



S-190 Unit 4: Topography

Summary:

The ability to identifying, analyzing, and using relevant situational information about topographic features can help predict wildland fire behavior is the responsibility of everyone on the fireline.

Incident Position Description (IPD) Alignment:

This unit aligns with the following FFT2 IPD specific duties
(<https://www.nwcg.gov/positions/fft2/position-ipd>):

- Apply the knowledge of fuels, terrain, weather, and fire behavior to decisions and actions.

Objectives:

Students will be able to:

- Identify topographic features found in the wildland fire environment.
- Describe the basic characteristics of topography and how they can affect wildland fire behavior.

Unit at a Glance:

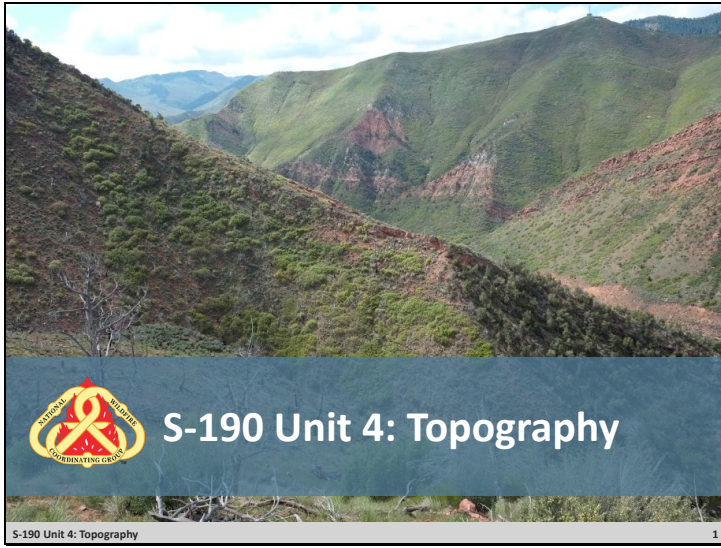
Topic	Method	Duration
Unit Introduction	Presentation	5 Minutes
Topographic Representations	Presentation	5 Minutes
Topographic Features	Presentation	20 Minutes
Topographic Characteristics	Presentation	15 Minutes
Total Unit Duration		45 Minutes

Materials:

- *Incident Response Pocket Guide (IRPG)*, PMS 461, <https://www.nwcg.gov/publications/461>.
- *NWCG Glossary of Wildland Fire*, PMS 205, <https://www.nwcg.gov/glossary/a-z>.
- Notebooks for participants.
- Ability to display images and video on large screen.
- White board or easel access for group breakout.

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Slide 1



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Slide 2

Objectives

Students will be able to:

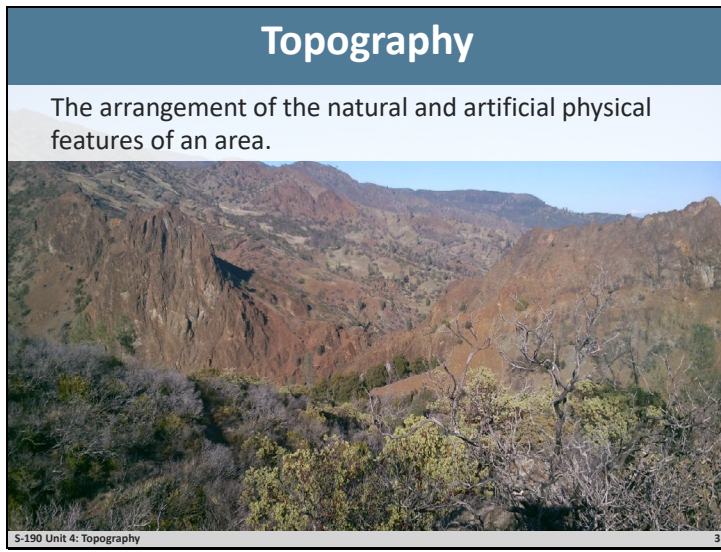
- **Identify topographic features found in the wildland fire environment.**
- **Describe the basic characteristic of topography and how they can affect wildland fire behavior.**

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☐ Review unit objectives.

Unit 4: Topography

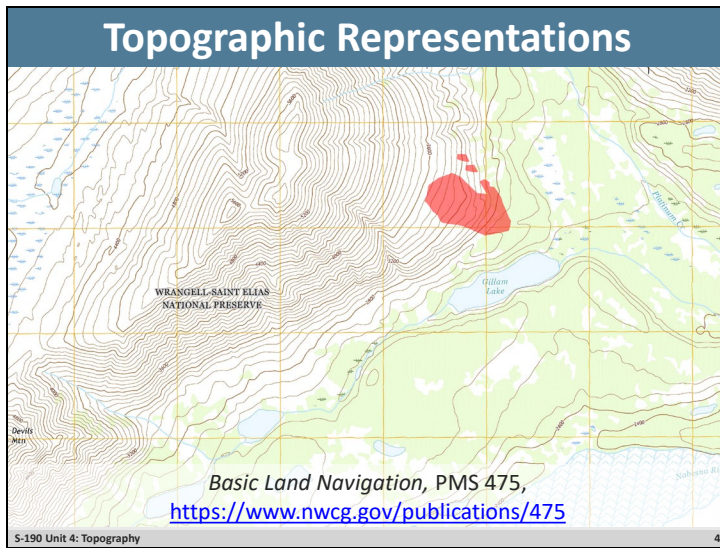
Slide 3



- Topographic influences on wildland fire behavior are much easier to predict than the influences of fuel and weather.
- Topography can be broken up into two primary categories:
- Topographic Features: Canyons, ridges, chutes and saddles, and natural, or constructed barriers.
- Topographic Characteristics: Slope, aspect, and position on slope.

