



## FI-110 Unit 4: Identifying the General Origin Area

### Unit Objectives:

- Understand the basic principles of fire behavior.
- Display a basic understanding of fire pattern indicators.
- Understand how to identify the signs of a general origin area in a wildland fire.

### Unit at a Glance:

Topics	Method	Duration
Basic Principles of Fire Behavior	Presentation	15 Minutes
Fire Pattern Indicators	Presentation	15 Minutes
How to Identify the Signs of a General Origin Area	Presentation/ Group Activity	10 Minutes
Identifying Signs of a General Origin Area, Examples (2)	Group Activity	10 Minutes
Knowledge Check/review	Group Activity	5 Minutes
<b>Total Unit Duration</b>		<b>55 Minutes</b>

### Materials:

- Computer, large monitor, or screen and projector.
- Notebook for participants.
- Ability to display images and video on large screen.
- White board or easel access for discussion or further explanations.

# Unit 4: Identifying the General Origin Area

## Slide 1



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## Slide 2

### Objectives

- Understand the basic principles of fire behavior.
- Display a basic understanding of fire pattern indicators.
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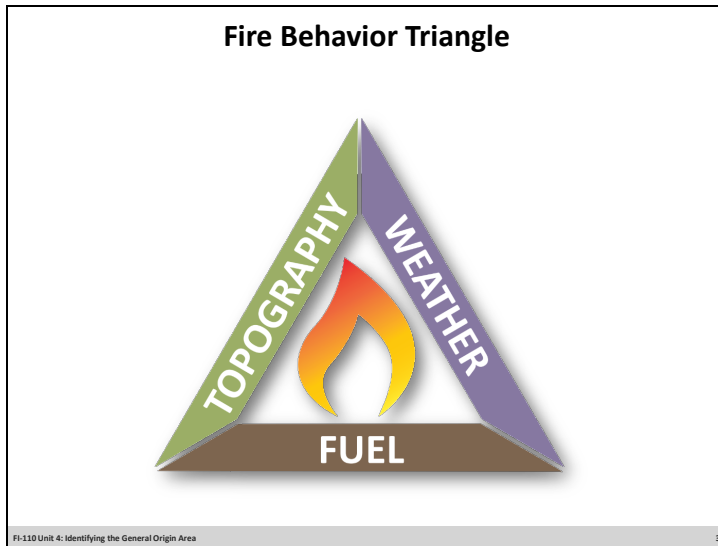


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- ☐ Review unit objectives.

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- Fuels, weather, and topography are the three factors that will cause the fire to form the advancing, backing, and lateral areas.

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#### Fire Behavior

- To identify the signs of a general origin area, apply basic fire behavior knowledge.
- Fire burning on flat ground, with similar fuels and calm winds will burn outwards in a circular shape.
- Shape of fire may be affected by changes in fuel, weather, or topography.
- These changes may affect the rate of spread.



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- Fire photos taken at one-minute intervals for the first 5 minutes on a fire in early April, Ontario, Canada.

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**Fuels**

Different fuel types, quantities, and moisture content will influence the intensity and rate of spread of a wildland fire.



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- Fuel factors that influence the intensity and rate of spread of a wildland fire:
  - Size: fine fuels, needles, grasses, coarse fuels, logs, stumps, trees, limbs.
  - Arrangement: ground fuels, surface fuels, ladder fuels, crown fuels.
  - Volume: amount of fuel available to burn.
  - Type: hardwood, softwood, mixed, wood, slash, grass.
  - Condition: dead, dying from insect and disease, wind events, ice damage.
  - Chemical content: resins.
  - Fuel moisture: amount of moisture within the fuels, the higher the moisture, the more difficult to ignite.
- If there were no moisture in the fuels, the fuel moisture would be 0%.
- Left photo: Grasslands, Guam: temp 87°F (31°C), RH 53%, winds 6mph (10km/hr).
- Right photo: Boreal, Northern Canada: temp 82°F (29°C), RH 37%, winds 7mph (12 km/hr).
- Historically, more firefighters have been killed fighting fires in light flashy fuels than any other type.

