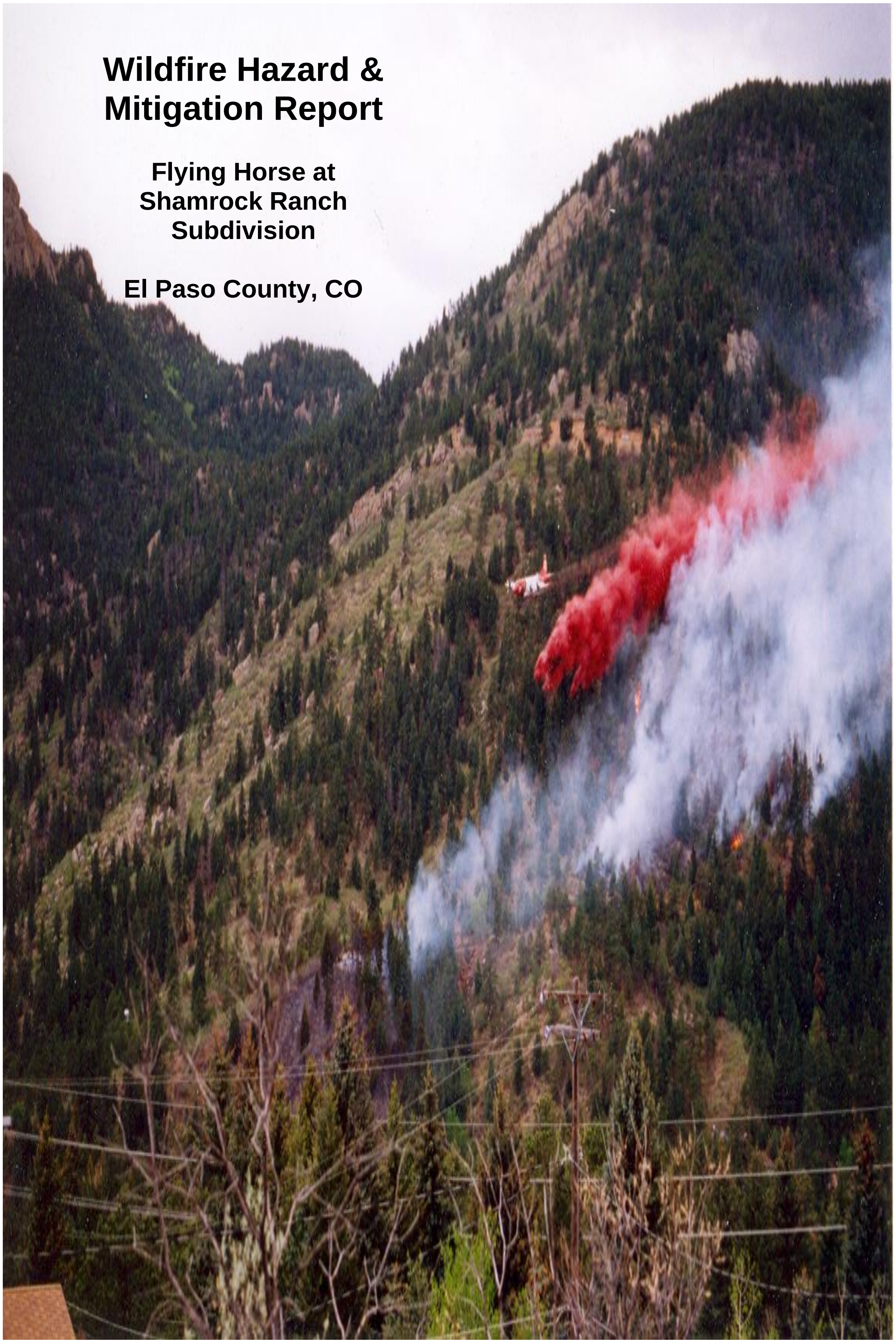
Wildfire Hazard & Mitigation Report

Flying Horse at Shamrock Ranch Subdivision

El Paso County, CO



Fire Hazard Evaluation Report

For the

Flying Horse at Shamrock Ranch Subdivision

El Paso, CO

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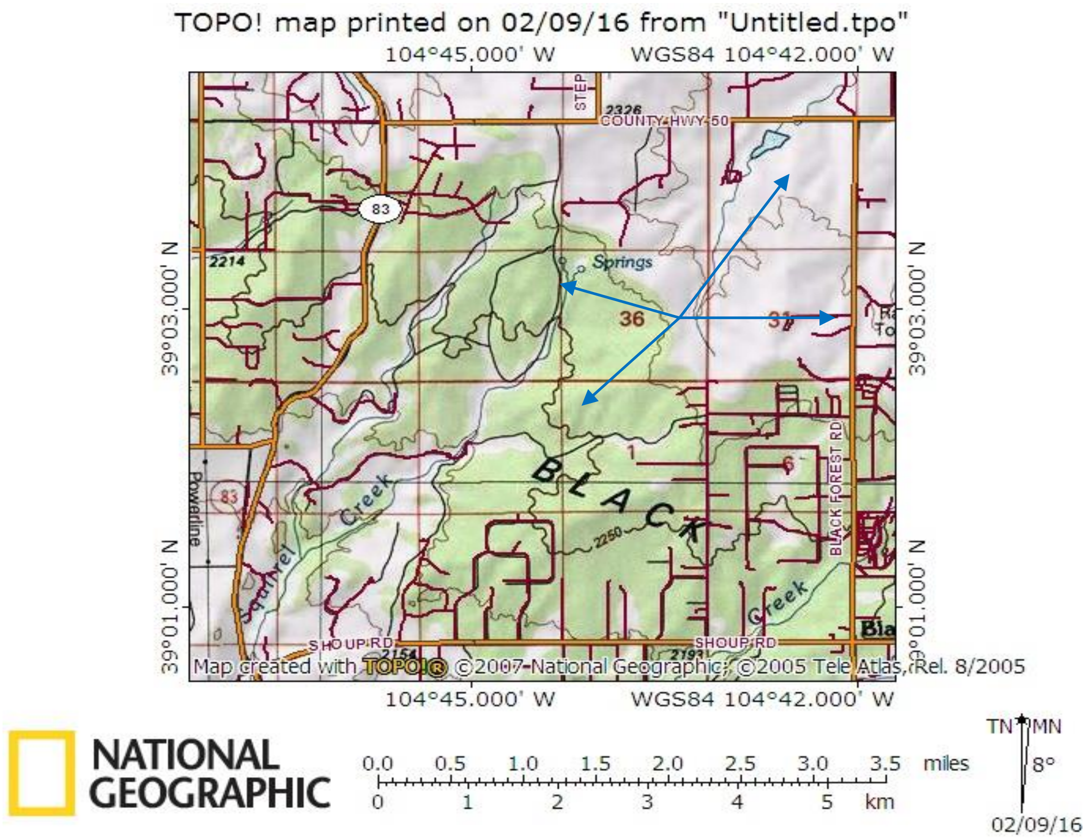
Warning and Disclaimer: The degree of protection from wildfire hazards intended to be provided by this plan is considered reasonable for planning purposes. It is based on accepted forestry and fire science methodology. This plan is intended to aid the Flying Horse at Shamrock Ranch subdivision in minimizing 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.

January 19, 2016

General Description

The Flying Horse at Shamrock Ranch is a private residential development planned for the Black Forest area in northern El Paso County, Colorado. The development plan proposes the subdivision of approximately 1,400 acres into 283 lots with structures. Within the 1,400 acres, a proposed golf course will encompass 200 acres and open space will contain approximately another 104 acres (22%).