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Slide 4



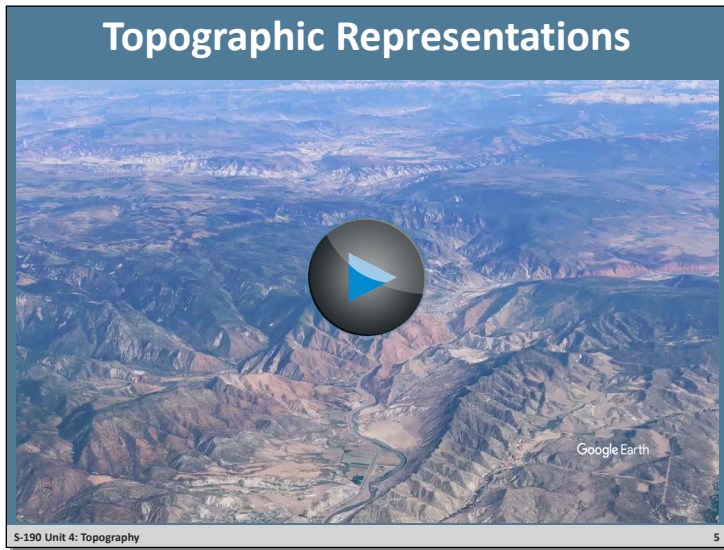
- Topography has a direct affect on wildland fire behavior. Fire personnel use various tools to assess and gather information about the topography of an area.
- A topographic map is an example of the most common tool that provides a picture of the terrain and constructed features through the use of contour lines, colors, and symbols.
- Contour lines represent the shape and elevation of the land, such as ridges, valleys, and hills.
- Colors and symbols are used to represent other features on the land, such as water, vegetation, roads, boundaries, urban areas, and structures.
- This unit references topographic maps and some of the basic information which can be derived from them. However, basic land navigation and map interpretation are not an intent of this unit or course.

Note to Instructor

- For individuals who are interested, *Basic Land Navigation*, PMS 475, <https://www.nwcg.gov/publications/475>, is a self-study introduction to land navigation. It can be downloaded at not cost. Or hard copies can be ordered from the *NWCG NFES Catalog – Part 2: Publications*, PMS 449-2, <https://www.nwcg.gov/publications/449-2>.

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Pre-Video Discussion

- Various programs and applications can provide topographic representations in 3D.
- The video is an example of a detailed representation of topographic features that can be generated through Google Earth.

☐ Play Video

Title Topographic Representations

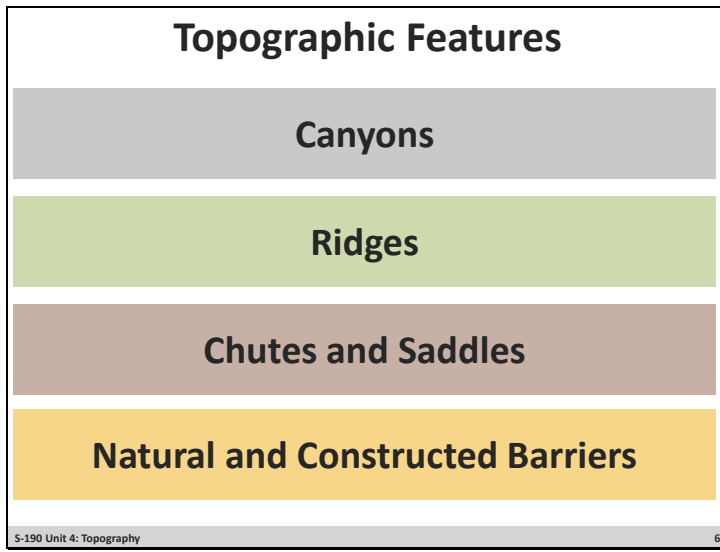
Summary Aerial topographic representation of the location of the 1994 South Canyon Fire on Storm King Mountain, near Glenwood Springs, CO.

Time (01:40)

No Audio

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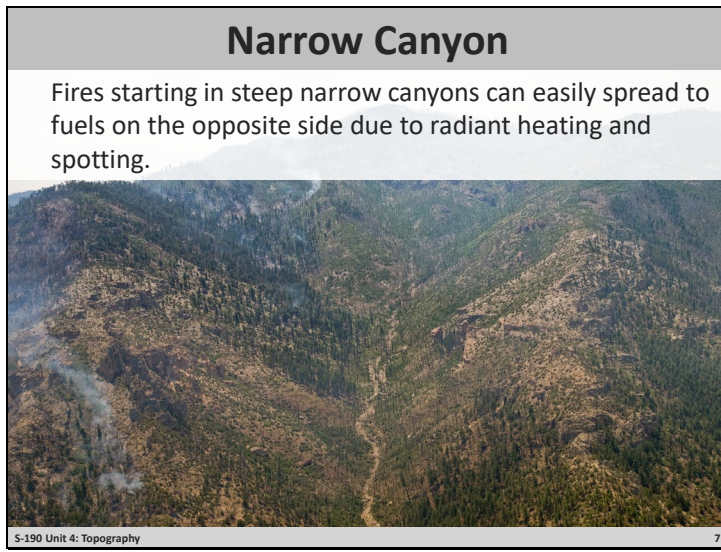
- ❑ Reference Look Up, Down and Around in the *Incident Response Pocket Guide (IRPG)*, PMS 461, <https://www.nwcg.gov/publications/461>.