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#### Fire Spread Factors

The two major factors that influence fire spread are:

1. Weather (wind)
2. Topography (slope)

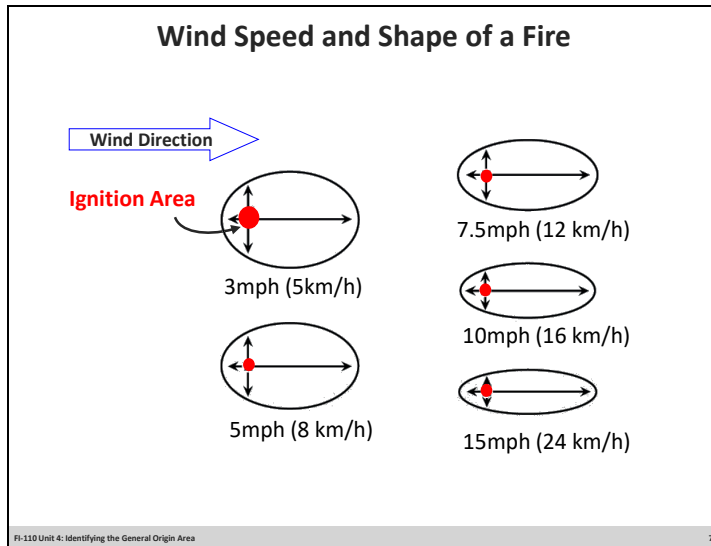


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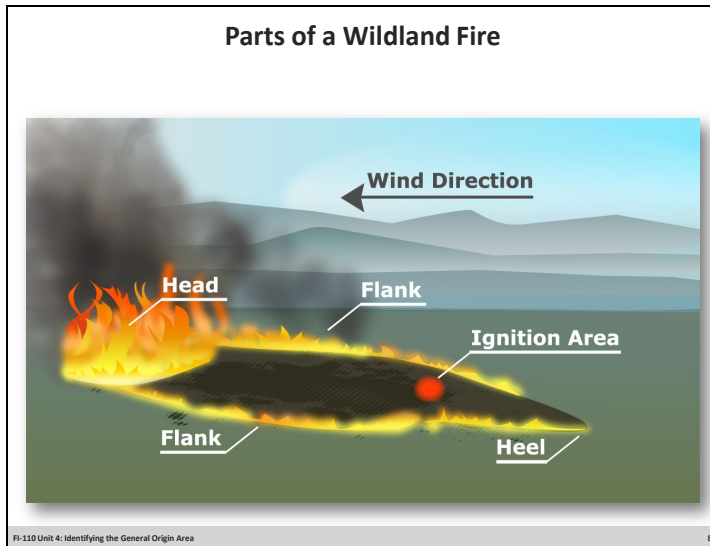


- Wind is the primary influence on fire spread.



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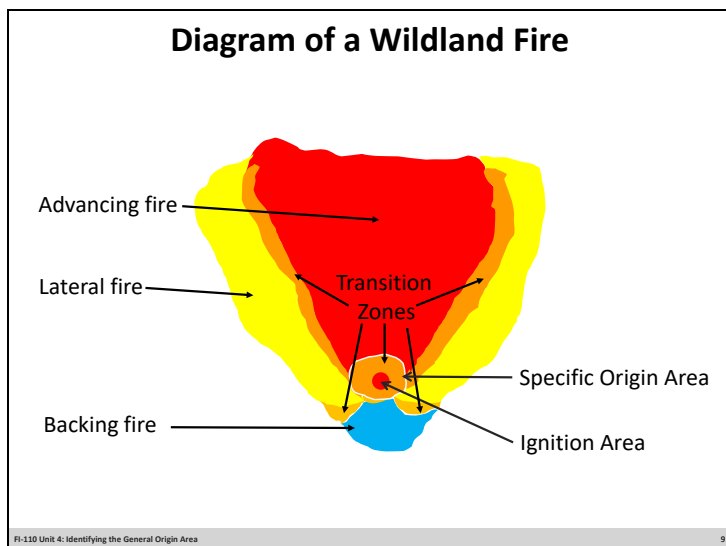
### Slide 8



- As a first responder, you may be more familiar with the terms head, flank, and heel to describe the parts of a fire. Investigators will use the terms advancing, lateral, and backing, respectively, to describe parts of the fire and its movement. These will be described in more detail later in the unit.

