atmosphere could be detected at this location, apparently venting the underground workings. Depending on atmospheric conditions, this area could provide oxygen to the nearby fire.

**Feature 3**
Feature 3 consists of a series of parallel, discontinuous, low temperature vents located at the base of a sandstone outcrop. The center of this 50 feet long series of vents is located about 100 feet higher in elevation than Feature 1 at 39° 36’ 08.5”, 107° 39’ 56.6”. Ground temperatures at this series of vents varied between 125° and 150°. Steam was observed to exhale from these features, which were moist at the ground surface.

**Feature 4**
Feature 4 is an approximately three feet by four feet by unknown depth vent, located at the base of the steeply dipping sandstone, approximately 150 feet east of Feature 3. The ground temperature of this vent, located at 39° 36’ 08.9”, 107° 39’ 56.6”, was measured at 250°.

Further to the east, as the ridgeline begins to fall rapidly toward the Grass Valley Road, a number of subsidence features exist. These generally occur at the base of a sandstone outcrop. The further uphill features were observed to vent at temperatures to 150°. Those features located further downhill were not observed to exhibit elevated temperatures. It is unknown whether these features serve to ventilate the fire or not.

**Feature 5**
Feature 5 is a heat altered area located on the south facing side of the ridgeline at 39° 36’ 08.6”; 107° 39’ 55.4”. This 40 feet (on strike) by fifteen feet (perpendicular to strike) area is located between a stratigraphically overlying white sandstone and an underlying buff sandstone. This area represents either a small rider seam, or a coal sequence accessed by another, southerly mine entry. The ground surface temperature in this area varied between 230° and 331°. An approximately eight-inch diameter, horizontal vent is located near the base of this area. The vent was observed to audibly exhaust very hot combustion gas. Significant sulfur deposition was present at the vent and in its immediate vicinity. The ground temperature at the vent was measured at 575°.

**Feature 6**
Feature 6 is a vent located near the groin of the drainage immediately south of the ridgeline. This area represents either a small rider seam, or a coal sequence accessed by another, southerly mine entry. Temperatures at this vent were measured at near 400°.

**General Observations**
It appears that three to four coal seams may be burning in this location. Some of the burning coal sequences may be small rider seams that over – or – under lie a mined seam.

The surface expression of the fire appears to be more localized, yet hotter, on the south side of the ridgeline. The fire(s) are likely better ventilated, and possibly located closer to the ground surface in this area.

The fire that is expressed near the ridgeline appears to be moderately active, and is likely located deeper within the ridge than are the more southerly fires.

This area poses a moderate wildfire hazard due to the proximity of the ridgeline vents to adjacent vegetation and to annual weed growth.

The area poses a moderate human health and safety hazard, due to the hot surface temperatures at the southerly vents, and due to the open vent at Feature 4.

<table>
<thead>
<tr>
<th>Harvey Gap Coal Mines 1, 2, 3 (Undifferentiated)</th>
</tr>
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<tbody>
<tr>
<td><strong>Years Operated</strong></td>
</tr>
<tr>
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<tr>
<td>1913–1968</td>
</tr>
</tbody>
</table>

* Not Reported
Grand Hogback, South Of Interstate 70
Possibly the best known sequence of underground coal mine fires are those located on the slope of the Grand Hogback, south of New Castle and the Colorado River facing Interstate 70. The fire zone is readily visible from Interstate 70 and is well known by highway travelers. The underground mine fires located along this portion of the Hogback provide a sufficient amount of heat to prevent snow from sticking in the winter, and to promote a healthy stand of bright green annual grasses in the spring. The annual grass growth, as does the absence of snow, provides a stark and visible contrast with the adjacent, unaffected areas.

Three mines appear to be burning in this area. From west to east, the mines that are burning are the Coryell, New Castle Number 1 and Vulcan. Historically, the McDonald Mine was thought to be burning, rather than the New Castle Number 1. However, Carroll and Bauer, 2002, indicate that the McDonald was an exploratory operation, and did not produce a significant amount of coal. The nearby New Castle Number 1 was a large operation that experienced a methane explosion in 1901. Due to the reported location of the New Castle Number 1 relative to the observed fire location, the volume of coal production and the 1901 underground explosion, it is presumed that the new Castle Number 1, rather than the McDonald, is burning at the mapped location.

Observation of the surface presentation of the fire indicates that two different seams are burning. It is presumed that the Allen seam is involved in fire at the Coryell and New Castle Number 1 mines, with the overlying Wheeler seam burning at the Vulcan.

Vulcan Coal Mine Fire
The Vulcan site was visited on June 19, 2002. The entire burn zone is easily distinguishable by the presence of dried cheat grass for much of the summer and early fall months. The westerly most area exhibiting fire characteristics is located at 39° 33’ 39.4”; 107° 30’ 24.1”. A small, closed subsidence feature may be found at this location. The periodic smell of coal combustion can be picked up near this westerly margin of the fire zone, although no vents were readily identified. Ambient ground temperatures of the fire zone were measured at approximately 115°. Temperatures measuring in the vicinity of 140° to 145° were observed within the subsidence feature.