Note to Instructor

Each topographic feature, and examples of these features, will be discussed separately on slides 7-18.

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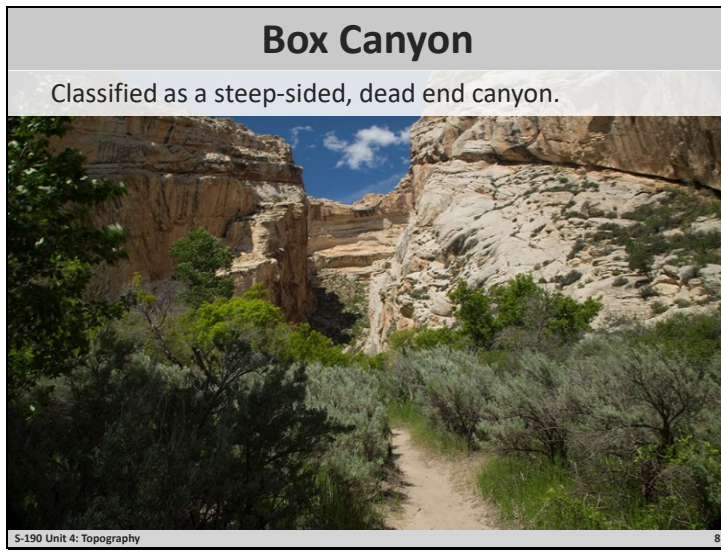
Slide 7



- Increases in wind and strong upslope air movement can be expected at sharp bends in the canyon.

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Slide 8



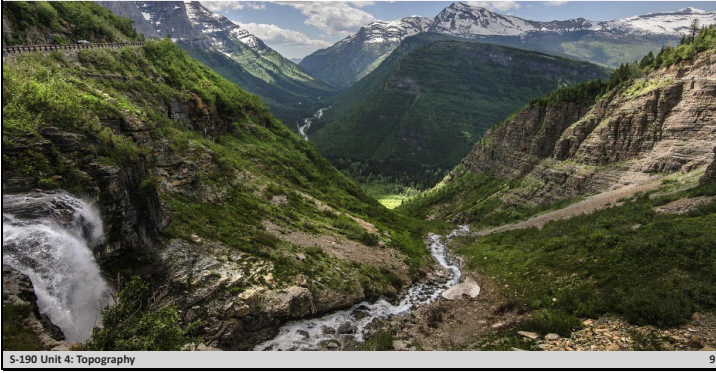
- Fires starting near the base of a box canyon can react similar to a fire in a fireplace. Air will be drawn in from the canyon bottom creating very strong upslope drafts.
- The upslope draft can create rapid fire spread up the canyon, also referred to as the chimney effect.

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Wide Canyon

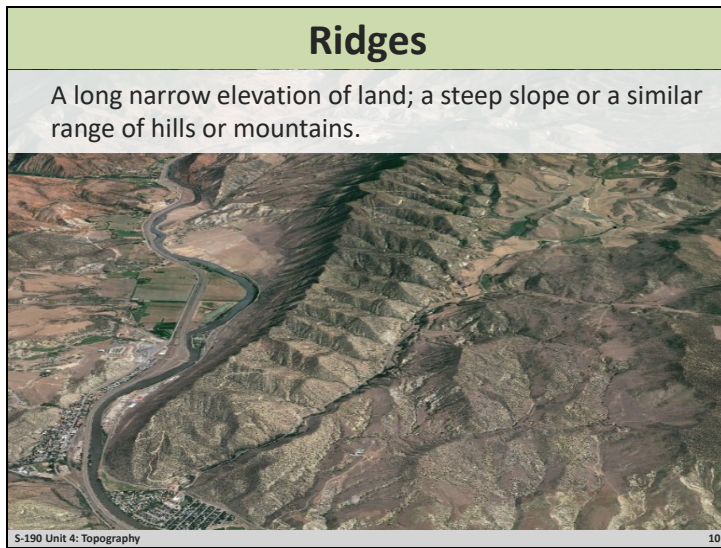
Fire in a wide canyon can be heavily influenced by wind. Prevailing wind direction can be altered by the direction of the canyon.



- Cross-canyon spotting of fires is not common, except in high winds.
- Drastic differences in fire behavior will occur on north or south aspects of the canyon.

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- A ridge is a common topographic feature typically consisting of a long high area that slopes down to two different aspects on either side.
- ☐ Reference the following four types of ridges in describing the predominate topographic features of an area:
1. Dominant.
 2. Spur.
 3. Flat.
 4. Knife.

Note to Instructor

Each of the four types of ridges will be discussed separately on slides 11-14.

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Dominant Ridge

Forms a prominent skyline feature and may have one or more spur ridges that connect to it.



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Spur Ridge

A small ridge which extends finger-like from a main ridge.