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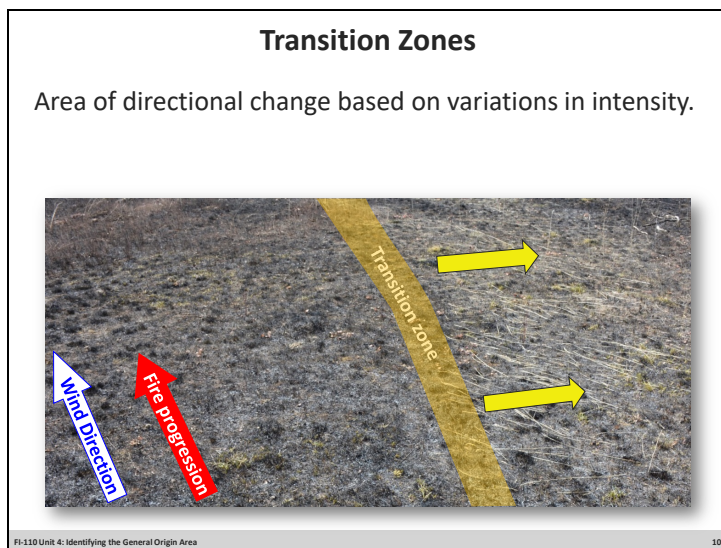
### Note to Instructor

This slide will display the transitions between the various parts of the diagram of a wildland fire. The instructor may advance the terms as required.

- Advancing fire
  - More damage
  - Cleaner burn
  - Rapid spread
  - Indicators in line with the direction of spread
- Lateral fire
  - Some residual fuels
  - Indicators at 45° to 90° angle
  - In line with advancing indicators if wind influenced
- Backing fire
  - More residual fuels
  - Indicators in line with the direction of spread
- Transition zones
  - See the following slide for further details.

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- Definition: Area of change between advancing, lateral, and backing vectors.

#### Note to Instructor

Point out the transition zone between the advancing and lateral fire.

- Advancing fire is moving bottom to top, lateral fire is moving left to right.
- Examples:
  - Advancing to lateral
  - Advancing to backing
  - Backing to lateral
- The yellow shaded line is the transition zone between advancing and lateral fire pattern indicators. Note the grass stems positioned at a 45° angle in the lateral area.

### Slide 11

#### 11 Fire Pattern Indicators

Can reveal the direction of fire progression at a precise location.

- |                   |                     |
|-------------------|---------------------|
| 1. Protection     | 7. Sooting          |
| 2. Grass stem     | 8. Staining         |
| 3. Foliage freeze | 9. Ash deposits     |
| 4. Angle of char  | 10. Cupping         |
| 5. Spalling       | 11. V or U patterns |
| 6. Curling*       |                     |

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- \*Curling will not be discussed during this course due to its limitations for a first responder.
- Fire pattern indicator: A physical object that displays changes (fire effects) from exposure to heat, flame, and combustion by-products that can reveal the direction of fire progression at a precise location with an accurate analysis. A fire pattern indicator is a single component of the overall fire pattern.
- There are 11 fire pattern indicators. With the correct use of these fire pattern indicators, a first responder will be able to identify and protect the general origin area.

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#### Protection – Advancing Fire

- The side of a physical object facing away from the oncoming fire is shielded from the full heat and/or byproducts of the fire.



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- Definition: A combustible or non-combustible object that displays differential damage or deposits on opposing sides due to the passage of the fire and indicates the direction of fire progression at that location.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.