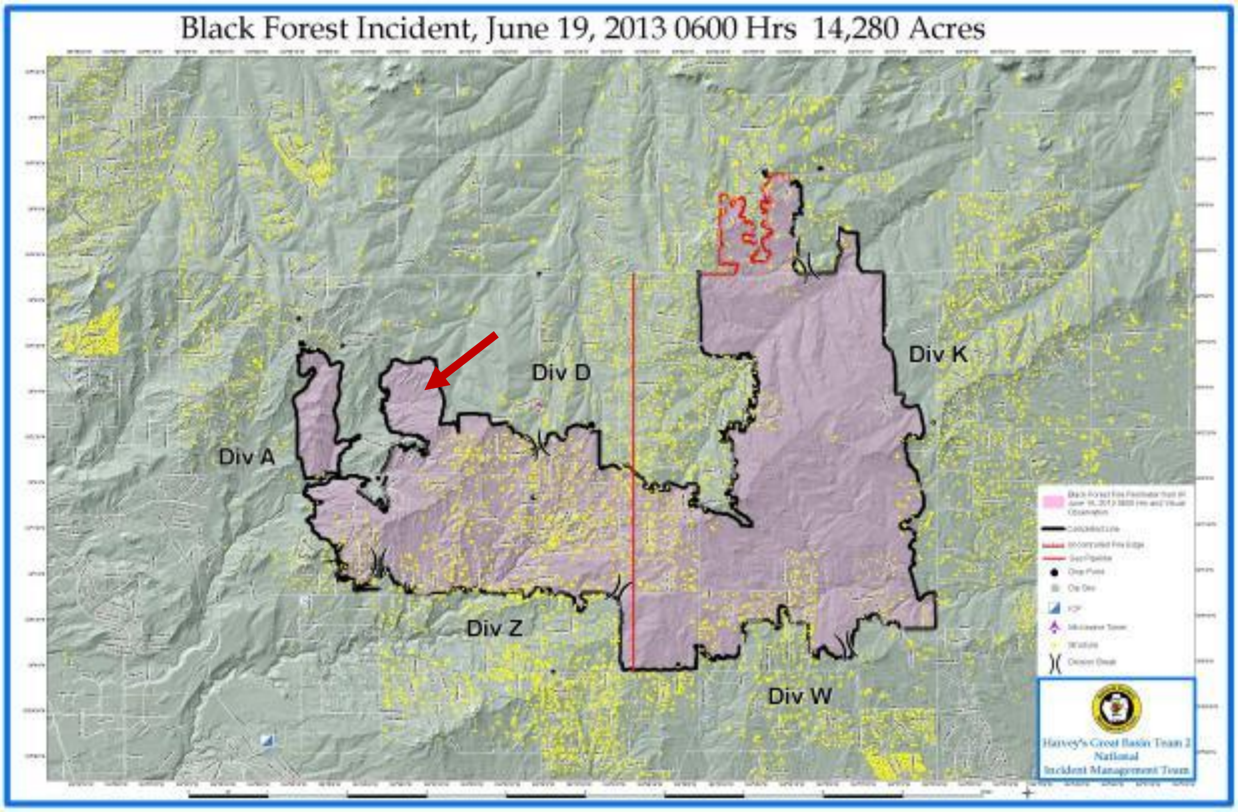
The property is located at the north terminus of Holmes Road and west of Black Forest Road in unincorporated land (see Map 1 below).



The subject property is partially bounded to the northwest by the High Forest Ranch subdivision and along the south with the Cathedral Pines subdivision (see Map 3, p. 31).

There is an additional access road and residential development off of State Highway 83 in the northwest one-quarter of Section 35. This access road provides an additional ingress and egress to the west from the main body of the development (see Map 2, p. 30).

This area does have a distinct and recent wildfire history. The Black Forest Fire burned across the property in June of 2013. It would become the most destructive wildfire in Colorado's history. Over 14,000 acres were burned (see Map 4 below) and upwards of 500 structures were destroyed.



Courtesy: National Wildfire Coordinating Group

Map 4. Extent of the Black Forest Wildfire (2013). Arrow shows approximate location of the forest area within the proposed subdivision.

Wildfire Hazard

Based upon the Wildfire Hazard Area Map (WHAM) developed by the Colorado State Forest Service in 1974, the site of the proposed development of 'Shamrock Ranch' subdivision contains a low hazard for meadows and a severe hazard rating for trees with ponderosa pine being the primary forest type (see Map 3). While this risk rating is forty-two years old, environmental change occurs very slowly in the Rocky Mountain West, so this rating still provides a relative accurate summary for the property.

As the Black Forest fire burned through a majority of the pine forest, a severe hazard for trees is probably a high estimate at the present time.

The Colorado Wildfire Risk Assessment Portal (CO-WRAP) was recently developed by the Colorado State Forest Service in 2012. The primary goal stated for this project is to "provide a consistent, comparable set of scientific results to be used as a foundation for wildfire mitigation and prevention planning…" This resulted in a web based mapping tool that provides wildfire risk assessment for Colorado. This tool was also used to assess the relative wildfire risk to the property.

Within the CO-WRAP mapping tool, wildfire risk represents "the possibility of loss or harm occurring from a wildfire." The wildfire risk for the subdivision is indicated as having the lowest risk.

The wildfire threat is defined as the likelihood of an acre burning. Within the CO-WRAP, the proposed development area is rated at the lowest wildfire threat level.

Based upon the fact that the Black Forest Fire burned through the existing forest in 2013, the wildfire threat analytic could be perceived as incorrect. As there were no significant improvements or residential structures, the risk of loss would appear to be relatively correct. But there was a residential structure lost in the Cathedral Pines subdivision to the south in spite of intensive mitigation and forest health treatments.

However, a disclaimer is provided as to the use of this tool. It is best used for broad landscape risk assessment and is not appropriate for site specific analysis such as the Shamrock Ranch subdivision. So in order to properly assess the wildfire hazard of the property, a field inspection was undertaken. This was performed during the weeks of January 3rd and 10th with forest inventory plots measured as part of the forest management plan requirement.

Prior to December of 2000, State School Section 36, which contains the pine forest that is the focus of this report, the property was owned by the State of Colorado. Documents found at the local state forest district office in Woodland

Park revealed that Section 36 has been the subject of several management plans since 1973. The most recent was a forest stewardship plan written in 1995.

The property was managed intensely by the state forest service under an agreement with the state land board starting in 1981. This resulted in extensive forest thinning practices across the majority of the section, including several clearcuts for dwarf mistletoe control. In 1985, a study site was developed by the USDA-Forest Service experiment station in Fort Collins to evaluate the effect of thinning on mountain pine beetle populations. The study plots still exist and were found during the forest inventory.

In October of 1996, a prescribed burn was successfully performed on 184 acres of the property (see Map 5, p. 33). These acres had previously been thinned, so the intent was to re-introduce fire back into the ponderosa pine forest (see Photo 1). One of the benefits of the fire was to significantly reduce the amount of fuel on the forest floor. The lack of a sufficient fuel bed would reduce the risk of a sustained canopy fire. This may have contributed to subsequent low intensity fire behavior as the Black Forest wildfire burned through the property.

Photo 1. The 1996 prescribed fire – note the open character of the residual forest.
Photo courtesy of the Woodland Park District, CSFS.

So forest stand structure within the proposed development has been modified since the original WHAM assessment and the CO-WRAP tool is inadequate to effectively evaluate the current hazard. **Upon completion of the field inspection, the current wildfire hazard within the forest stand could be considered as moderate.**

The moderate wildfire hazard rating is based upon several observations. The first being is that the Black Forest Fire burned through the property mostly as a low to moderate intensity wildfire. While there are two locations that experienced severe intensity and subsequent total tree loss (see Map 5, p. 33), the majority of the forest burned through the pine needle and litter layer on the forest floor. This is probably due to the absence of larger material that would have provided additional heat to ignite the tree canopy above. This lack of larger fuel for combustion can be attributed to the prescribed fire treatment in 1996.

While there was and continues to be an increase of ground fuel from annual pine needle drop, it is not readily available. The pine needles compress into a tight arrangement that does not burn readily. So even though over sixteen years passed since the prescribed fire, the pine needle layer was insufficient to ignite a crown fire. So this may be considered a testament to the use of prescribed fire in lowering wildfire behavior.

Secondly, the historical thinning treatments reduced or eliminated the presence of ladder fuels to allow a ground fire to reach into the forest canopy. Thinning treatments were based upon a shelterwood system, where a new stand or forest is established under the canopy or shade of the existing forest stand. This typically involves the removal of weakened, stressed, and crowded trees in the understory and the removal of crowded trees and trees of poor growth form in the overstory. So this type of treatment will typically result in an open park-like stand where it will be difficult for a wildfire to sustain itself as a crown fire.