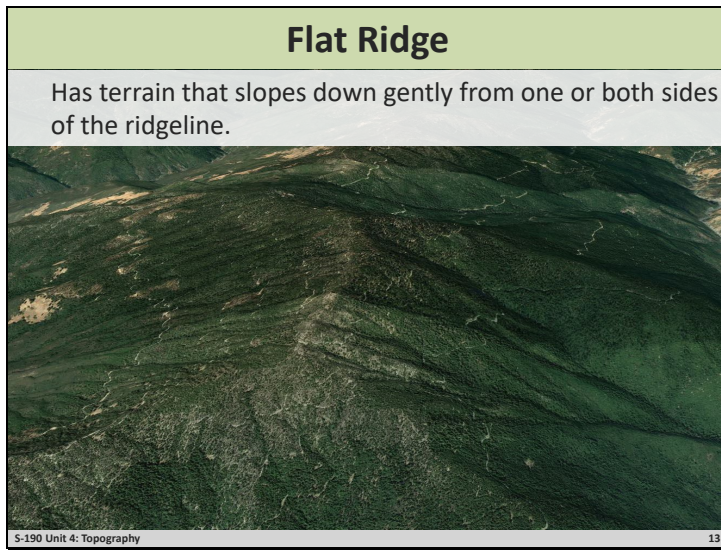


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Slide 13



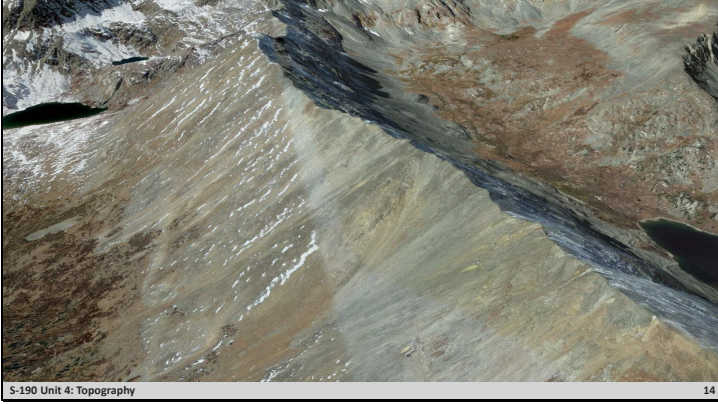
- Often make good places for fire containment because of easier travel along the ridge and moderate fire behavior.

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Knife Ridge

Has steep slopes that extend down both sides of the ridgeline.



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Ridge Influence on Fire Behavior

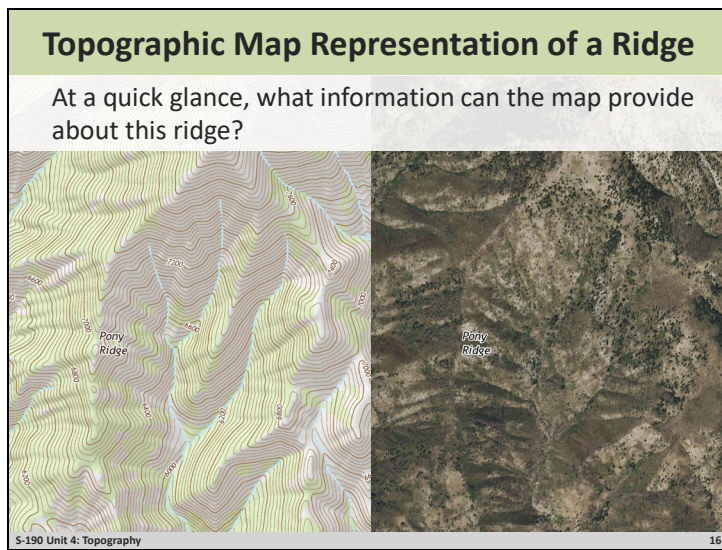
Ridges may offer a good place to assist in containing a fire.



- When fires reach a ridgeline, the rate of spread often slows as it encounters an opposing upslope airflow from the other side of the ridge.
- This effect can slow the fire spread and limit spotting concerns on the opposite slope.
- However, the effect of erratic winds caused by various winds converging at the ridgetop can change fire behavior. This is especially likely if the winds on one side of the ridge are stronger than the other.

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Question: At a quick glance, what information can the map provide about the ridge?

Answer: It is a named landmark feature (Pony Ridge), so it can be used as a point of reference.

Answer: It provides information on the shape and elevation of the area.

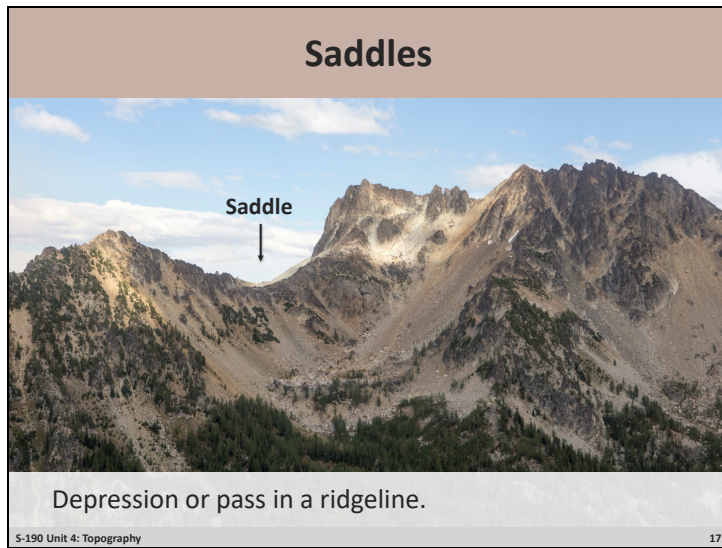
Answer: Colors provide information on the predominate vegetation cover; green shading indicates woodland.

Question: How would fire personnel benefit from obtaining information on the fuel availability?

Answer: Terrain indicates a baseline on the quantity of fuel available for combustion based on slope, aspect, and other terrain features.