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#### Protection – Advancing Fire



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- Compare and contrast damage on the left side of the tire versus on the right side.

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#### Grass Stems – Backing Fire

- Typical of a low-intensity backing fire.
- Majority of stems/heads will point in the direction the fire came from.



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- Definition: The un-consumed grass stems and heads of cured grass left lying on the ground after the passage of a fire that under certain circumstances point in the direction that the fire came from.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.

Definition Extension: Typically found in areas of low-intensity burning including but not limited to the backing and lateral areas of fire progression. These indicators are typically missing from areas of high-intensity burning where they are normally consumed.

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#### Foliage Freeze – Advancing Fire

- Foliage is frozen in the direction the wind blew when the fire passed.



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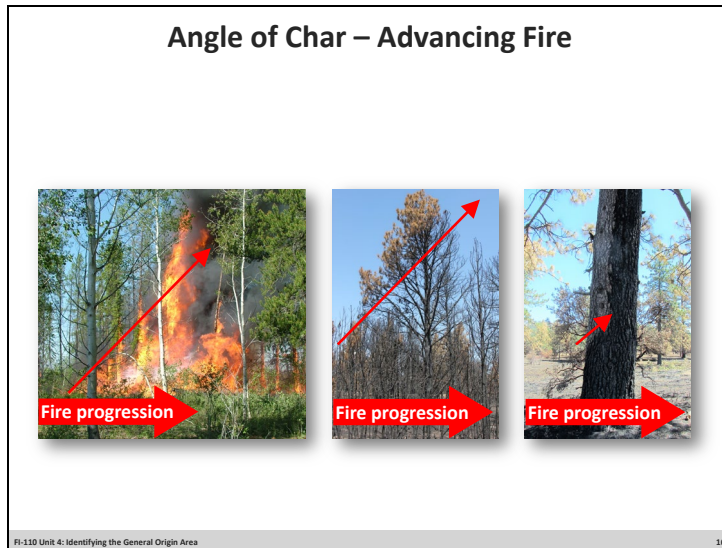
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- Definition: Small branches, needles, and leaves swept into a position by the wind and fixed by desiccation indicating the wind direction at the time of fire passage.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.
- Definition Extension: Desiccation is the act of drying or becoming dry.
- An indication of wind direction at the time of the fire.



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- Definition: Angled or horizontal char or scorch pattern created on standing fuels as fire burns up to, past, and beyond, indicating the direction of fire progression at that point.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.
- Fire enters low, exits high.

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#### Angle of Char – Advancing Fire on Sloped Terrain

- Angle of char on this tree trunk is steeper than the slope, indicating the fire advanced from left to right up the slope with the wind.
- Vertical char line on the right side of the tree trunk is due to wind vortex flame wrap.



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- The photo shows a second tree behind the first.
- Vertical char line on the right side of the tree trunk is due to wind vortex flame wrap, and while it is a reliable wind direction indicator (wind from left to right), it is not a part of the angle of char fire pattern indicator.
- The stronger the wind, the higher the flame wrap.

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#### Angle of Char – Backing Fire

- Fire backing into the wind, the overall char pattern is parallel to the ground.



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- Flame wrap extends up the downwind side of the tree trunk and should not be confused with the angle of char fire pattern indicator but is evidence of wind direction.

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#### Spalling – Advancing Fire

- On rocks in advancing fire area.
- Concentrated on the exposed side.
- Absent/less evident on the protected side.



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- Definition: Rock or boulders that display more chipping or pitting on the exposed surface than the protected surface due to the passage of the fire indicating the direction of fire progression at that location.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.
- Exposed side is the side facing the oncoming fire, not necessarily the direction of the ignition area.

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#### Sooting – Advancing Fire

- Soot deposits on the exposed surface of the object.



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- Definition: Objects displaying more soot deposits on the exposed surface of the object than on the protected surface of the object indicating the direction of fire progression at that location.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.