Additionally, as the shelterwood system results in the shading of the forest floor, ponderosa pine has difficulty in regenerating itself from seed. So typically there is not widespread pockets of crowded young trees commonly referred to as "doghair". These "doghair" pockets can readily provide enough fuel to burn and ignite the forest canopy overhead. Another benefit of this shading is the self-pruning effect of ponderosa pine. As the level of sunlight lowers as the forest canopy closes, the lower limbs of the pine will die-back, resulting in trees with few or no live green branches on the lower portion of the main trunk. This has the effect of reducing the availability of pathways for a wildfire to leave the ground and burn into the canopy. While there is evidence of young trees being killed in the forest, the relative wide spacing of these trees or groups of trees was insufficient in generating sufficient heat to ignite the main forest canopy.

The previous observations are further supported by the effects of the wildfire when it passed through small patches of "doghair" stands. As these are tight stands of multiple trees, it would be expected that a fire would consume these locations in their entirety. This was not the case in almost all instances that were observed. Based on the very low scorch pattern at the base of the trees, the fire passed through these thick pockets of pine at a very low intensity and flame length. There was not sufficient heat generated to ignite and burn these small stands that would normally be readily available for combustion (see Photo 2).

Photo 2. This picture provides an example of where ground fire passed through a "doghair" stand of trees. The flame length had to have been very short in order for this stand to survive with only branches very close to the ground being burned.

A final observation relates to the topography of the property. The forest drains to the west towards Black Squirrel Creek. This results in about a 175-foot drop in elevation from the top of the ridge which is a boundary between the grassland and the forest. This would roughly be where the access road enters from Holmes Road. So it would be probable that the high winds present during the Black Forest Fire could have been lifted over the majority of the forest and was not a significant factor that influenced the fire behavior and spread. If the shelterwood system is included, the canopy would have shielded the forest floor further reducing the effect of wind on the fire. This is what may have resulted in only twenty-two acres being severely burned with total tree loss.

Wildfire Behavior

This section takes into account the role of the three major components that affect wildfire behavior; fuels, topography and weather. These three components will be examined in relation to the 'Flying Horse at Shamrock Ranch' development plan.

Fuels

The area was field checked and the results of the WHAM and the CO-WRAP were modified 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 meadow areas are best described under Fuel Model 1 (see Appendix A). "The fine, very porous and continuous herbaceous fuels that have cured or are nearly cured govern fire spread. Fires are surface fires that move rapidly through the cured grass. Very little shrub or timber is present, generally less than one-third of the area." It can be further refined to GR 2 - Low Load, Dry Climate Grass (Dynamic) using the models developed by Scott & Burgan (2005). This fuel type encompasses approximately 65% of the total area.

Interestingly, a map of the Black Forest Fire indicates none of the meadow area actually burned in 2013. It is assumed that the ranch road running along the top of the ridge was either used as a control line or was sufficiently wide enough to prevent any ground fire from crossing over from the forest area.

The remaining forested area (35%) can be described as Fuel Model 8. "Slowly burning ground fires with low flame lengths are generally the case…"

It can be further defined as TL1 – Low Load Compact Conifer Litter. In this fuel model the primary carrier is compact litter such as needles with a depth of 1-2 inches. This fuel model is very characteristic of a recently burned forest. Based upon the prescribed fire in 1996 and the Black Forest fire in 2013, it is very appropriate to use this fuel model and reflects the actual fire behavior experienced.

Even at wind speeds of twenty miles per hour, a fire's rate of spread and flame length will be very low. However, under severe weather conditions such as high temperatures, low humidity combined with high winds, this fuel model can pose a significant hazard. Again, based upon the scorch height on the pine, it appears that the wildfire backed down the slope, in spite of the extreme fire weather conditions present.

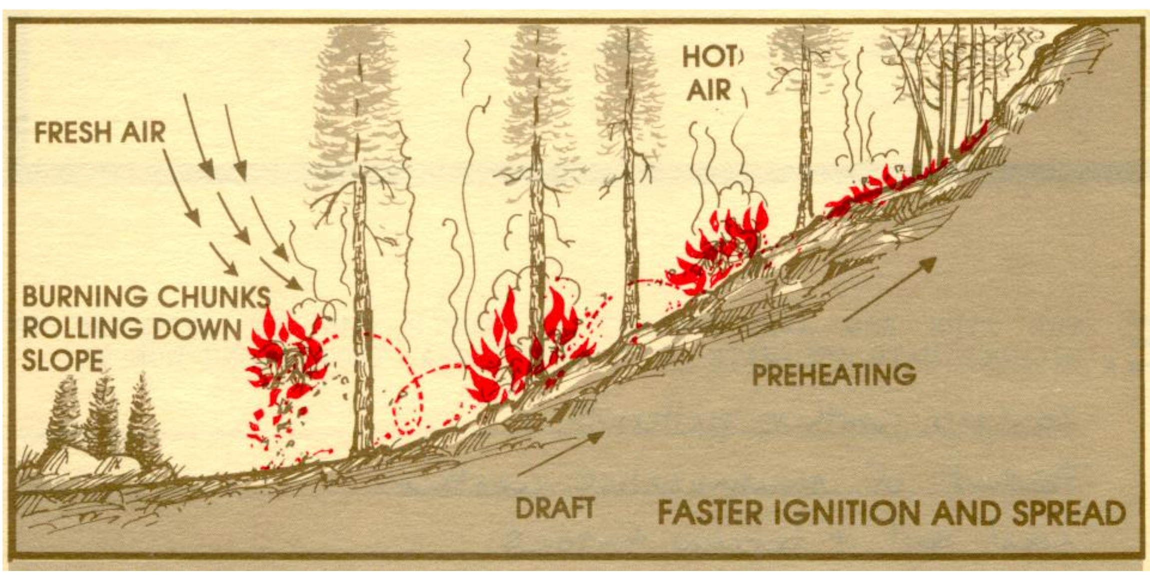
Topography

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.

For example, even though snow cover was present during the field inspection, the shallow south facing slopes had melted snow pack. The surface of the ground was exposed and was slowly drying out.

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



Graphic courtesy of the National Wildfire Coordinating Group

The topography of the property drains to the west from the top of the ridge. From the top of the ridge, the slope drops slightly to the east to a small drainage saddle which then flows to the north. Land lying east of the drainage saddle flows to Black Forest Road (see Map XX).

The drainage saddle creates an intermittent flow through several flood control dams. This weaves through the most northern portion of the development terminating in a retention pond along Hodgen Road (see Photo 3). This detention pond was found to be dry during the initial reconnaissance visit.

The slopes and drainages in the forested area range from 3-8%. Outside the forested area, within the meadow or grassland area, the slope ranges from 1-3%. Slopes in excess of 25% are considered extreme slopes in regards to their effect on wildfire behavior. So the topography of the property should not unduly affect wildfire behavior except on a very isolated basis.

Photo 3. This photograph is taken from Hodgen Road looking south over the northern area of the proposed development. The black arrow indicates the location of the forested portion of the property. The detention pond is at the orange arrow.