Feature 1
Feature 1 is a narrow fracture about 50 feet long, three feet wide and two to three feet deep. The feature trends parallel with the contour. Ground surface temperatures within the fracture were measured at 150° to 180°. The smell of coal combustion was apparent at this feature site, which is located at 39° 33’ 36.2”; 107° 30’ 12.9”.

Locations of the New Castle Number 3, Coryell, New Castle Number 1 and Vulcan Mine Fires. North at top.

Vulcan and New Castle Number 1 Mine Fires. View toward South.
Feature 2
Feature 2 is a large area located well upslope, and about 200 yards westerly of what appears to be the abandoned Vulcan Mine loadout. This feature presents itself as a barren area on the coal outcrop. A significant amount of white, sulfuric precipitate is present on the outcrop. This area is easily discernible from Interstate 70. This area appears to be a vent that displays a low level of activity. Surface temperatures were measured at 100° to 120°. Above average ground moisture indicates that some degree of vent activity exists. This feature is located at 39° 33’ 33.3’’; 107° 30’ 02.5’’.

Feature 3
Feature 3 is located easterly of Feature 2 at 39° 33’ 33.3’’; 107° 30’ 02.0’’. This feature consists of a series of three to five steaming, low temperature vents located just above, and parallel with, the coal outcrop. Ground surface temperatures were measured at 90° to 130°. Both sulfur and creosote were observed to be horizontally distributed along the face of this feature.

Feature 4
Feature 4 is similar to Feature 2 in that it presents characteristics of a low temperature area venting inefficient fire activity. Ground surface temperatures were measured at 105°. Interestingly, this vent area is likely fracture controlled, as the vents are vertically distributed, rather than occurring parallel with the outcrop. The area is generally barren of vegetation, with vents occurring in an altered shale outcrop. Minor sulfur deposition and some wet spots are observed here. This feature is located at 39° 33’ 33.1’’; 107° 29’ 59.5’’.

No fire features were observed to occur beyond, or east of, Feature 4. Therefore, it is assumed that Feature 4 establishes the eastern margin of the Vulcan Mine Fire zone. However, a collapsed shaft / mine entry was observed at 39° 33’ 30.5’’; 107° 29’ 51.8’’. It is unknown what, if any, relationship this feature may have with the Vulcan Mine, or with the fire.

General Observations:
The Vulcan Mine Fire is likely a diffuse, low temperature fire.

The mine is burning intermittently in distinct areas.

The fire may have migrated into the overlying seam.

Micro-fractures providing an air source are plentiful over the fire surface as a result of the numerous small subsidence features that are present.

Public safety hazards are low, given the low temperatures, and lack of large or open vents.

Wildfire hazard potential is low, given the low ground surface temperatures.

Vulcan Coal Mine

<table>
<thead>
<tr>
<th>Years Operated</th>
<th>Formation / Mined Seams</th>
<th>Strike</th>
<th>Dip</th>
<th>Mining Method</th>
<th>Total Production</th>
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<tbody>
<tr>
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<td>Unknown / Shaft Entry</td>
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New Castle Number 1 Mine Fire
The New Castle Number 1 Mine Fire was visited on June 19, 2002. The New Castle Number 1 is located west of the Vulcan Mine fire. The New Castle Number 1 is apparently burning in the Allen coal seam. The easterly margin of the New Castle Number 1 fire zone is the first area west of the Vulcan presenting indicator vegetative changes. This presumed easterly margin of the fire is located at 39° 33’ 38.7’’; 107° 30’ 40.8’’. This location is within a draw on the flank of the Hogback at an altered shale outcrop. Ambient ground temperature at this location is 98° to 110°, with little evidence of immediately underlying fire presenting itself.

Feature 1
The ridgeline just west of the beginning of the New Castle Number 1 Fire zone is 75 feet to 100 feet wide area, exhibiting a series of small to almost imperceptible low temperature vents. These vents are generally discontinuous, exhibit moss growth, and are fairly wet. Ground surface temperatures at the vents are generally 125°, with temperatures reaching 140° to 150° at the westerly margin of the area. The central portion of Feature 1 is located at 39° 33’ 39.5’’; 107° 30’ 44.4’’.

The westerly portion of the Feature 1 vent area is the site of a subsidence feature closure completed by the Division in May 2002. The subsidence feature was approximately 30 feet in diameter, and, excepting an active chimney at the western margin, was collapsed. The ground surface temperature at the active chimney was measured at over 250° before it was closed. This feature was closed by injecting high slump grout into the chimney until refusal, then constructing a concrete pad that overlaid the margins of the chimney by approximately 15 feet. Specially built concrete blocks were helicoptered to the site and were placed over the concrete cap. The concrete blocks and cap were then backfilled with dirt. The backfill was found to be intact at the time of the New Castle Number 1 Mine Fire evaluation. No evidence of
breach, venting or failure of the backfill was observed. Backfill ground surface temperature was measured at 110°, within the range of ambient ground surface temperatures.

**Feature 2**
Feature 2 is a one-foot diameter circular vent located about 50 feet west of the subsidence feature closed by the Division. This feature is located within the margins of a draw or gully. Subsidence characteristics within the gully are evident, including indications of circular failure patterns along the sides and a small lip that has developed at the vent location.