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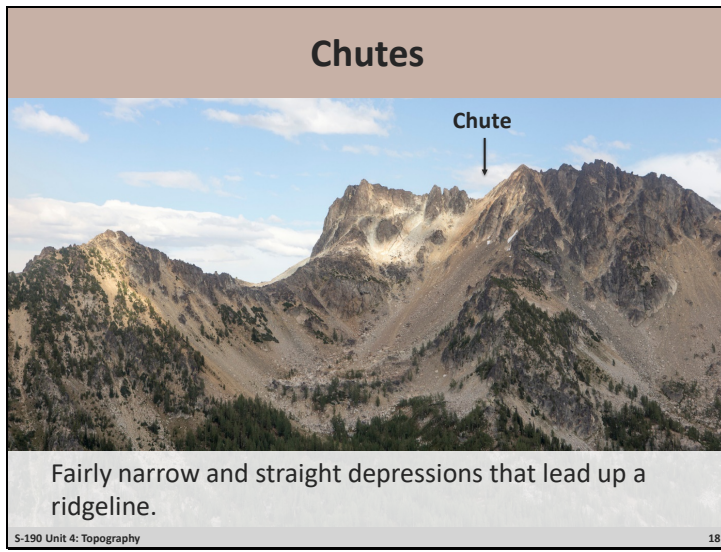
Slide 17



- Wind blowing through a chute or saddle can increase in speed as it passes through the constricted area and spreads out on the downwind side.
- The effect on fire behavior can lead to a change in direction and an accelerated rate of spread.
- This effect is similar to the chimney effect associated with box canyons.

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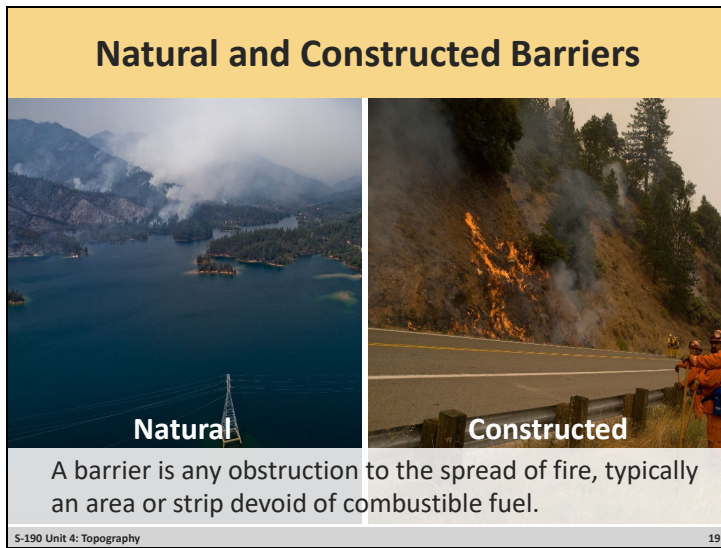
Slide 18



- Wind blowing through a chute or saddle can increase in speed as it passes through the constricted area and spreads out on the downwind side.
- The effect on fire behavior can lead to a change in direction and an accelerated rate of spread.
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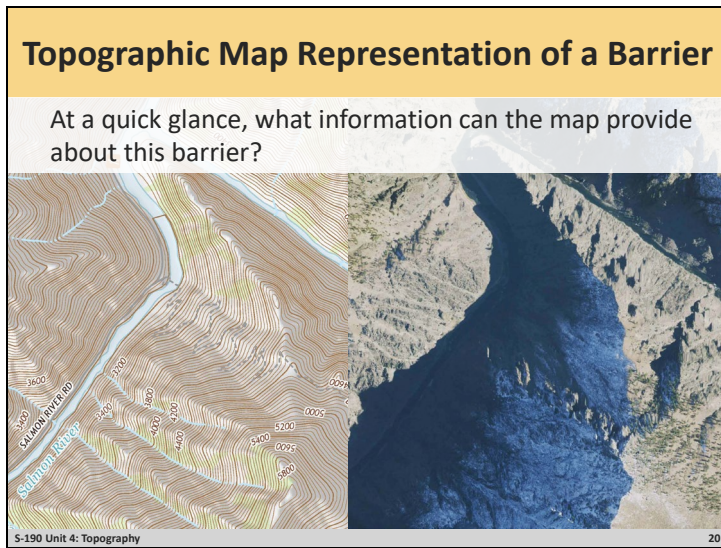
Slide 19



- Barriers to fire may include both natural or constructed types.
- Natural barriers include:
 - Rivers.
 - Lakes.
 - Rocks.
 - Rock slides.
- Constructed Barriers include:
 - Roads.
 - Highways.
 - Reservoirs.
- Most barriers are effective at limiting or slowing surface fire spread. Containment lines created by firefighters are classified a constructed barrier.

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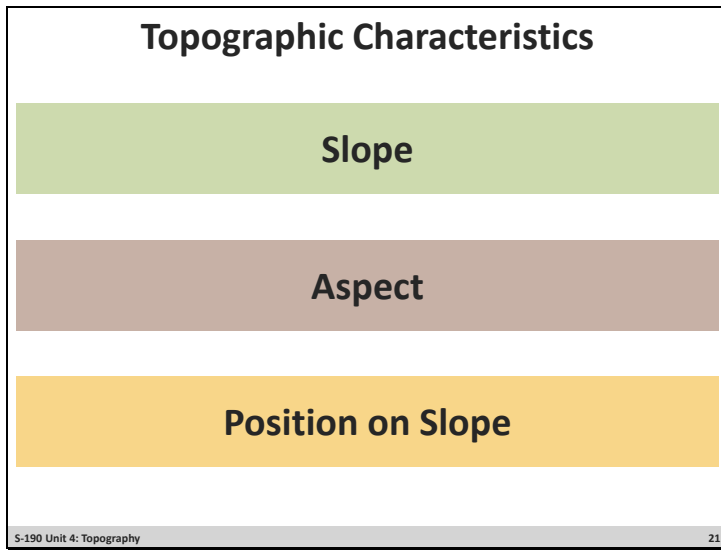
Question: At a quick glance, what information can the map provide about the barrier?