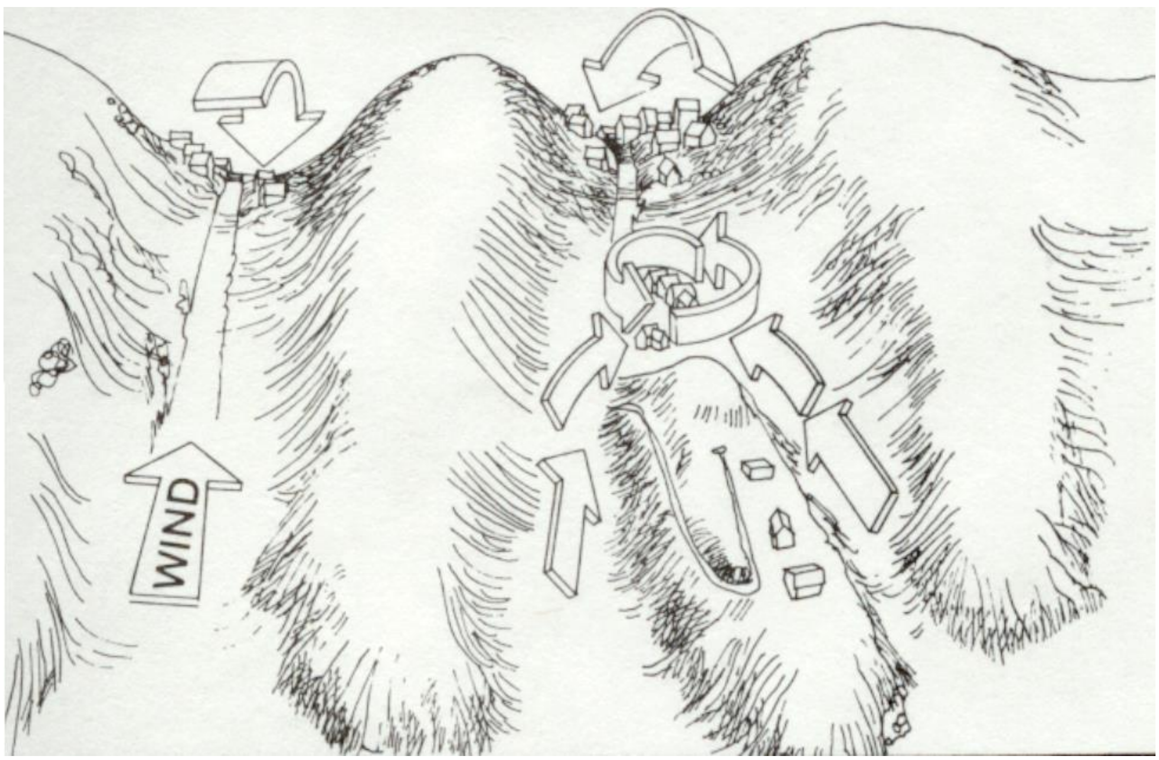
Weather

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 to be 1,000-hour time lag fuels. So this fuel requires a long period of time of dry or wet weather in order to affect its combustibility.

Winds can influence the direction and rate of spread of a wildfire. Of greater concern is the short spotting of the fire by embers transported by winds ahead of the main fire.

Figure 2. Drainages Tend to Draw in Fire



Graphic Courtesy of Colorado Springs Fire Department

There are narrow but short drainages within the proposed subdivision that may influence winds during a wildfire (see Figure 2 above). This could increase fire behavior on a localized basis but it should not influence fire spread over a large portion of the property. One exception would be in the northern portion of the subdivision where the drainage feeds the flood control dam along Hodgen Road. This would require a wind blowing in from the north which could occur during a cold front moving through the area in the late fall/early winter season.

Several common weather factors link three recent wildfire events in the local area, the Hayman Fire in 2002, Waldo Canyon Fire in 2012 and the recent Black Forest Fire (2013). The presence of low humidity (4%), high day time temperatures (90º F) and high wind speeds (20-25 mph.) with gusting conditions (30-40 mph.).

While these three weather factors were present over a very short period of time prior and during the Black Forest Fire, a single ignition at the right moment, can lead to catastrophic loss.

Finally, in the event of extreme fire behavior, the fire itself will exercise some degree of influence on its own environment.

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

Predicted Fire Behavior

As the Black Forest Fire did burn through the forested portion of the proposed Flying Horse at Shamrock Ranch, the fire behavior described under Fuel Model 8 was confirmed. The fire burned downhill slowly and the rate of spread and flame lengths were low.

Using the BehavePlus5 fire modeling system, the following predictions can be made for the grass land fuel model. The inputs are based upon a 95-degree temperature day with a relative humidity of 4% with little cloud cover at 2:00 p.m. in the month of June. These are similar weather conditions that existed during the Black Forest Fire. The drainage in the northern portion of the subdivision that reached Hodgen Road is used in this example.

The prediction was based on using two different live fuel moistures. As this is a grass fuel, the moisture of the grass is a major factor in determining wildfire spread. In addition, as the future use of the grasslands will become residential development, it is reasonable to assume that the grass will have varying degrees of irrigation.

Under a scenario of the live fuel or green grass having a 1% moisture level and is almost totally cured, a wildfire could be projected to spread at a rate of 1,260 feet per minute. The flame length would be about seventeen to eighteen feet long. This is a fire that would probably require indirect attack and would not be easy to control. There is a high probability the fire would jump over any maintained roads it encountered.

Under a different scenario, where the live fuels have a moisture content of just 4%, a substantially different outcome occurs. A wildfire would spread at a rate of around 380 feet per minute. This is about one-third of the rate of spread under the previous scenario. Even more importantly, the flame length is cut in half and would range in eight to nine feet in length. This would lend itself to containment by an improved road within the subdivision or at a minimum by initial attack forces.

Note that this model assumes an untreated grass fuel condition. If the grass is irrigated or even mowed to a lower height, it can be reasonably expected to further reduce the availability of this fuel type to burn

Finally, it should not be assumed that the main periods of fire danger would be in the summer months. As past history has shown, out of season fire events are much more common than might be expected or realized 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 totally eliminated. In the Spaatz Fire near Monument, 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. As previous local wildfire incidents have demonstrated, this loss can occur very quickly with little or no advanced warning.

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.

Due to the recent passage of fire through the forest, specific mitigation treatments are listed under the 'Forest Management' section starting on page twenty-three (23).

- **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 site. However, it is not reasonable nor practical to remove these types of fuels from the entire property.

Based upon the burn evidence from the Black Forest Fire, the existing fine ground fuels were compacted and should remain in place in the future. Whenever possible these fuels should not be raked up or disposed of. The removal may allow the establishment of grasses or woody shrubs, which pose a higher wildfire risk. Retention of the compacted needle/litter layer prevents this from occurring on a large scale.

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. For example, a landscape crew cutting plastic weed barrier fabric ignited a grass fire during windy weather conditions in November 2001. This fire spread through open space in the Jackson Creek development and reached approximately 80 acres in size before its spread was halted by Baptist Road in northern El Paso County.

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 close proximity to the structure. It will also retard the spread of a fire off of the immediate site 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 will be unique for each lot that is developed, it will be difficult to make specific recommendations here. However, it is recommended that each lot be treated prior to completion of the structure.

Specific information on the development of wildfire safety zones are available through the CSU Cooperative Extension Service in the Quick Guide Series Fire 2012-1, *Protecting Your Home from Wildfire: Creating Wildfire-Defensible Zones*. The web page is linked here at Creating Fire Safe Zones.

- **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 grass and timber fuel models are continuous. Obviously, the pasture/grasslands contain an unbroken line of fuel reaching from tree line to the east and north.

In the timber fuel model, it is the ground fuels and aerial fuels that are continuous. While there are open spaces within the forest, these should not have a lasting impact on a wildfire’s spread.

• **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 any of the fuel models to burn should be considered a year round hazard and not limited to the summer months. There have been a number of wildfire events, although small, in the past few months within the city limits of Colorado Springs and in eastern El Paso County.

While there is currently significant snow cover on the proposed subdivision, recent 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 late summer burning conditions.

Other Considerations

Firebrands & Secondary Ignitions

It is becoming more apparent that a majority of 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 burning 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 again seems to infer that 'defensible space', while a good starting point, may not be the only strategy to reduce 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. If parking is to be allowed along the constructed roadway at least nine feet of improved width should be included.

Additional space along the roadways is important for on-street parking. There will be times when contractors, landscape companies and visitors along the road may reduce the passable width of a road from on-street parking. This may result in a road being reduced to a single car width. Such conditions may increase the response time of emergency agencies. It is recommended here that the subdivision advise residents to encourage on-street parking users to keep their vehicles along one side of a road and discourage parking use on both sides of a road where it may reduce the passable road width.

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.

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 so as 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. **For this subdivision it is strongly recommended that the use of ornamental junipers 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 level of irrigated greenbelt. Irrigated lawns around a structure are very effective fuel breaks and serve as defensible space in the event of a wildfire. The development of the golf should enhance wildfire safety and slow the advance of wildfire as it is assumed that the fairways will be supported by some level of irrigation.

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.

By retaining a native landscape, particularly in the grassland, periodic mowing of native grasses will reduce the wildfire hazard and any subsequent spread.

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. Based upon the fire scarring of tree trunks from the Black Forest Fire, this should prevent flame lengths from reaching the building and causing an ignition.