The vent, which is located at 39° 33’ 39.9”; 107° 30’ 46.7”, is actively venting the mine fire. Ground surface temperatures at the vent were measured at 170°. The vent moves a significant volume of exhaust gases, which can be felt exiting the feature. Interestingly, the smell of mine atmosphere predominates, with only a periodic scent of combustion present. Oxygen content just within the vent was measured at 11%, with carbon monoxide measured at 435 parts per million.

The westerly margin of the New Castle Number 1 Mine Fire is located at 39° 33’ 43.2”; 107° 30’ 54.7”. Fire related vegetation exists from Feature 2 to this location, where the oak brush / mountain mahogany community predominates. At this interface, ground surface temperatures were measured at 95°, well within ambient conditions.

**General Observations:**
Small fire, somewhat diffuse toward its easterly margin.

Likely in the coal outcrop at the easterly margin.

The fire may be moderately efficient and more active at its westerly margin.

Feature 2 may indicate portions of the mine are not burning, and are somewhat discontinuous from burning portions.

Low public safety hazard due to lack of significant vents and elevated temperatures.

Low wildfire hazard due to low temperature vents and lack of persistent vegetative cover.

**Coryell Coal Mine Fire**
The Coryell Mine Fire was visited on June 20, 2002. The Coryell is the furthest west of the three mine fires located south of Interstate 70 near New Castle, and is likely burning in the Allen coal seam. The features observed at this fire zone are numbered from west to east. The traverse began near the River Bend Subdivision, and proceeded east.

The beginning of the fire zone is presumed to coincide with a closed subsidence feature located at 39° 34’ 06.2”; 107° 32’ 09.1”. Minor vegetative changes were observed to occur at this location, within the feature itself. The ambient ground surface temperature was measured at 850 to 900 at this location.

**Feature 1**
Feature 1 is an open subsidence feature located at 39° 34’ 05.3”; 107° 32’ 07.7”. This is a recent feature that was sealed by the Division in November, 2004.

The feature was approximately 20 feet in diameter, and about 15 feet deep. A slight combustion smell emanates from the feature; however, interior ground surface temperature was measured at 95°.

**Feature 2**
Feature 2, located at 39° 34’ 03.6”; 107° 31’ 58.7”, is a venting fracture within an area barren of vegetation. The area barren of vegetation begins at about 50 feet west of this feature. The vent is semi-circular, and is approximately three feet long by six inches wide by 15 inches deep at the east end, with an unknown depth at the west end. Ground surface temperatures within the vent were measured at 155°. Carbon monoxide was measured at 145 parts per million at the west margin of the vent. Significant moss growth occurs in the area barren of vegetation, covering the ground surface more extensively at the vent.

**Feature 3**
Feature 3 is a series of three discontinuous vents measuring a total of five feet long by eight inches wide by unknown depth. These vents are semi-circular in shape, and begin in a draw located at 39° 34’ 02.9”; 107° 31’ 56.1”. Ground surface temperatures were measured at 250°.

Numerous small, discontinuous vents are located in the vicinity of Feature 3, and throughout this area that is barren of vegetation. Many of the vents are likely longer than they present at the surface, but are healed or otherwise covered by active
colluvial cover movement. It is assumed that other small vents are completely hidden by the colluvial cover. This venting zone extends generally from the location of Feature 3 to a ridgeline located at 39° 34’ 03.1”; 107° 31’ 54.5”.

No indications of fire are observable on the ground between the easterly extent of the barren / vent zone near Feature 3 and a large area supporting a healthy stand of annual grass, located at 39° 33’ 58.6”; 107° 31’ 37.0”. Ground surface temperature was measured at 110° at this location.

To this point, each of the numerous draws within the burn zone(s) has supported significant subsidence features. These are typically large (20 feet diameter), circular, rock filled depressions. None of these exhibit elevated ground temperatures, yet no subsidence features were observed at areas that do not exhibit fire characteristics. It is likely that these subsidence features, and thus the related burn zone, are coincident with upward stoping in the underlying mine. Ground surface temperatures between 120° and 145° are common.

**Feature 4**

Feature 4 is a vent located at 39° 33’ 57.9”; 107° 31’ 36.6”. This vent is a circular, horizontal feature measuring about 4 inches in diameter. Ground surface temperature within the vent was measured at 170°. The area surrounding the vent exhibits many diffuse vents; with some sulfur precipitate noted in the general area.

Little evidence of fire characteristics, excepting small, discontinuous areas of annual grass exist for a distance of approximately 400 feet to the east of Feature 4.

**Feature 5**

Feature 5 is a small subsidence feature situated on ridge. Ground surface temperature within the feature was measured at 125°, with carbon monoxide measured at 128 parts per million, and oxygen at 16 percent. This low temperature vent and vent zone is very moist. Feature 5 is located at 39° 33’ 50.6”; 107° 31’ 16.4”.

**Feature 6**

Feature 6 is a one-foot diameter, generally circular vent that appears to expand underground, parallel with contour. This feature, located at 39° 33’ 49.7”; 107° 31’ 13.6”, exhibits a ground surface temperature of 140°. Numerous small vents are located in the immediate vicinity of this vent.

