



## FI-110 Unit 5: Fire Cause Categories

### Unit Objective:

- Introduce the basic causes of wildland fires.

### Unit at a Glance:

Topics	Method	Duration
General Cause	Presentation	45 Minutes
Scenarios (4)	Group Activity	10 Minutes
Knowledge Check/review	Group Activity	5 Minutes
<b>Total Unit Duration</b>		<b>1 Hour</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 5: Fire Cause Categories

## Slide 1



# Unit 5: Fire Cause Categories

## Slide 2

### Objective

- Introduce the basic causes of wildland fires.



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- ☐ Review unit objective.
- Your agency may identify these fire causes into separate categories.
- This course provides a framework to work from and recognizes the uniqueness of each agency.
- There may be occasions when a formal investigation may not be required, pending your agency.
- Photo above: The investigator in this fire is from Australia. Fire spread from a stolen vehicle and the fire burned into the surrounding vegetation causing significant damage to a local sawmill.

## Unit 5: Fire Cause Categories

### Slide 3

General Cause	
• Natural	• Railroad operations and maintenance
• Undetermined	• Recreation and ceremony
• Debris and open burning	• Smoking
• Equipment and vehicle use	• Misuse of fire by a minor
• Firearms and explosives	• Arson
• Fireworks	• Other causes
• Power generation/ transmission/distribution	

- The intent of the unit is to provide an introduction to the variety of fire causes and further educate those that may require an understanding of basic origin and cause determinations.
- For most first responders, their responsibilities may end after they have identified the general origin area boundary. This may vary between agencies.
- Reference: <https://www.nwcg.gov/data-standards/approved/wildfire-cause>.

### Slide 4

#### Natural: Lightning

Electrical discharge associated with thunderstorms can strike:

- Trees
- Snags
- Power poles
- Ground




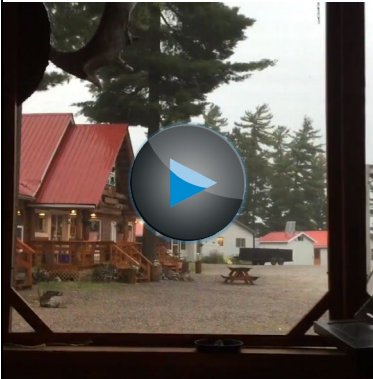
- ☐ Check your agency lightning detection monitoring system for recent activity in the fire area and understand the accuracy of these instruments.
- Consider seeking local witnesses for weather and lightning observations.
- Specific cause may include: lightning, volcano.

## Unit 5: Fire Cause Categories

### Slide 5

#### Natural: Lightning

- Strike marks on trees, other vegetation and objects
- Splintered wood fragments
- Needle shower



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#### ☐ Play Video

**Title** Video obtained from the internet. Credit: Olivier Dorion, Bryson Lake Lodge in Mansfield-et-Pontefract, Quebec, Canada.

**Summary** Video of tree being struck by lightning.

**Time** (0:30)


**Audio**

- Consider the possibility that frost cracks may cause a similar scar in colder climates.

## Unit 5: Fire Cause Categories

### Slide 6

**Fire Cause Undetermined**

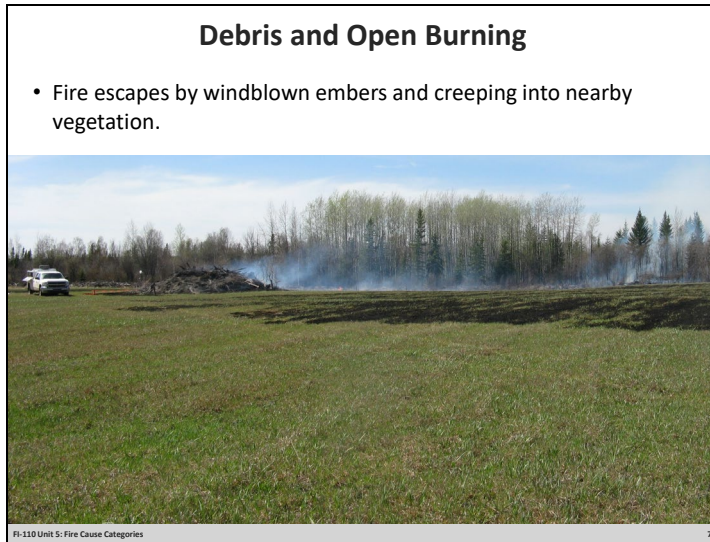


- Not all fires may have a determined cause.
- If unable to identify the cause of a wildland fire, it should be reported as undetermined.

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- Undetermined, has two cause classifications:
  1. Undetermined/undetermined: cause classification has not been determined.
  2. Human/undetermined: human cause classification determined; however, the general cause has not been determined.

### Slide 7





- A debris pile or burn barrel may be present at or near the ignition area.
- Photograph and document.
- Specific cause may include:
  - Branding
  - Burn barrel
  - Burning personal items
  - Distress/signal fire
  - Ditch/fence-line burning
  - Escaped prescribed burn
  - Field/agricultural burning
  - Hand pile slash
  - Machine pile slash
  - Open trash burning
  - Other land clearing
  - Pest control



### Slide 8

**Debris and Open Burning**

- Photograph and document barrels or piles.



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- Protect evidence by restricting access to the general origin area.
- ☐ Ask students what problems they see with this burn barrel or debris pile.
  - Pile located beside standing coniferous fuels, additional piles, and no fire breaks in place.