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. Otherwise the protection initially provided by this technique will be lost.

Construction Considerations

As the fuels in this subdivision are trees and grasses, 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 the accumulation of needles 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 major factor in the loss of structures in the historical fire record. These locations 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.

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

In a recent 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 is exhibited upon initial installation.

Combustible roofs become at risk due to the expected aerial firebrands that will be created as wildfire moves through the proposed development. The lodging of brands in combustible roof materials allows entrance for a wildfire into a structure. In this author's experience of fighting wildfire, it is difficult to defend a combustible roof.

Non-combustible roof materials should be used in the construction of all structures on this site.

An additional consideration is the construction of the roof itself. Whenever possible, complex roof designs should be avoided. Flammable material, such as pine needles, may accumulate to roof to wall edges such as a dormer or chimney. This leaves what may be a non-combustible roof vulnerable to ignition. Non-combustible materials such as metal flashing should be used at the intersections between horizontal and vertical surfaces if some exposed component would be considered combustible. Roof vents should have mesh screens installed to reduce the risk of embers entering into the attic area.

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 the wildfire risk is low, the primary fuel involved will be grass on relatively flat slopes. A wildfire in these areas can be high in intensity but typically have a low duration. In other words, grass fires burn hot and fast. Therefore, there may not be enough heat buildup to ignite combustible siding materials. In these locations the use of non-combustible siding may not significantly reduce the risk to wildfire, particularly where a stone border is placed around the foundation.

Where a higher wildfire risk is found, such as in the ponderosa pine forest, the opposite can be true. During periods of drought, ponderosa pine needles develop an extra waxy layer of cuticle over the needles to retard moisture loss from the tree. So the needles will become a hotter fuel when ignited. Depending on the proximity of trees, in particular young reproduction, this additional fuel availability may be sufficient to ignite combustible siding materials.

It is recommended that residential lots within the boundary of the existing forest and in locations that are not located immediately adjacent to the golf course, 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 local fire protection districts will need to haul water into the site during a fire.

At the present time, the Black Forest Fire/Rescue Fire Protection District has the following resources:

1 – Type 1 Engines: 500 gallons' total
4 – Type 3 Engines: 1,750 gallons' total
3 – Water Haulers - 6,000 gallons' total

There are two full-time staff members at Station 1 whose primary responsibility is medical emergencies. The primary resource for fire suppression is volunteer firefighters and has a wide range of response time and availability.

These resources are available for dispatch at the Station 1 located at Teachout Road and Burgess Road. Station 2 is located on Hodgen Road between Black Forest Road and Herring Road and is staffed by part-time employees. Based upon the apparatus resources available, there should be a sufficient water supply for any initial attack response on the proposed subdivision.

That portion of the subdivision that is entered from State Highway 83 lies within the Donald Westcott Fire Protection District (DWFPD). There is no boundary conflict between the two districts as there is an automatic aid agreement between them as well as other neighboring fire districts. DWFPD has a fire station located at 15505 State Highway 83. This station has a Type 1 engine and a Type 3 engine available for initial attack. Both have a 500-gallon water capacity. There is also a water tender available with a 1,500-gallon water capacity.

The Black Forest Fire Protection District should be consulted with on any specific requirements of NFPA Standard 1142, 'Water Supplies for Suburban and Rural Fire Fighting' that may not be addressed here.

Home Owners Association

The Home Owner's Association (HOA) will be responsible for some or all of the implementation and annual inspection of the wildfire mitigation activity, particularly in regard to fuel availability. Specific activities should be developed through a Community Wildfire Protection (CWPP). This effort is supported through National Fire Protection Association (NFPA) through its Firewise Communities and Fire Adapted Communities Programs. Additional information can be obtained at the website through the link

It is suggested here, at a minimum, that the HOA schedule cleanup days in the spring and in fall after needle drop. This will allow an opportunity for the community to work together to improve and maintain their wildfire safety. The Association should budget for the removal and disposal of the material that is collected.

In the event of a wildfire incident, evacuation becomes a major factor in the response efficiency of the fire suppression forces. Once the construction of residences within the development occurs, an evacuation plan should be developed in cooperation with the local fire protection district. This plan should result in the appropriate evacuation routes being designated and signage placed along those routes.

The HOA, at the very minimum, should develop an educational plan to help keep the threat from wildfire foremost in the community's mind. This may include articles in the HOA newsletter, presentations at meetings and even posting the wildfire hazard on a daily basis at the entrances to the Flying Horse at Shamrock Ranch community.

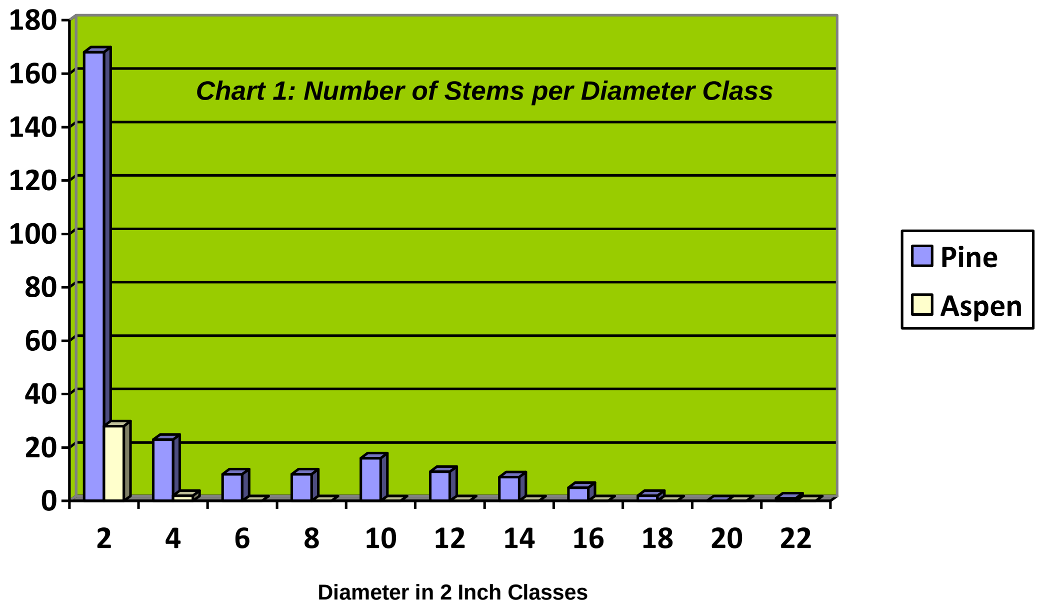
Forest Management

As stated previously, there has been some level of forest management activity since 1973. As part of the wildfire hazard evaluation, a forest inventory was performed, the results of which are included here. The intent of the inventory is to provide a current assessment of the forest resource and to provide activities that can be taken to ensure that health into the future. These activities will also maintain or reduce the moderate wildfire hazard that exists.

The forest should be considered as a ponderosa pine forest. While a nominal number of other species, such as Douglas-fir, spruce and aspen, can be found within the property, the forest will reproduce naturally to ponderosa pine. This is a fire adapted specie and is well suited to the site.

The current forest is composed primarily of ponderosa pine (88.3%) having an average diameter of 12.2 inches. Aspen was tallied during the inventory but the values are highly erroneous and it does not have that high of a representation in the forest as a whole. Aspen was found almost entirely in the drainage on the far south end of the property. This is the area immediately adjacent to the Cathedral Pines subdivision.

The following chart depicts the range of diameters of trees tallied during the inventory and the respective number of trees within each diameter class.