Intermittent annual grass and barren areas exist east of Feature 6; however, no venting was observed in any of these locations. An abandoned, closed mine entry was observed downslope of the presumed end of the Coryell Mine Fire zone at 39° 33’ 49.4”; 107° 31’ 12.6”. No evidence of underlying fire presents itself from the east end of the Coryell survey to the west end of the New Castle Number 1 Mine fire survey.

**General Observations:**

The Coryell Mine fire is more active than either the New Castle Number 1 or Vulcan Mine fires.

The fire exhibits intermittent areas of activity and inactivity.

Fire activity is diffuse within areas of surface expression.
The Coryell is more prone to large subsidence events than the New Castle Number 1 or Vulcan Mines. This may be due either to the mine having less cover between the ground surface and the active mine, or perhaps different mining methods were being employed.

Surface expression of fire activity is related to subsidence events.

Fire is relatively hot, yet low in activity and intensity.

Public safety hazard is moderate due to the subsidence activity.

Surface fire hazard is low as a result of relatively low temperatures and intermittent vegetative cover.

### Coryell Coal Mine

<table>
<thead>
<tr>
<th>Years Operated</th>
<th>Formation / Mined Seams</th>
<th>Strike</th>
<th>Dip</th>
<th>Mining Method</th>
<th>Total Production</th>
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**SOUTH CANYON VICINITY**

South Canyon, located west of Glenwood Springs, was host to at least four different coal mines. Mining was active in and near South Canyon from the mid-1880’s until 1953.

There is some confusion about the names of the various mines at this location. State mining records indicate that the South Cañon Number 1 was the largest producer, and enjoyed the longest life. This mine is located on South Canyon Road, about one mile south of the Garfield County Landfill. Apparently because the mine extended to both sides of South Canyon Creek, parts or all of the mine has been known as South Cañon, New South Canyon, South Cañon Number 1 and South Cañon Number 2. To eliminate confusion, this mine is referred to as South Cañon Number 1 in this document. This name includes all mining activities conducted at this location.

The U, Wheeler and D coal seams were mined at the South Cañon Number 1. Other mines in the vicinity include the Zemlock mine, located south of the South Cañon Number 1, and the Gem, also known as the South Cañon Number 2. The Zemlock probably mined the Allen seam. There is no indication of fire in the Zemlock. The Gem, which is burning, likely mined the Wheeler and D seams. The Gem Mine is located in a tributary canyon to South Canyon, south of the Garfield County Landfill.

**South Cañon Number 1 Coal Mine Fire**

The South Cañon Number 1 Mine extracted coal from the Wheeler D and U seams. Mining of the Wheeler and D seams extended from east to west perpendicular to the strike of South Canyon Creek, beneath the creek and up two side canyons. Mine maps indicate that the mine entries were located east of South Canyon Creek, with an air entry located west of the creek. Field evidence suggests that at least one additional entry may have been located west of the creek.

Wildfire investigators have cited venting from the South Cañon Number 1 mine fire as the cause of the Coal Seam Wildfire of June 2002.

The Division has conducted a number of projects at the South Cañon mine fire in past years (see Table 4, Status of Sites Where Underground Fire Control Work Has Been Accomplished). Three subsidence features and three adits have been closed in the past. All of the closure work has been for the purpose of protecting...
South Cañon Number 1 Mine Fire, West Burn Zone.

public health and safety. Two fences have also been constructed, one on the east side of the canyon, and one on the west side. The fences serve to minimize public access to the fire zones.

In order to describe the mine fire, the South Cañon Number 1 Mine fire area is divided into east and west burn zones, with South Canyon Creek forming the dividing line between the two areas. The location map shows the east and west burn zones. Preliminary investigations indicate that the two burn zones originated from the same fire, but are separated underground as a result of mine flooding in the vicinity of South Canyon Creek.

West Burn Zone

The westerly burn zone begins west of, and uphill from, South Cañon Road. The burn zone extends along the presumed coal outcrop westerly to near the canyon ridge. This is a north-facing slope extending from an east to west trending ridge to a parallel canyon. The most active areas within this larger area occur at the mid-point, and near the western extremity of the zone. During the late winter of 2002 / 2003, it was observed that the west side of the canyon held snow cover from the road to the location of Feature 1. This indicates that the active zone begins at Feature 1; and extends westerly from that area. A number of large subsidence features exist east of Feature 1, however, no elevated surface temperatures have been measured within these features. About half way up the burn zone within the canyon, rail iron and miscellaneous debris, as well as a barely perceptible depression, indicates the possible location of a collapsed mine entry. However, no entry has been portrayed on the mine maps at this location.

West Burn Zone Feature 1

Feature 1 is located near the mid to easterly portion of the west zone. It is believed by wildfire investigators to have been the point of ignition for the Coal Seam Wildfire in 2002. This area was evaluated on June 18, 2002, approximately six days after the wildfire began. The feature, located at 39° 32' 09.8”; 107° 25’ 10.2”, is situated immediately adjacent to a footpath that was walked in Spring 2002. At that time, no venting was occurring at this location.

