire. Fire apparatus available at the Cascade Fire Department consists of 2 – Type 2 Engines containing a total water capacity of 1,750 gallons. There is also 2 – Type 6 Brush Trucks with a combined capacity of 500 gallons. Additional water supply could be supplied by the Green Mountain Falls Fire Department through a mutual aid agreement.

At present, there is no full-time staff. The fire department is manned entirely by volunteers. Therefore, any response time to a wildfire incident will vary widely.

Emergency Exit

There is an old trail that cuts through the property to the Pikes Peak Highway. This could be improved to be utilized as an emergency exit. One hurdle to this use is that permission would need to be obtained from the city of Colorado Springs as it would cross their property.

At a minimum, the trail should be maintained and improved to serve as a fuel break. This would possibly provide wildfire suppression forces additional time to launch an initial attack.

Forest Management

It becomes quickly apparent that the dwarf mistletoe infection and its potential control is the highest priority for the forest stand on the property. Dwarf mistletoe is a parasitic plant which feeds off its host plant. In this instance, both ponderosa pine and Douglas-fir are infected with this parasite.

Dwarf mistletoe does not directly kill the affected trees. It reduces their health as the mistletoe competes for water and nutrients. With the recent severe drought, this added stress does start to kill trees. In addition, this makes the tree susceptible to insects such as bark beetles. These insects attack and complete the process the mistletoe started.

In 1977, Frank Hawksworth developed a 6-class rating system for dwarf mistletoe. By dividing the crown of a tree into thirds, a numerical number was assigned to the level of infection in each third. Zero if no infection was observed, one if it was lightly infected and two if the tree had a heavy infection in that third. The three numbers are added together to achieve the overall infection rating.

In the ‘GPP’, most of the Douglas-fir have a rating of three or higher. This would leave two options for treatment. The first would be to clearcut the entire forest stand. As the location is being developed for residential use, it would not be prudent to remove all the trees.

The other option is to do nothing and leave the forest uncut. This option is untenable due to the wildfire hazard this condition presents. This could be best summed up as ‘Do nothing now or Watch it Burn Later”. It is just a question of when the property may burn, not if.

The best course of action would be to remove infected trees whose health is so poor that they would not produce any seed to restore the forest. Any smaller trees under the main canopy that have an infection rating over 1, would be removed as well. This would reduce the wildfire risk posed by the Very High Load Dry Climate Timber-Shrub fuel model.

If enough trees are retained to produce seed, there should be sufficient seedlings established over time to replace the overstory. The trees originally left would then be removed to avoid infecting the new stand.

Based upon the inventory results, just less than 10% of the trees are dead. Which leaves an average of 254 trees per acre on average. And of those trees, 159 trees lie in the 2-4-inch diameter classes. This number of smaller trees represents almost 63% of the total number of trees found on the property. It would not be out of the question to safely remove half if these trees to eliminate mistletoe infection and lower the wildfire hazard yet still retain the benefit of residing in a forest location.

Appendix A

Fuel Model Descriptions

Fuel Model 10 Summary Page

Source: Anderson, Hal E. Aids to Determining Fuel Models for Estimating Fire Behavior, National Wildfire Coordinating Group, General Technical Report INT-122, April 1982.

"This report presents photographic examples, tabulations, and a similarity chart to assist fire behavior officers, fuel management specialists, and other field personnel in selecting a fuel model appropriate for a specific field situation. Proper selection of a fuel model is a critical step in mathematical modeling of fire behavior and fire danger rating."

Very High Load, Dry Climate Timber-Shrub (TU5) Summary Page
Long-Needle Litter (TL8) Summary Page

Source: Scott, Joe H. & Burgan, Robert E. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's (1972) surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153, Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

"This report describes a new set of standard fire behavior fuel models for use with Rothermel's surface fire spread model and the relationship of the new set to the original 13 fire behavior fuel models."