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#### Staining – Advancing Fire

- Vaporized volatile oils/resins from the flame and smoke column condensed onto cooler objects.
- Objects display more stain deposits on the exposed surface.



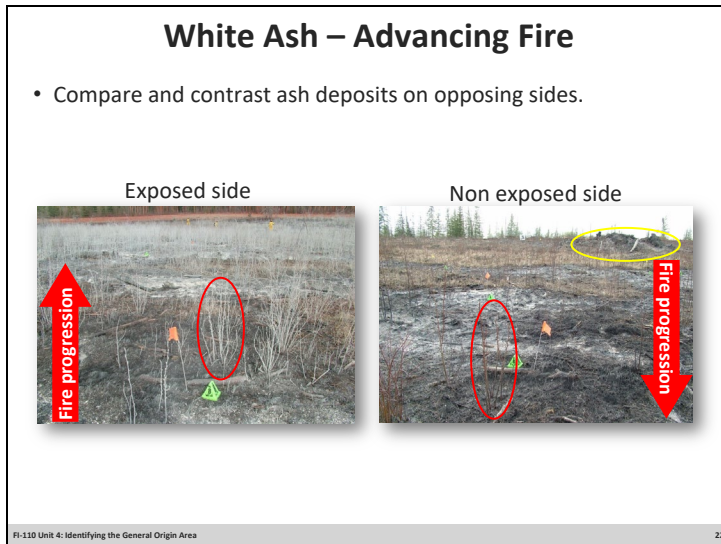
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- Definition: Objects displaying more stain deposits on the exposed surface of the object than on the protected surface of the object indicating the direction of fire progression at that location.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.

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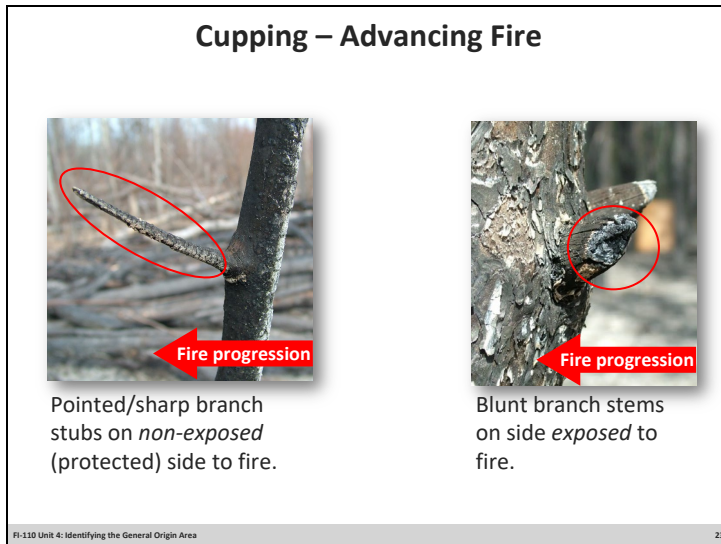
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- Photo is an example of white ash deposits dispersed downwind in fine particles. The exposed side is covered in deposited white ash. The non-exposed side is bare of white ash.
- Definition: There are two subsets of the white ash fire pattern indicator:
  1. Deposits: Objects displaying more white ash deposits on the exposed surface of the object as opposed to the protected surface of the object indicating the direction of fire progression at that location.
  2. Exposure: Objects displaying more attached white ash on the exposed surface of the object as opposed to the protected surface of the object indicating the direction of fire progression at that location.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.
- The white ash in the left photo can be seen on the standing brush stems. When looking back in the direction the fire came from the white ash is no longer visible as in the right photo.
- Area circled in yellow is the remains of a smoldering brush pile from where the fire originated.