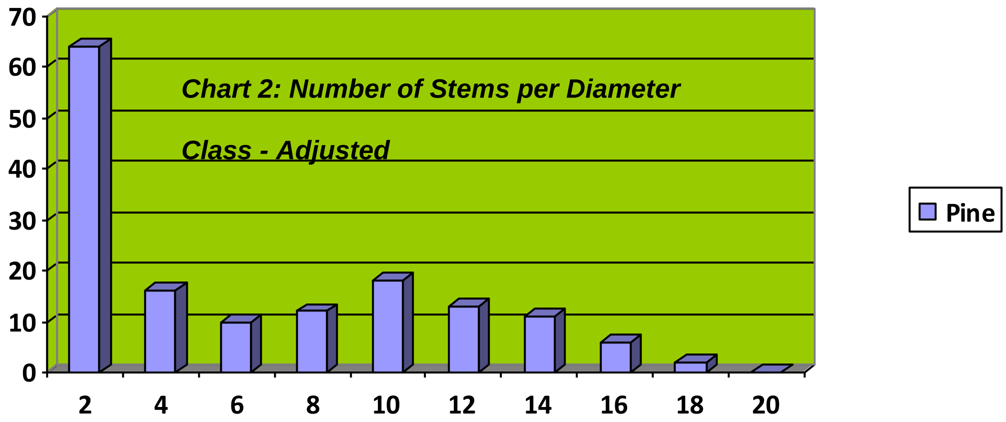


Based upon the results from the inventory, it would appear that the forest is composed of mostly small diameter trees (69%). Again, this is not necessarily the case. The results are being skewed by plots that were tallied in locations where dwarf mistletoe (DMT) control occurred. Since control of DMT, the remaining larger trees provided a seed source for pine regeneration. Hence a greater preponderance of smaller trees that would be present in these plots (see Photo 4). Again, while these DMT areas are located throughout the property, the ones most tallied were in the same area as the aspen were found.

Aspen exists only as a remnant population. It is found only in exposed locations within the drainages. While healthy aspen should be retained in small pockets, it should not be actively managed to increase its presence in the forest. This is due, in part, to its presence in the lower extent of its range in the local area. Aspen does not have sufficient growing conditions on this site to increase its population to become a sustainable forest type.

Photo 4. This picture provides a view of a dwarf mistletoe treated area. The majority of the trees are in the 2 to 4- inch diameter range.

So the inventory data was manipulated to separate out the plots where a large number of small diameter trees were tallied and that were noted to be located in a patch or stand of pine reproduction. This resulted in the following chart.



The total number of stems on a per acre drops from 256 to 152, a reduction of 41%. The largest reduction is in the two-inch diameter class from 168 trees per acre to only 64. This would seem much more reasonable as the two-inch diameter would represent only 42% of the diameter classes present, not over 65% as would have been previously.

Interestingly, the average diameter of the forest stand increased only slightly from 12.2 inches upwards to 12.9 inches. So this confirms the presence of mature, large trees in the total stand which is the impression one gets when walking through the majority of the forest (see Photo 5 below).

Photo 5. This photograph shows a representative area outside of DMT control treatments. The residual trees are widely spaced apart and has an open park-like appearance. There is a DMT control area in the background of the photograph.

The inventory data is probably still being skewed as there are plots located next to thick stands of pine reproduction. These plots are probably tallying more small trees than may be actually present across the entire forest.

In any case, the relatively higher average diameter does pose an issue. Mountain pine beetle (MPB) epidemics have occurred in the Black Forest area. Conditions that contribute to outbreaks are where the majority of trees having diameters larger than 6 inches and which are overcrowded and stressed.

The current forest condition would not be considered stressed. The trees are not stressed as would be the case in an overcrowded or non-treated pine forest. The number of trees per acre based upon the average tree diameter is higher than would be preferred in regard to attack from MPB.

Growing stock level (GSL) is an expression of the desired number of stems per acre. Presently, the forest has a GSL of 150. The preferred target to suppress large outbreaks of MPB is between 80 to 90 which translates to somewhere between 87 to 98 trees per acre, assuming an average diameter of thirteen inches.

On average this would indicate that the number of trees per acre should be reduced by 62 trees upwards to 72. In the case of the Flying Horse at Shamrock Ranch, a large number of mature trees will be removed for construction of residential structures on individual lots, development of subdivision roads and the proposed golf course. This will probably reduce the average number of trees per acre to the target level. So the probability of an epidemic attack by MPB should be low.

However small clusters of pine trees could be attacked in the future. So one technique would be to actively manage locations of open space to lower the GSL on those acres. This will reduce the risk of beetle populations growing to larger and possibly damaging populations. Note that individual residential lots could also be treated as well. This will also reduce or maintain the wildfire hazard on a localized basis

On residential lots, the ponderosa pine could be thinned sufficiently so the end result is that the remaining tree crowns do not touch one another. This should reduce the threat from MPB attack as well as lowering the risk of a crown fire event.

Dwarf mistletoe (DMT) remains a slight threat to the forest, mostly in locations that were treated in the past. In these locations, most notably along the southern boundary with Cathedral Pines, not all of the larger infested trees were removed. In the last fifteen to twenty years, these retained trees may have been infected and have produced aerial shoots. These shoots produce seed which can spread the infection. So at the time of control treatment, these shoots may not have been visible. In any event, some of the large trees that were retained to provide seed to reforest these DMT treated locations will need to be removed.

Since the initial treatment, the ponderosa pine has reproduced from seed produced by the retained trees. But DMT has also infected some of this pine reproduction. So this should be considered as the most important priority for management.

Prior to the sale of any residential lots, the previously DMT treated locations should be entered and any infections should be treated. This may be as simple as pruning a single tree branch or complete removal of individual trees. At the same time, these locations, as well as any “doghair” stands should be thinned as well. This will reduce, if not eliminate, the last major wildfire threat condition.

Based upon inventory results, these stands of reproduction could contain upwards of 1,446 stems or trees per acre. Using a target GSL of 90 and using an average diameter of 3.8 inches, the residual number of trees per acre would be 454. So it not unreasonable to expect to remove almost three-quarters of the trees in “doghair” stands or DMT treated areas.

So the work plan for forest management and subsequent wildfire mitigation are as follows:

Prior to the sale of residential lots,

1. Thin reproduction in DMT control areas and any other “doghair” stands to a target GSL of 90. This is approximately 450 to 500 trees on a per acre basis. Trees that are the tallest, with a straight main trunk and a large diameter trunk at ground level should be retained. The branches of the remaining trees should not touch one another in most instances.

2. Tree that have visible aerial shoots of dwarf mistletoe in the upper one-half of the live green crown should be removed entirely. As it may take up to four years for an infection to produce an aerial shoot, there is a high probability more branches are infected than can be visibly seen. This should reduce, if not eliminate, future infections. Otherwise, individual branches should be pruned off at the main trunk.

3. All material that is cut (slash), such as trees and branches, should be chipped in place or removed from the site in its entirety. This will prevent an increase in the presence of available dead ground fuel, particularly near the southern boundary with Cathedral Pines.

4. Forest locations along the property perimeter should be thinned, if necessary, so as to create a fuel break. In those areas, the branches of

adjacent trees should not touch one another. All dead ground fuels larger than one-inch in diameter as well as any slash from trees removal should be chipped or removed from the site. The width of the fuel break should be at least the average tree height at the location. This will typically range from 50 to 70 feet.

As trees will be removed during the development of the golf course, it will be reasonable to treat forested open space locations at the same time. For these locations the work plan is as follows:

1. All of the open space locations will be thinned to a target GSL of 90. Depending on the diameter of the trees, this might result in 15 upwards of 50 trees needing to be removed on a per acre basis.

2. As in almost all cutting treatments, slash that is generated should be chipped on site or removed so as to reduce the wildfire hazard.

Prior to the occupancy approval for structures on residential lots, the following should be completed:

1. Each lot in the forested area should be inspected for dwarf mistletoe. Any visible infections should be removed.

2. Each lot in the forested area should inspected for any additional wildfire mitigation treatment. Any treatment necessary should be completed prior to occupancy.

These inspections can be completed by private consultants, the state Forest service or a qualified representative of the local fire protection district.