The June 2002 evaluation revealed that the feature was conical in shape, and was estimated to be approximately 18 inches in height, with a basal diameter of four feet. The material was tan to buff in color, and consisted of fine grained rock ash, with periodic pebble occurrences. The ground surface temperature of the feature was 270°, but when the ash crust was broken and the interior was exposed, the temperature was measured to increase to 720°. The wind was blowing at the time of the site visit, but carbon monoxide was measured at 221 parts per million. It was observed that the carbon monoxide content increased as wind velocity increased, likely due to a drawing effect from the wind. Oxygen was consistently measured at 21.8 percent. This feature has been
observed on numerous occasions since the June 2002 evaluation. Observations made in 2003 indicate that the ground temperatures at this location do not exceed ambient, off-fire conditions.

Other small, cooler vents and fractures had developed in the immediate vicinity of Feature 1. These were observed to occur within about 20 feet of Feature 1, and generally on-strike to the west of this feature. Temperatures of these smaller vents did not exceed 180°.

West Burn Zone Feature 2
Feature 2 is an 18 inch diameter vent composed of rock ash. The material of the small vent is the same in color and texture as that at Feature 1. This feature is located about eight feet north of the fence corner that existed at the time of the site visit (the fence has since been extended to the west) at 39° 32' 10.2"; 107° 25' 10.6". The ground surface temperature of Feature 2 was measured at 500°.

Visits to these features since the initial inspection indicate that the vents have become less active. Temperatures of 200° to 300° have been measured at both locations. These vents appear to be off-strike with the main fire body, and thus may represent a localized movement of the fire from the mined coal seam to a small, underlying rider seam.

West Burn Zone Feature 3
Feature 3 is a relatively large, venting fracture zone located about 150 feet west of Feature 2, and about 50 feet higher in elevation. The fractures are located in what appears to be a highly altered shale outcrop that is present on a small transverse ridge. Temperatures within this complex vary from 175° to over 600°. The smell of coal combustion is noticeable, as is a large amount of a white precipitate. This material cannot be approached due to extremely unstable ground conditions, but it is assumed that this material is sulfur deposited throughout the vent zone. Numerous small vent areas as well as individual vents surround the Feature 3 vicinity. The area may also present stability issues, as suggested by the large scale fracturing and over-steepened slopes in the vicinity.

West Burn Zone Feature 4
Feature 4 is another zone feature, located at the far westerly extent of the west burn zone. This area is approximately 400 feet in length (parallel with contour) by an estimated average of 100 feet wide (perpendicular to contour). The area begins down-slope of a transverse ridge, and strikes across the ridge to its west side. The most active portions of the zone occur on the east-facing portion of the ridge. Although the entire area exhibits elevated ground temperatures, discrete vents are located on the east side. Vent temperatures of about 250° are common. The individual vents exhibit substantial creosote and sulfur deposition. From the base of the canyon, smoke is commonly observed to emanate from the area.

Viewed from the transverse ridge, the entire west side fire zone strikes north 500 west, directly in-line with a subsidence feature observable above the presumed mine entries on the east side of the canyon. Mine maps indicate the strike of the mine, and presumably of the D seam, to be north 570 west.

The west side of the transverse ridge exhibits moderately elevated ground temperatures of less than 250°, and less discrete individual vents. A large, closed subsidence feature observed to hold snow delineates the most westerly extent of surface features related to mining on the west side of South Canyon.

General Observations (West Burn Zone):
Feature 1 Vicinity:
New vents may have formed as a result of the fire moving into an underlying rider seam.

This area is intermittently active to very active, likely dependent upon oxygen availability.

The fire in this area is very hot, and very efficient.

The area exhibits stability problems that may result in a large scale subsidence, or surficial failure event.

Feature 2 Vicinity:
The fire in this area is active at this location, and appears to be consistently so over time.

The fire was hot at the time of the site visit, but may vary in efficiency, as evidenced by the large area of white precipitate noted there.

Some potential for slope failure exists at this location.

Feature 3 Vicinity:
This area appears to function as a low temperature chimney for the most westerly portion of the fire.

Fire is inefficient at this location as evidenced by creosote and sulfur deposition, and smoke occurrence.

The west side of the fire presents public safety issues. A fence and sign have been placed to minimize public use of the area.

Wildfire hazard is likely variable due to the active and migratory nature of the fire. The hottest portions of the fire are devoid of combustible materials.
The area east of South Canyon Creek is the location of the old mapped mine entry areas, mine facility remnants, numerous subsidence features, vents and an active burn zone. In terms of fire activity, a mid-slope road remnant, approximately parallel with an exclosure fence, separates the zone into a down-slope inactive area, and an upslope active area. The fence was constructed by the Division, and is in place at about the separation between the up-slope and down-slope areas. The fence serves to minimize public ingress to the active burn zone.