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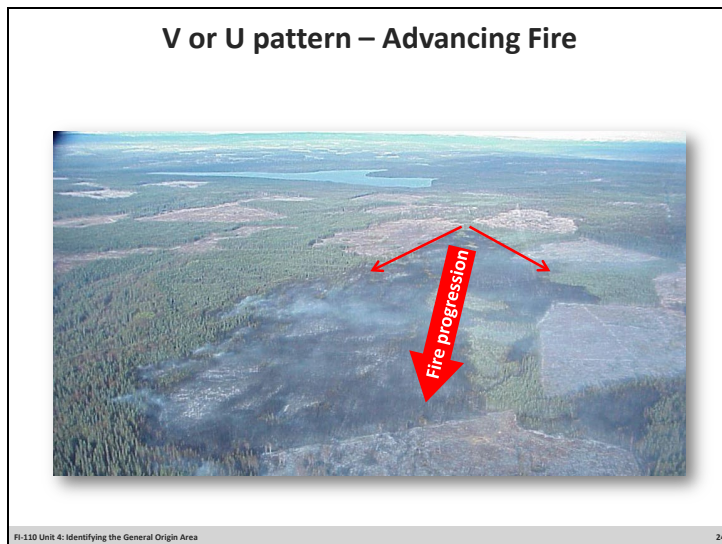


- Definition: A concave or cup-shaped char pattern found on the side of fuels exposed to the oncoming fire including:
  - Small stumps (generally 10 inches [25cm] diameter and less are more reliable).
  - Grass stem ends.
  - Terminal ends of brush and tree limbs (generally less than 1/2 inch diameter [1cm]), that indicate the direction of fire progression at that point.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.



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- Definition: Fire pattern resembles a V or U shape and indicates the direction of fire progression in that area.
- One of the 11 NWCG categories of fire pattern indicators. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.
  - V shapes are predominately influenced by higher winds and/or steeper slopes.
  - U shapes are predominately influenced by lower winds speed and/or gentler slopes.
  - Usually associated with larger objects or areas which are easily visible from a distance.
  - Usually found in areas of higher fire intensity.

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#### Identifying the General Origin Area

Correctly identifying and protecting the general origin area is critical to the investigation.



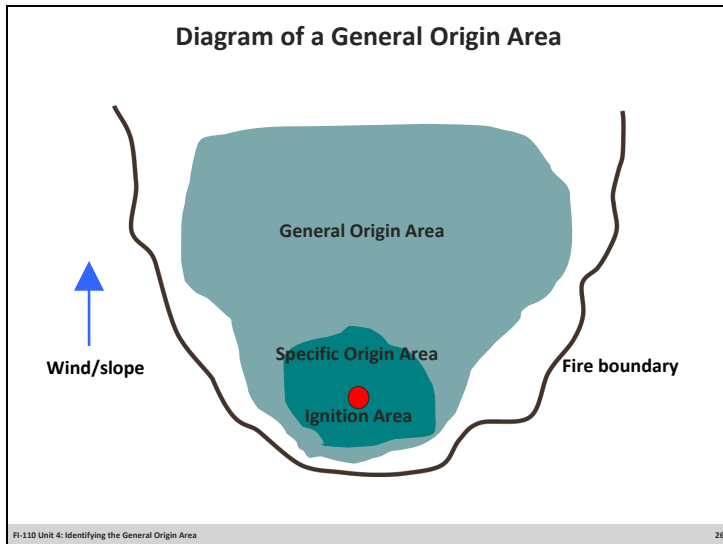
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- The general origin area is flagged off in this photo.