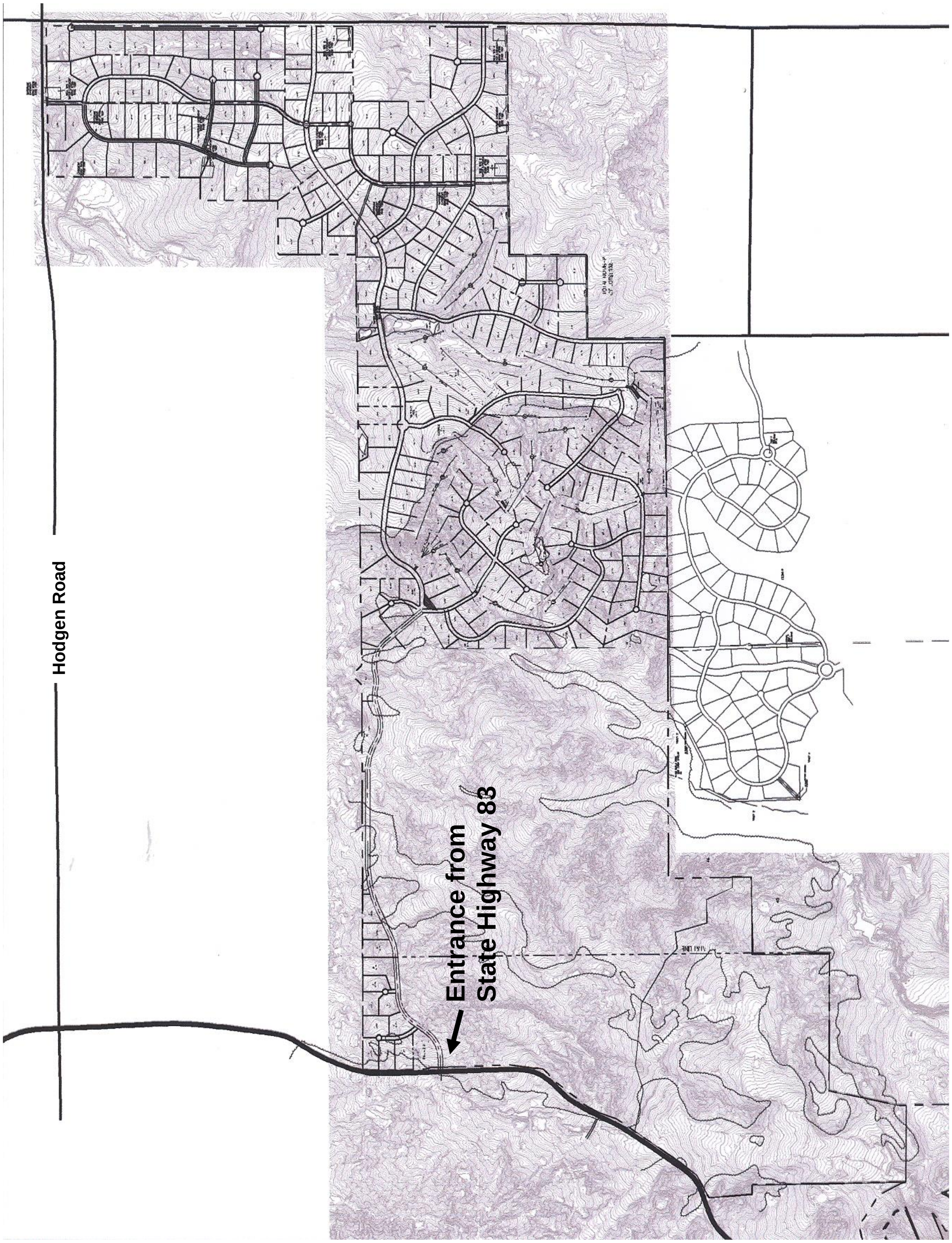
Appendix A

Maps

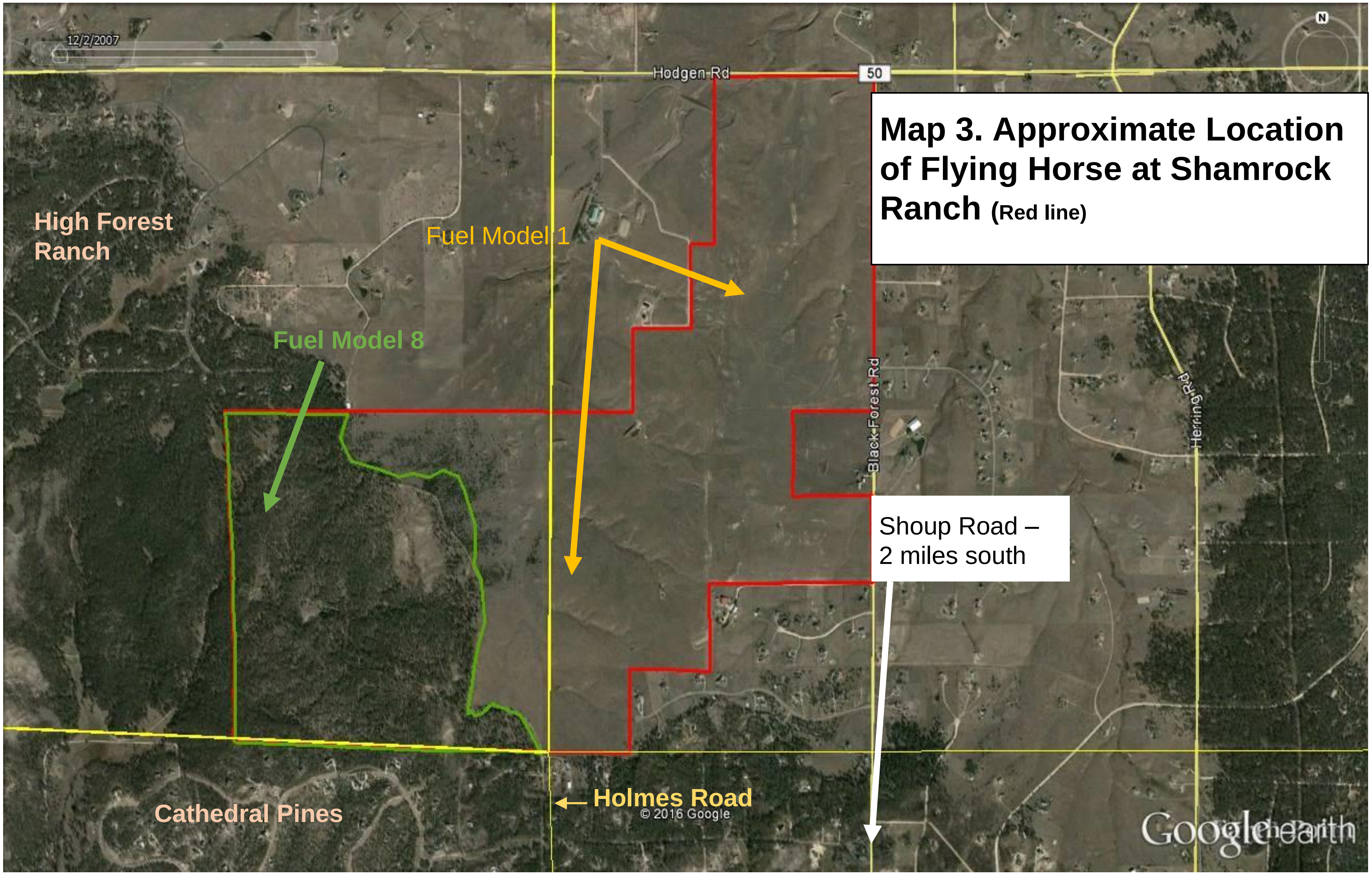
Map 2. – Subdivision Map

Map 3. - Approximate Subdivision in Google Earth with Fuel Models

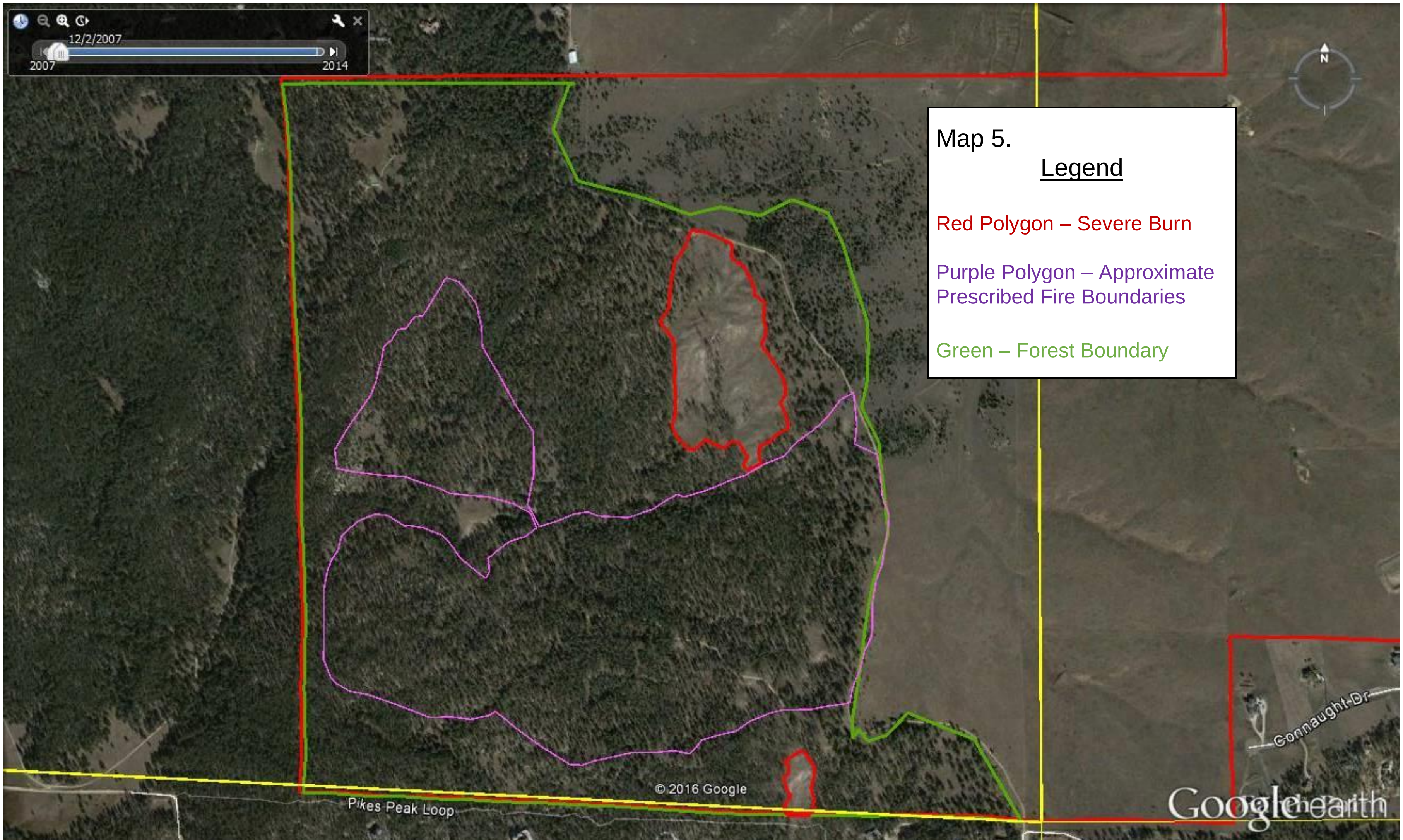
Map 5. - Locations of 2013 Severe Wildfire and Location of 1999 Prescribed Fire



Map 2. Subdivision Map with Entrance from Highway 83



Map 3. Approximate Location of Flying Horse at Shamrock Ranch (Red line)
12/2/2007
Hodgen Rd
50
High Forest Ranch
Fuel Model 1
Fuel Model 8
Black Forest Rd
Herring Rd
Shoup Road – 2 miles south
Holmes Road
© 2016 Google
Cathedral Pines


12/2/2007
2007
2014
N
Map 5.
Legend
Red Polygon – Severe Burn
Purple Polygon – Approximate Prescribed Fire Boundaries
Green – Forest Boundary
Connaught Dr
© 2016 Google
Pikes Peak Loop
Google earth

Appendix B

Fuel Model Descriptions

Fuel Model 1 & 8 Summary Pages

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.”

Fuel Model GR2 & TL1 Summary Pages

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.”

FUEL MODEL DESCRIPTIONS
Grass Group

Fire Behavior Fuel Model 1

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. Very little shrub or timber is present, generally less than one-third of the area.

Grasslands and savanna are represented along with stubble, grass-tundra, and grass-shrub combinations that met the above area constraint. Annual and perennial grasses are included in this fuel model. Refer to photographs 1, 2, and 3 for illustrations.

This fuel model correlates to 1978 NFDRS fuel models A, L, and S.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch dead and live, tons/acre	0.74
Dead fuel load, ¼-inch, tons/acre	.74
Live fuel load, foliage, tons/acre	0
Fuel bed depth, feet	1.0

Photo 1. Western annual grasses such as cheatgrass, medusahead ryegrass, and fescues.

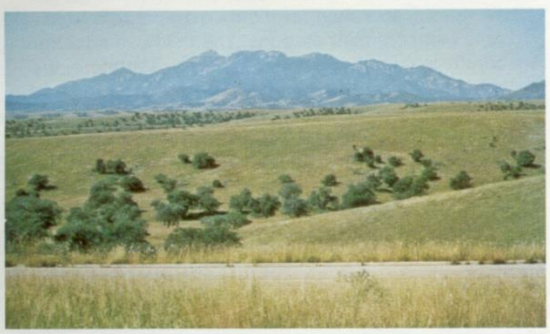


Photo 2. Live oak savanna of the Southwest on the Coronado National Forest.

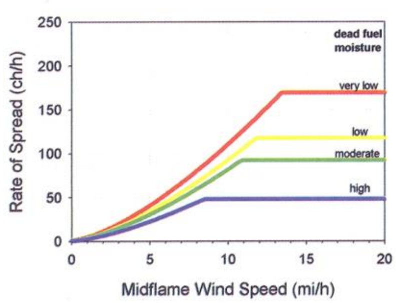
Photo 3: Open pine—grasslands on the Lewis and Clark National Forest

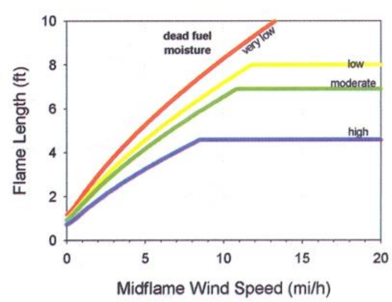