Down-Slope Area
The mine entry area, located just above creek level, defines the lower portion of the down-slope area. Above and east of the mine entries are many shallow, linear subsidence features. These appear to have formed along main haulage ways constructed either in rock, or, in some cases, in coal. Most of the features are collapsed, or have been closed by the Division. However, two open, active features were recently discovered near the mine entries. There is no indication of fire activity in this lower area. Elevated ground surface temperatures are not observed in this area. Snow cover persists in this area as well. It is possible, however, that due to the number and extent of subsidence features, and due to the presence of collapsed entries, the area may be an important factor in providing oxygen to the active fire zone further east.

Up-Slope Area
The active up-slope burn zone is estimated to be 150 feet wide (north to south) by up to 600 feet long in slope length. The area is a valley-like depression trending east to west. Parallel ridge-lines form the north and south margins of the area. The area is characterized by denuded shale outcrops venting steam at lower elevations, and smoke from near the north ridge crest. Numerous lineal and circular depressions, generally tending east and west, exist in this area. Most of these are located adjacent to the base of the northerly ridge. Two recent features have developed near the base of the south ridgeline. About mid-slope on the north ridgeline iron, timber, steel, and miscellaneous debris, as well as a barely perceptible depression indicates the possible location of a collapsed mine entry. However, no entry has been portrayed on the mine maps at this location.

East Burn Zone (Up-slope area) Feature 1
Feature 1 is the long vent zone lying adjacent to the base of the northerly ridge. The feature begins down-slope at the east margin of a 30 feet diameter closed and cool subsidence feature. The zone strikes parallel with the base of the ridge, and runs uphill through vent zones exhibiting varying degrees of activity. This zone must be observed from the north ridgeline, as ground conditions within the zone are unstable and hazardous.

The various, discontinuous vents in the zone are generally fracture related. Venting may occur at almost any point within the long fractures. Ground surface temperatures vary from 150° to 300°. A dark precipitate, possibly creosote, and a white, sulfur-appearing precipitate, are observable at various locations. Interestingly, the sulfur precipitate becomes yellow at the up-slope area. The areas containing the dark precipitate exhibited ground surface temperatures at the higher end of the spectrum.

The upper-most extent of the zone occurs at the crest of the northerly ridge. Here the fire vents smoke that is usually apparent from South Canyon road. The vent at this location acts as a chimney for the underlying fire, venting high temperature (600° ground surface temperature) high sulfur, noxious smoke. Carbon
monoxide was measured about 60 feet north of the uppermost vent in a slight breeze at 62 parts per million. The upper extent of the zone is located at 39° 31’ 58.5”; 107° 24’ 41.7”.

East Burn Zone (Up-slope area) Feature 2
Feature 2 is a circular, open subsidence feature estimated to be six to eight feet in diameter at the ground surface, but appears to expand to at least twice this dimension within a few feet of ground surface. This feature is located south of Feature 1 in the valley. Ground surface temperatures within the feature were measured at 470°. No creosote or sulfur was observed at this site.

East Burn Zone (Up-slope area) Feature 3
Feature 3 is a circular, open subsidence feature estimated to be eight to ten feet in diameter. The feature appears closed at four feet depth, however, a small very active chimney is observable near the east margin at the base of the feature. This is a new feature, having developed during the winter or spring of 2002 / 2003. Ground surface temperatures within the feature were measured to vary between 450° and 675°. No creosote or sulfur was observed at this site. This feature is located 30 feet downslope from Feature 2, and south of Feature 1 in the valley.

General Observations (East Burn Zone (Up-slope area):
Down-slope area
Subsidence events are a result of near-surface mining activity. Subsidence still active near mine entries. Subsidence features and collapsed mine entries may provide oxygen to fire.

Up-slope area
Fire active, near surface at lower most portion of area. Fire more inefficient than west side of South Canyon. Fire likely in Wheeler and D mines and in intermediate or overlying rider seams.

Public safety hazard is high due to active subsidence and unstable ground. Wildfire hazard is low due to lack of fuels at the vent areas.

South Cañon Coal Mine

<table>
<thead>
<tr>
<th>Years Operated</th>
<th>Formation / Mined Seams</th>
<th>Strike</th>
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<td>53 SW</td>
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<td>924,974</td>
</tr>
</tbody>
</table>

Gem (South Canyon Number 2) Coal Mine Fire
The Gem mine fire was visited on July 1, 2002. The surface expression of the fire is located on a north-facing slope. The site is accessed via an unimproved dirt road from the Garfield County Landfill. The westerly margin of the fire zone begins on a west facing ridgeline, and extends easterly across the nose of the ridge, through a small drainage, and onto the adjacent ridgeline. Approximately 70 percent of this two to three acre fire zone is located on the westerly ridge.

Feature 1
Feature 1 is a large, subsidence feature located on the west side of the westerly ridgeline. The feature is about four feet deep on the flank of the ridge above the westerly draw, and is incised into this flank. The feature is four feet deep on the low side, with a 20 feet tall backwall on the uphill side. It is oblong in shape, measuring 20 feet by 40 feet, and is closed. The feature, located at 39° 32’ 25.2”; 107° 25’ 55.4”, is large enough that it is easily discernible in aerial photos.

The feature vents along the backwall side at numerous, small (four to six inch diameter), moss–supporting, low temperature vents occurring in a sandstone outcrop. The northeast portion of the feature supports small, almost imperceptible vents, which exhibit ground temperatures of 220°.