Answer: It is a named landmark feature (Salmon River), so it can be used as a point of reference.

Answer: It provides information on the shape and elevation of the area.

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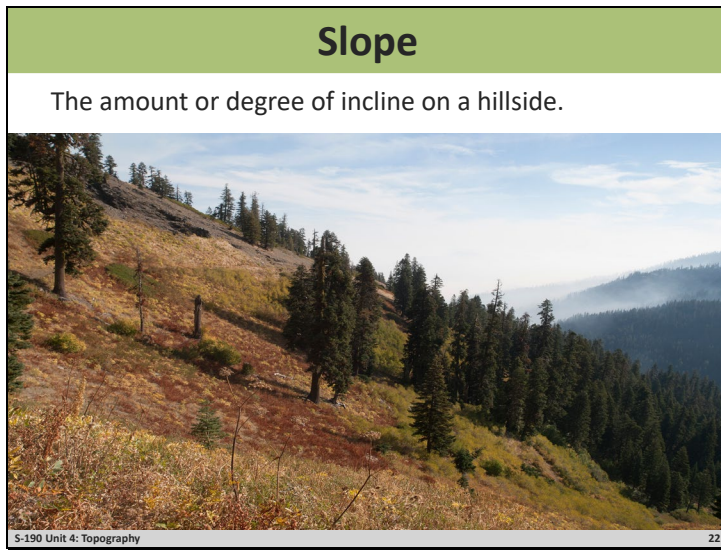
- Have direct influence on fuel temperature and moisture.
- The characteristics presented in this unit are:
- Slope.
- Aspect.
- Position on slope.

Note to Instructor

Each characteristic and example will be discussed individually on slides 21-26.

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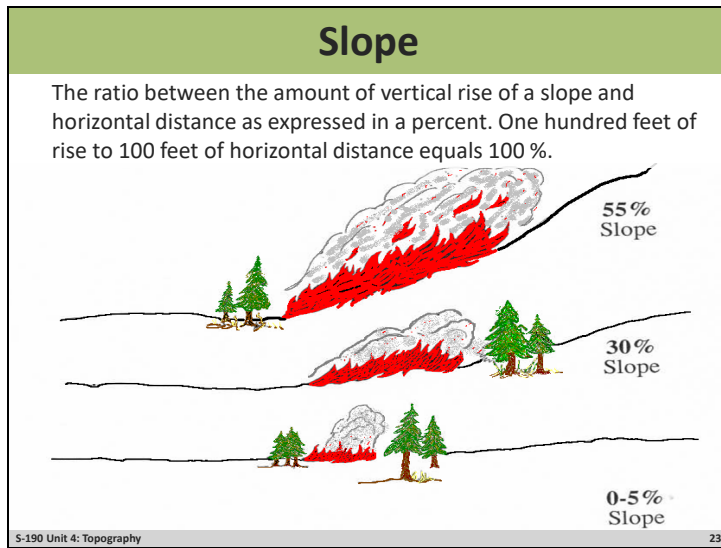
Slide 22



- The slope of a hill side is what is referred to when describing how steep it is.
- It can affect the amount of fuel available.

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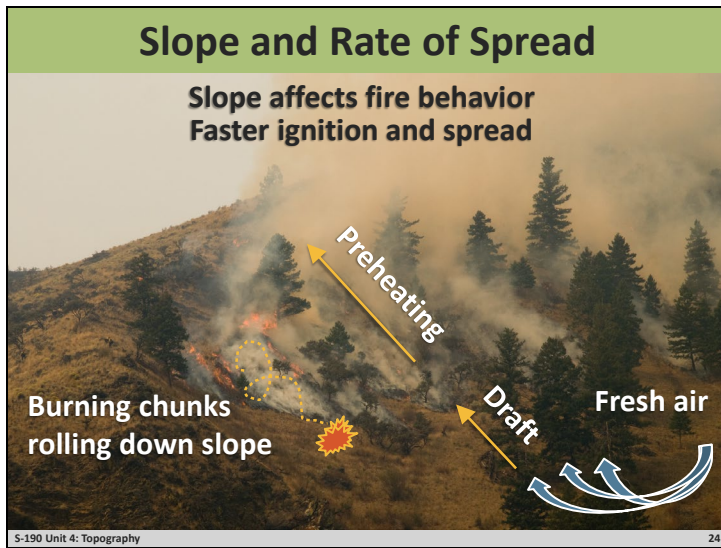
Slide 23



- For example, a highway sign in a mountainous area may say 6% grade ahead. This indicates that for every 100 feet you travel, you will gain, or lose 6 feet in elevation.
- A fire at the 0-5% slope range is primary influenced by wind and fuel arrangement. It typically develops and spreads at a slower rate.
- A fire at the 30% slope range has the potential to develop and spread uphill at a faster rate.