Fire Behavior Fuel Model 10

The fires burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead-down fuels include greater quantities of 3-inch (7.6-cm) or larger limbwood resulting from overmaturity or natural events that create a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees are more frequent in this fuel situation, leading to potential fire control difficulties. Any forest type may be considered if heavy down material is present; examples are insect- or disease-ridden stands, windthrown stands, overmature situations with deadfall, and aged light thinning or partial-cut slash.

The 1978 NFDRS fuel model G is represented and is depicted in photographs 28, 29, and 30.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch dead and live, tons/acre	12.0
Dead fuel load, ¼-inch, tons/acre	3.0
Live fuel load, foliage, tons/acre	2.0
Fuel bed depth, feet	1.0

The fire intensities and spread rates of these timber litter fuel models are indicated by the following values when the dead fuel moisture content is 8 percent, live fuel moisture is 100 percent, and the effective windspeed at midflame height is 5 mi/h (8 km/h):

Model	Rate of spread *Chains/hour*	Flame length *Feet*
8	1.6	1.0
9	7.5	2.6
10	7.9	4.8

Fires such as above in model 10 are at the upper limit of control by direct attack. More wind or drier conditions could lead to an escaped fire.

Photo 28. Old-growth Douglas-fir with heavy ground fuels.

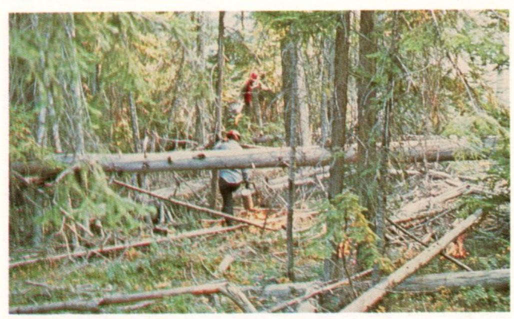


Photo 29. Mixed conifer stand with dead-down woody fuels.

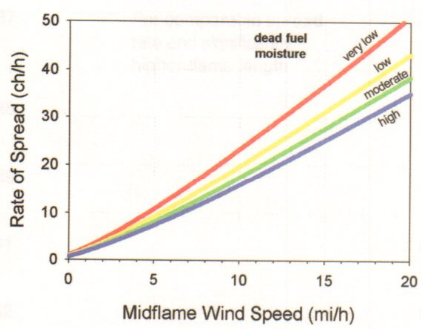
Photo 30. Spruce habitat type where succession or natural disturbance can produce a heavy downed fuel load.

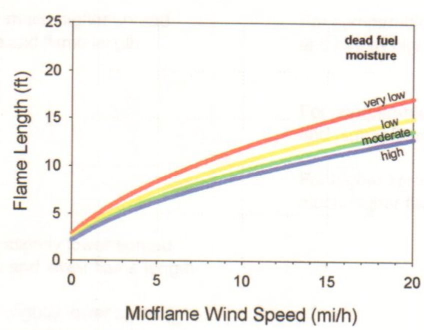
TU5 (165)

Very High Load, Dry Climate Timber-Shrub

Description: The primary carrier of fire in TU5 is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length moderate.

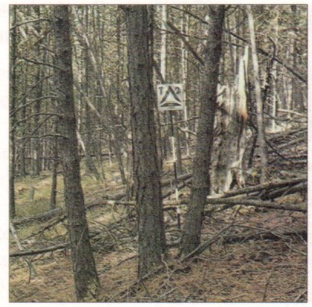
Fine fuel load (t/ac)	7.0
Characteristic SAV (ft-1)	1224
Packing ratio (dimensionless)	0.02009
Extinction moisture content (percent)	25





TL8 (188)

Long-Needle Litter



Description: The primary carrier of fire in TL8 is moderate load long-needle pine litter, may include small amount of herbaceous load. Spread rate is moderate; flame length low.

Fine fuel load (t/ac)	5.8
Characteristic SAV (ft-1)	1770
Packing ratio (dimensionless)	0.03969
Extinction moisture content (percent)	35