The intermediate ridge is characterized by “micro-hummock topography”, which is reminiscent of a landslide body, without an upland scarp. The “micro-hummock topography” is a term given to a ground surface on a hillslope that contains a series of small steps, on the order of two to six inches of vertical relief each, separated by a steep slope that extends anywhere from a few inches to a foot in length, before transitioning to another step. The small vertical steps support very small vents or open fractures near the base of each. Plentiful moss growth and excessive moisture are present in this area. Ambient ground temperature across this area, which is located at 39° 32’ 33.0”; 107° 25’ 59.8”, varies between 120° and 130°.

Feature 2
Feature 2 is a series of eight to ten vents that exhibit ground surface temperatures of 130°, with one vent measured at 180°. Feature 2 is located at the far eastern portion of the fire zone, about 50 feet south east of the central ridge. The central part of this area is located at 39° 32’ 31.8”; 107° 25’ 56.2”. Some sulfur development was observed in this area, while none was observed in the westerly areas. The area surrounding this series of small vents supports substantial moss development, and significant available moisture. This area also supports the “micro-hummock topography” observed at the central ridge area.
Areas within the burn zone, but that are not significantly active, support a robust stand of annual grasses. The areas above and below the surface expression of the fire, and particularly in the intervening central draw, support a vigorous stand of Mountain Mahogany and Oak. No elevated heat values were measured in either the adjacent areas or in the central draw.

No evidence of the mine entry was located during the field reconnaissance. A landslide body located immediately to the west may have obscured the entry area.

**General Observations:**

This is a fire that exhibits low surface heat at vent locations.

The fire appears not to be very active near the ground surface. Possibly, the greatest amount of activity is located near the working face, rather than in the stopes.

The heat appears to be dispersed by geologic conditions, such as fractures and dip.

Venting is dispersed along the areas exhibiting “micro-hummock topography”.

The fire presents a low surface fire potential due to the low heat values measured at the surface, and the fact that the hottest vents are located in non-vegetation bearing outcrops.

Public safety hazard is low due to the remote, and relatively inaccessible location of this fire.

<table>
<thead>
<tr>
<th>Gem Coal Mine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Years Operated</strong></td>
</tr>
</tbody>
</table>
Pocahontas Mine Fire. View towards Southwest

Locations of Pocahontas and Sunshine Mines. North at top.

GRAND HOGBACK SOUTH OF GLENWOOD SPRINGS
Two coal mines on the Grand Hogback south of Glenwood Springs are known to be burning. These fires are unrelated to the South Canyon vicinity mine fires.

Pocahontas Number 1 and 2 Coal Mine Fire
This site was visited on July 1, 2002, and has been observed from the Four Mile Road on numerous occasions since the site visit. The Pocahontas Mine Coal Fire was accessed by walking toward the north along an abandoned dirt road from near the formerly permitted Sunlight Coal Mine located adjacent to Four Mile Road near the Sunlight Ski Area.

The site was readily visible from the abandoned road from a half-mile or more distance. The site exhibits the classic surface characteristics of an annual grass cover surrounded by oak and mountain mahogany. Intermittent red shale outcrops occur within the burn zone as well. From a distance, it appears that the site has two distinct areas that exhibit surface characteristics of underground fires. Each area is barren with annual grasses growing immediately above each.

The southerly area exhibits an eight feet diameter by four feet deep subsidence feature, which may be located at one of the entry areas. This closed feature is located at 39° 24’ 40.7”, 107° 19’ 20.7”. The temperature of the ground surface at this location was measured at 126° to 140°. These temperatures were marginally higher than the ambient ground temperatures that were measured to vary between 110° and 125°.

The northerly area also coincides with a closed feature that is reminiscent of a collapsed adit entry. The entry area is located at 39° 24’ 43.1”, 107° 19’ 21.5”. This area also exhibits barren red shale material at the elevation of the collapsed entry, with annual grasses growing immediately upslope. Ground temperatures at this area were measured at 135°.

The highest ground temperatures were noted at a point located at 39° 24’ 41.9”, 107° 19’ 22.1”. This area is about 40 feet west of and 15 feet upslope from the center of the southerly barren area. Ground temperatures were measured at between 150° and 165°.

No deposition of sulfur, creosote or other combustion by-products were observed anywhere on the site.

A number of subsidence features were observed upslope of the burn area. Most varied in size from about six by ten feet to 20 by 25 feet on a side, each being closed at five feet depth. A larger closed subsidence feature, approximately 20 by 40 feet by 15 feet deep was also observed. These features are all located upslope and...
west of the surface expression of the underground fire. All exhibit mountain mahogany growth and other species atypical of heated soils, indicating that the fire is not present immediately below.

**General Observations:**

Fire appears to be centered between the two possible entry collapses, with heat apparent in the immediate vicinity of each entry and the intervening outcrop.

No mineral, sulfur or creosote deposition was observed.

No distinct or visible vents observed on site.

Fire may be relatively near surface.

Fire likely very low temperature.

Low public safety hazard due to remoteness of the site, and lack of access.

Low surface fire potential due to the lack of vents and low observed surface temperatures.