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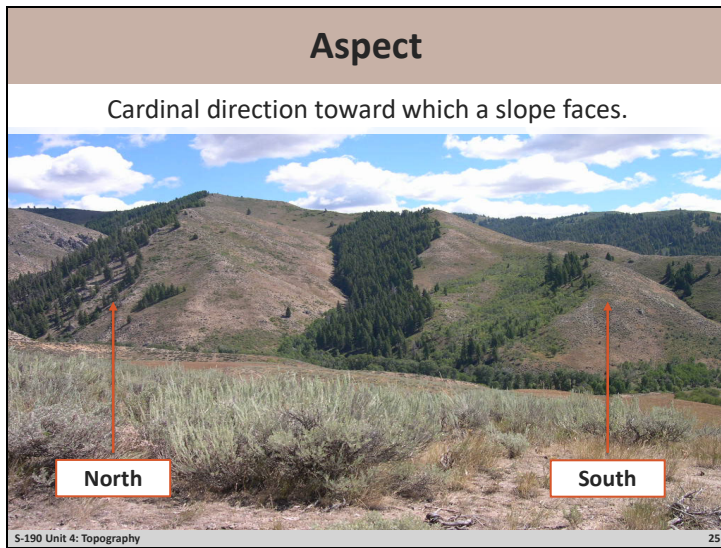


Rate of Spread – The relative activity of a fire in extending its horizontal dimensions. Usually it is expressed in chains or acres per hour for a specific period in the fire's history.

- The slide is a visual example of a fire developing in the 30% slope range and the slope's effect on rate of spread.
- Fires move at a faster rate of spread uphill than downhill; therefore, the steeper the slope, the faster the rate of spread.
- Convective and radiant heating are key factors in this rate of spread. The fuels above the fire are brought into closer proximity with the progressing fire, drying out, or preheating the fuels ahead of the approaching fire, making them more receptive to ignition, and increasing rate of spread.
- Another concern with steep slopes is the possibility of burning material rolling down the hill and igniting fuel below the main fire.
- Although fires typically burn slower down slope, a downslope wind can impact rate of spread and create what is referred to as a downhill run.
- Slope reversal can lead to dramatic changes in fire behavior. When a fire burning downslope reaches the bottom and begins burning uphill on the opposite aspect, fire behavior is likely to increase.

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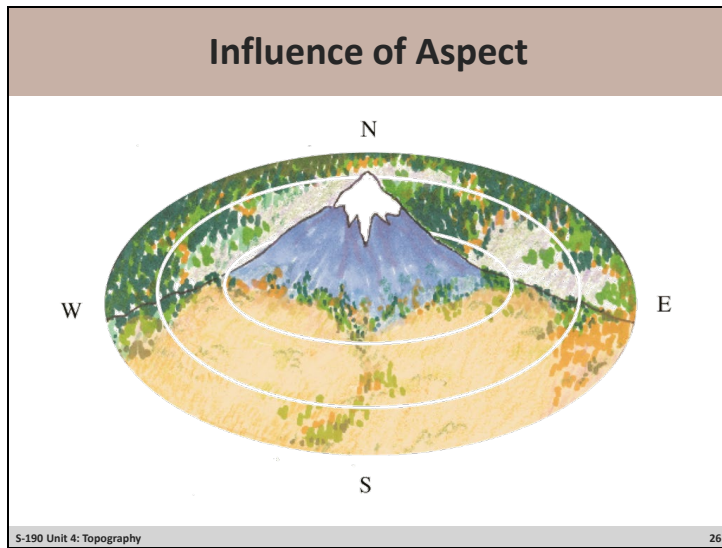
Slide 25



- The aspect of a slope determines the amount of heating it gets from the sun. Therefore, it influences the fuel on that slope.
- Aspect is described by using the cardinal direction (north, east, south, west) the slope is facing.
- Discuss the drastic difference in fuel on the different aspects shown in the image.

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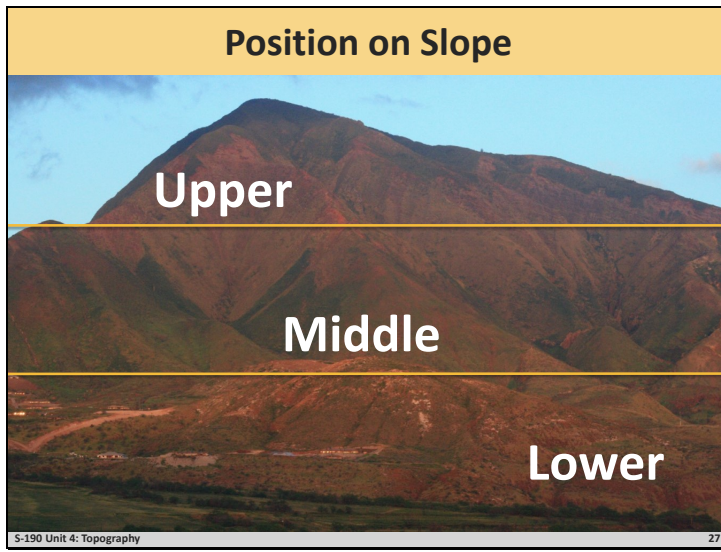
Slide 26



- South and southwest slopes are the most critical in terms of start and spread of wildland fires.
- South and southwest slopes are exposed to more sunlight and typically have:
 - Lighter and sparser fuels.
 - Higher temperatures.
 - Lower humidity.
 - Lower fuel moisture.
- North facing slopes have more shade which causes:
 - Heavier fuels.
 - Lower temperatures.
 - Higher humidity.
 - Higher fuel moistures.