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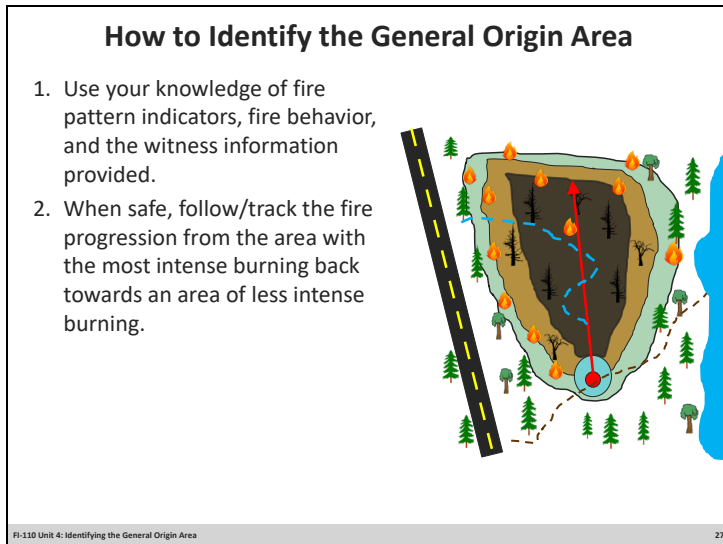
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- ❑ Explain the definition of these areas. However, the focus must remain on protecting the general origin area. Reference: *Guide to Wildland Fire Origin and Cause Determination*, PMS 412, <https://www.nwcg.gov/publications/412>.
- General Origin Area (GOA)
  - Definition: The larger area where the fire first established itself and is identified by an analysis of the fire behavior context, fire pattern indicators, and witness statements.
  - Definition Extension: The general origin area includes within its boundary the specific origin area and ignition area and is typically less than ½ acre (0.25 hectare) in size.
- Specific Origin Area (SOA)
  - Definition: The smaller area within the general origin area where the fire's direction of spread was first influenced by fuel, weather, and/or topography.
  - Definition Extension: The SOA will contain the Ignition Area. Generally, this area is characterized by subtle and microscale fire pattern indicators as a result of less intense burning associated with the initial stages of the fire.
- Ignition Area (IA)
  - Definition: The smallest area that a wildland fire investigator can define based on the physical evidence of the fire pattern indicators, within the specific origin area, in which a competent ignition source came into contact with the first fuel ignited and combustion was sustained.

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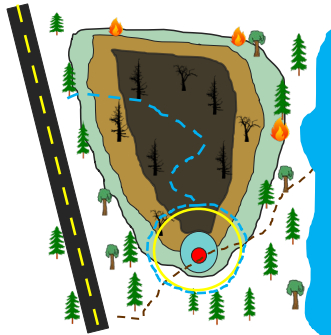
- In the example shown, these colors represent the following:
  - Dark brown: high-intensity burn.
  - Light brown: moderate intensity burn.
  - Light green: low-intensity burn.
  - Red circle: ignition area.
  - Turquoise: specific origin area.
  - Blue dashed line: the path the first responder walked looking for the general origin area.
  - Brown dashed line: a path to the lake.
  - Yellow line: area flagged off by first responders to protect the general origin area.
- The example shows a wildland fire parallel to a highway. A fire has occurred along the pathway to the lake. As a first responder, once the fire is safe, follow the fire's progression from an area with the most intense burning back towards an area of lesser intense burning, identify and protect the general origin area. If unsure, stay further back, or consult with a more experienced person on site.
- A V or U pattern may be observed as you get closer to the general origin area; however, each fire will have its own set of circumstances.
- It is important to know your role. Protect the general origin area.

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#### How to Identify the General Origin Area

3. This area is usually towards the heel of the fire and is often identified as the area discovered burning by the first person(s) on scene.
4. Place flagging to protect the general origin area.
5. Flag and protect any signs of evidence you identified.



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- The general origin area is typically less than  $\frac{1}{2}$  acre (0.25 hectare) in size. This is the area you want to protect.

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**General Origin Area**

- This is the area you need to protect.
- Typically less than ½ acre (0.25 hectare) in size.
- Includes within its boundary the specific origin area and ignition area.



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- Use the initial attack photo to assist you if needed. A larger area protected is better than a smaller area. Let the investigator determine if the area you protected can be reduced in size. You can always enlarge the protected area, but don't make it smaller.
- Example:
  - Photoset: Initial attack and investigator photo of a debris pile holdover fire.
  - Ignition area (red dot), specific origin area (orange), and general origin area (yellow), the area you want to protect.