GR2 (102)

Low Load, Dry Climate Grass (Dynamic)

Description: The primary carrier of fire in GR2 is grass, though small amounts of fine dead fuel may be present. Load is greater than GR1, and fuelbed may be more continuous. Shrubs, if present, do not affect fire behavior.

Fine fuel load (t/ac)	1.10
Characteristic SAV (ft-1)	1820
Packing ratio (dimensionless)	0.00158
Extinction moisture content (percent)	15





Timber Group

Fire Behavior Fuel Model 8

Slow-burning ground fires with low flame lengths are generally the case, although the fire may encounter an occasional "jackpot" or heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperatures, low humidities, and high winds do the fuels pose fire hazards. Closed canopy stands of short-needle conifers or hardwoods that have leafed out support fire in the compact litter layer. This layer is mainly needles, leaves, and occasionally twigs because little undergrowth is present in the stand. Representative conifer types are white pine, and lodgepole pine, spruce, fir, and larch.

This model can be used for 1978 NFDRS fuel models H and R. Photographs 22, 23, and 24 illustrate the situations representative of this fuel.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch, dead and live, tons/acre	5.0
Dead fuel load, ¼-inch, tons/acre	1.5
Live fuel load, foliage, tons/acre	0
Fuel bed depth, feet	0.2

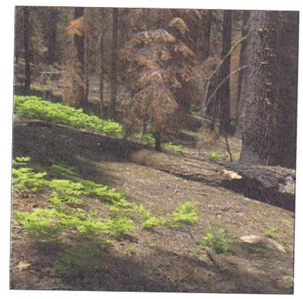
Photo 22. Surface litter fuels in western hemlock stands of Oregon and Washington.

Photo 23. Understory of inland Douglas-fir has little fuel here to add to dead-down litter load.

Photo 24. Closed stand of birch-aspen with leaf litter compacted.

TL1 (181)

Low Load Compact Conifer Litter



Description: The primary carrier of fire in TL1 is compact forest litter. Light to moderate load, fuels 1 to 2 inches deep. May be used to represent a recently burned forest. Spread rate is very low; flame length very low.

Fine fuel load (t/ac)	1.0
Characteristic SAV (ft-1)	1716
Packing ratio (dimensionless)	0.04878
Extinction moisture content (percent)	30