**Pocahontas Numbers 1 & 2 Coal Mine (Undifferentiated)**

<table>
<thead>
<tr>
<th>Years Operated</th>
<th>Formation / Mined Seams</th>
<th>Strike</th>
<th>Dip</th>
<th>Mining Method</th>
<th>Total Production</th>
</tr>
</thead>
<tbody>
<tr>
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<td>N 17 W</td>
<td>42 SW</td>
<td>Drift</td>
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</tr>
</tbody>
</table>

* Not Reported
Sunshine Coal Mine Fire

This underground mine fire is burning at the historic Sunshine Mine, northeast of the Sunlight Ski Area, and immediately west of the recently reclaimed Sunlight Coal Mine. Rushworth, et al., 1988, did not report this mine as either burning or dormant. Indications are that this mine has been burning for an extended period of time; however, it is not known how long the fire has been active.

The Division of Minerals and Geology became aware of this fire as a result of a phone conversation with the Glenwood Springs City Planners Office. The City Planner reported that a resident of a condominium at the Sunlight Ski Area had observed smoke rising from a ridgeline northeast of the ski area. The Glenwood Springs Fire Department and a Bureau of Land Management helicopter evaluated the site and determined that the smoke was rising from the ground. Following that determination, the Division was notified of the fire, and asked to provide consultation services to the City.

The Sunshine Mine fire was visited on August 29, 2003 with staff from the Glenwood Springs Fire Department and City Planners Office. The location of the fire can be easily viewed from the parking lot of the condominiums located at Sunlight Ski Area. The fire-impacted area appears as a large annual grass dominated hillslope, surrounded by piñon juniper forest. When observed from the condominiums at the time of the site visit, no smoke or steam was observed to emanate from the Sunshine Mine fire.

Access to the site is provided via a very steep slope north of Four Mile Road. The surface expression of the fire is located along a westerly facing ridgeline that extends approximately parallel with the strike of the Grand Hogback. A number of venting fractures are present along the ridge, just west of its crest. These features strike approximately north to south, and appear to be related to a coal rider seam, presumed to be present at this location. Temperatures of the vents vary from 280° at the most down slope vent, to 370° at the furthest up-hill vent. These discontinuous fractures are generally one inch wide, and vary from six inches to ten feet in length. These vents and the presumed rider seam are strongly related to a sandstone crop located stratigraphically immediately above. In some areas, coal combustion near the ground surface is sufficiently hot to cause overlying pine duff to smolder. Evidence of burnt roots and dead and dying piñon pines were observed along the west facing side of the ridgeline.

Two other vents were observed off-strike from the parallel fractures, these being located about ten feet easterly of the ridge crest, on the east facing slope. These vents were located near the upper portion of the fire zone. These features are discontinuous, and are roughly circular in shape. The temperature of these features is about 200°. Condensate is apparent on the overlying rocks, and even on the thermometer surface when placed over the vents.

The size of the surface expression of the fire is difficult to ascertain. The vegetative cover over an area that includes the east side of the ridgeline is predominately annual grass. This change in cover generally indicates underlying heating. Excepting the two vents observed off-strike from the parallel fractures, no venting was observed to occur east of the ridgeline vicinity. Further, the rock units east of the ridge are stratigraphically lower than the strata that underlies the ridgeline and the ground west of the ridge. This is important because fire characteristics are generally observed in units stratigraphically higher than the burning seam. It is possible that radiation of heat is causing the vegetative change observed...
east of the ridge, or perhaps heating from another, stratigraphically lower burning unit is occurring in this area, however no other evidence of an underlying fire was observed.

The total area that exhibits a predominantly annual grass cover is estimated to be 200 feet perpendicular with contour, by 500 feet parallel with contour. The area of active venting is estimated at 200 feet perpendicular with contour, by 100 feet parallel with contour.

**General Observations:**
It is likely that the long-abandoned Sunshine Mine is burning to a greater or lesser extent well below the ground surface.

Mine maps indicate that the stope extraction method was used to recover coal at this site.

It is possible that the underground fire in the Sunshine Mine is hottest along the westerly margin of the mine, thus causing heating and combustion of an overlying rider seam at the ground surface. It may be that the rider seam that is causing the venting and vegetative changes observed west of the ridge line.

The underlying fire may be less intense, or the heat is dissipating more rapidly near the eastern margin of the mine. This would account for the vegetative changes observable east of the ridgeline, and for the lack of venting in this area.

The human health and safety risk at this site is moderate. The heat of the vents, and their apparent near-surface origin are cause for concern. However, the steepness of the slopes leading to the site, and the lack of visual fire clues ameliorate this concern.

The wildfire risk from this fire is high. This is due exclusively to the west-of-ridge venting. These features appear to vent near surface combustion, and were observed in one instance to be hot enough to cause pine duff to smolder. The Glenwood Springs Fire Department and the Bureau of Land Management are aware of this situation, and have reportedly made contingency plans to deal with a wildfire should one occur at this location.

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<tr>
<td>1888–1900</td>
<td>Mesaverde / *</td>
<td>N 18 W</td>
<td>40 SW</td>
<td>Stope</td>
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* Not Reported