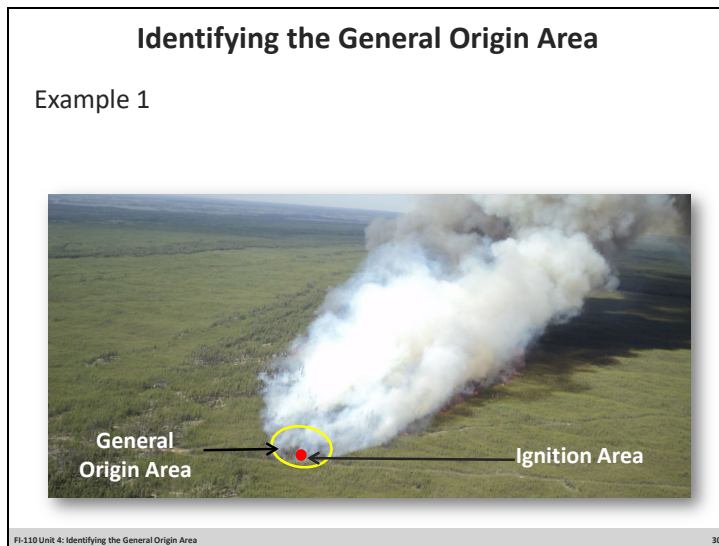
#### **Note to Instructor**

The general origin area was not flagged off and a dozer (top right) went across and near the ignition area, while a hose lay did come very close. What problems could arise to your scene from heavy equipment or personal? A reason to ensure it is flagged off and secured!

- In this example, there had been three separate debris piles. Two out of the three had been burnt several months before this wildland fire occurring. The middle pile smoldered and spread into the adjacent forest.

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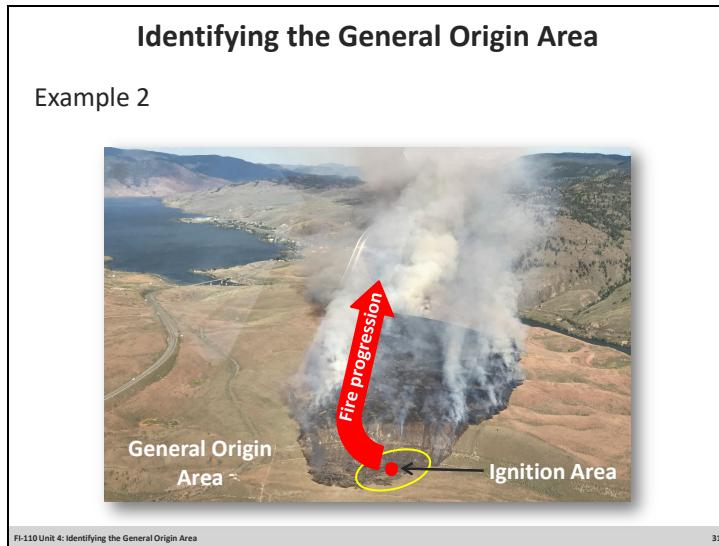
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- ☐ Ask the students to identify the general origin area.
- Work from the area of more intense burning to the area of less intense burning, following the fire's progression back towards the ignition area.
- Photo of a V pattern. (V or U pattern example to use with the students.)
- The fire in this photo resulted in burning over 1.7 million acres ( 700,000ha) and was human caused.

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- ☐ Ask the students to identify the general origin area.
- In this photo, a wind shift occurred as it moved up a hill and over a ridge.
- The general origin area is the area you as a first responder want to protect and keep secure. The cause of this fire was undetermined.




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#### Objectives

- Understand the basic principles of fire behavior.
- Display a basic understanding of fire pattern indicators.
- Understand how to identify the signs of a general origin area in a wildland fire.



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- ☐ Review unit objectives.
- By interpreting the fire pattern indicators, you should be able to correctly identify and protect the general origin area of most fires you encounter.
- The Pine Gulch Fire in Colorado. Photo by Eric Coulter, BLM.