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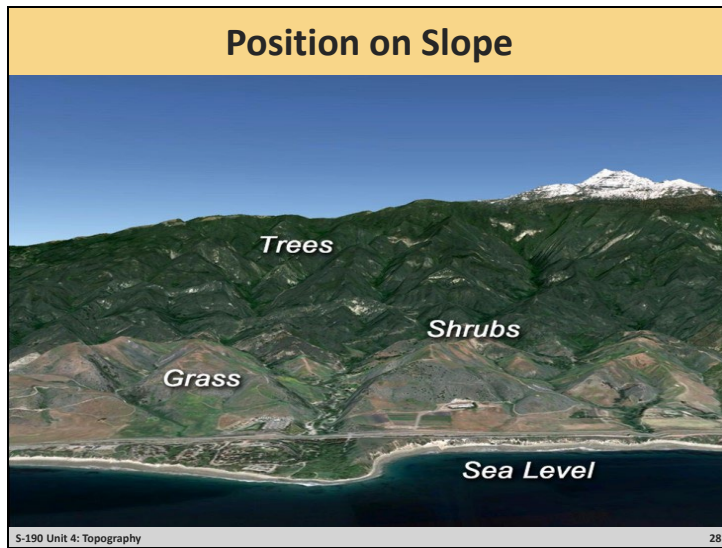
Slide 27



- Position on slope is a way to describe the relative location of something on the hillside.
- It is common to hear the terms lower, middle, and upper as a way to describe the location.

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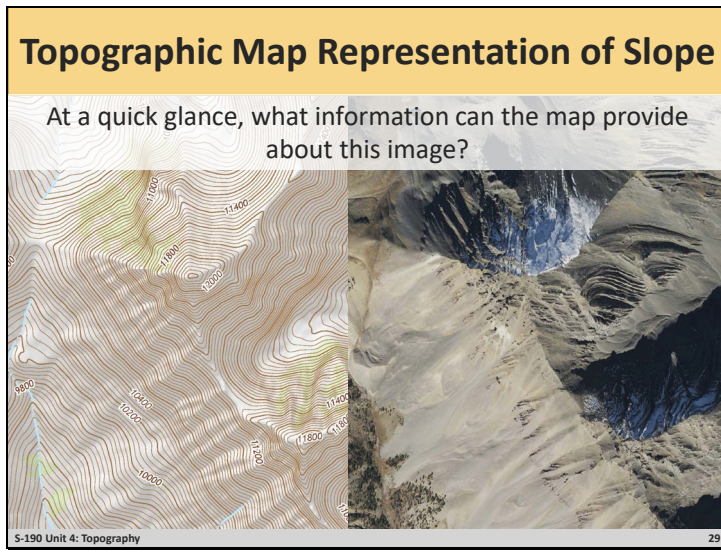
Slide 28



- Position on slope corresponds with elevation in determining type, conditions, and amount of fuel.
- Position on slope is directly related to:
 - Types of fuels.
 - Moisture levels.
 - Wind exposure.
 - Temperature.
- Fuels at a lower position on slope and at a lower elevation will dry out and be receptive to ignition and spread faster than fuels positioned higher on the slope.

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Question: At a quick glance, what information can the map provide about this image?

Answer: It provides information on the shape and elevation of the area.

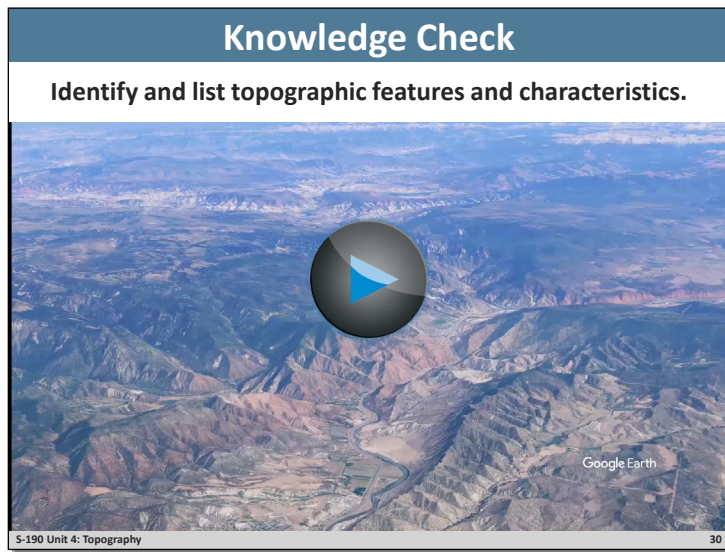
Question: How would fire personnel benefit from obtaining information on the fuel availability?

Answer: Terrain indicates a baseline on the quantity of fuel available for combustion based on slope, aspect, and other terrain features.

- ☐ Advise participants that the images provide an example of how slope is represented on a topographic map. On this map image, we can see that the highest point of elevation of this mountain is 12,000 feet. The contour lines provide an indication of how steep the slopes are on the different aspects of this mountain.
- ☐ Task participants with describing how fire personnel could benefit from obtaining the elevation, slope, and aspect of a particular area before arriving on scene.

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Video Exercise

- It is a representation of an area near Glenwood Springs, Colorado, known as Storm King Mountain. It was the location of the historic South Canyon Fire that occurred in July 1994.
- ☐ As students revisit the topographic representation from the beginning of this unit, task them with identifying, and writing down as many topographic features as possible.
- ☐ Play Video
 - Title** Topographic Features and Characteristics
 - Summary** Aerial topographic representation of the location of the 1994 South Canyon Fire on Storm King Mountain, near Glenwood Springs, CO.
 - Time** (03:20)
 - No Audio**

Post-Video Discussion

- ☐ Discuss the topographic features and characteristics identified, and describe how those features can affect wildland fire behavior.

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Objectives

Students will be able to:

- **Identify topographic features found in the wildland fire environment.**
- **Describe the basic characteristic of topography and how they can affect wildland fire behavior.**

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☐ Review unit objectives.