#### ☐ Play Video

**Title** Ground fire burning.

**Summary** Video of a ground fire burning in peat from the remains of a burning debris pile. When exposed to oxygen, burning particles ignite.

**Time** (0:13)



**Audio**

## Slide 9

**Fire Cause Categories**

**Equipment and vehicle use:**

- Passenger vehicle/motorized RV
- Chainsaws/brush-saw/weed trimmer
- Heavy equipment
- Other small engine equipment
- Welding
- All-terrain vehicles (ATVs)



FI-110 Unit 5: Fire Cause Categories

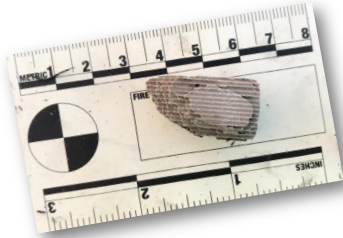
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- Specific cause may include:
  - Electric motor/power tools/battery
  - Trailer
  - Aircraft
  - Chainsaw/brush-saw/weed trimmer
  - Commercial transport vehicle
  - Heavy equipment and implements
  - OHV/ATV/motorcycle
  - Passenger vehicle/motorized RV
  - Tractors/mowers/brush hogs
  - UAS/model rockets and airplanes
  - Watercraft
  - Welder/grinder/cutting torch
  - Other small engine equipment

### Slide 10

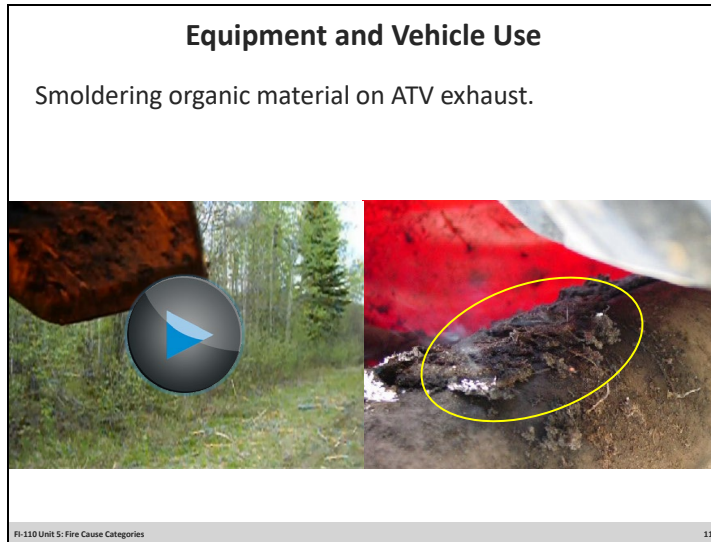
#### Equipment and Vehicle Use: Ignition Sources

- Catalytic convertor particles
- Exhaust system
- Overheating/radiant heat
- Friction
- Refueling operations
- Rock/hard surface strike
- Spark arrestor failure/missing
- Chain/dragging object



- Photo of a catalytic convertor particle, initially protected in the general origin area by first responders and later discovered and seized by investigators from an ignition area.

### Slide 11



- These organics were removed by the operator and combustion occurred.

#### ☐ Play Video

**Title** ATV exhaust system.

**Summary** Video of an ATV exhaust system with smoldering organics.

**Time** (1:03)

**No Audio**

### Slide 12

#### Equipment and Vehicle Use

Identify and protect areas where portable equipment was used.



- Photo of a portable generator from which a wildfire occurred.

### Slide 13

#### **Equipment and Vehicle Use: Cutting, Welding and Grinding**

- Fires may start from sparks or hot metal fragments.
- Welding slag and debris may be found near the ignition area.



Evidence of oxyacetylene cutting

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- If you find evidence, flag, and protect this location even if not in the ignition area.
- Keep suppression efforts away so not to destroy potential evidence as small particles may easily be lost or damaged.
- Ensure the investigator is aware of your findings.

### Slide 14

#### Equipment and Vehicle Use

Identify and protect tire or track impressions.



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- The reason to document this is to show there was equipment in or near the general origin area that may have caused the fire.
- Equipment shown is a hydro-axe.

### Slide 15

#### Equipment and Vehicle Use

Identify and protect strikes on rocks.



- Mechanical or other strikes against a rock may cause sparks which could result in a fire.



### Slide 16

#### Equipment and Vehicle Use

There may be evidence of equipment operation at or near the ignition area.



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- These fires may originate near the location where equipment was being operated.
- Equipment in this photo is a processor and used for delimbing trees at a logging site.

### Slide 17

#### Equipment and Vehicle Use

Identify and protect scrape marks on pavement.



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- The fire(s) may have started from a dragging metallic object and causing sparks, e.g., grader blade, chains, etc.

### Slide 18

**Firearms and Explosives Use:  
Ammunition**

Identify and protect any evidence of firearms use near the general origin area.



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- Specific cause may include:
  - Black powder/muzzle loading
  - Blasting
  - Exploding target shooting
  - Flares/fusees
  - Inert target shooting
  - Military ordnance
  - Non-military tracer
  - Other explosives
- Spent casings (shells) of different calibers may be found in or near the general origin area but could also be found well outside that area.
- Right photo is a marine flare pistol. Commonly found used when lighting flare stacks in the oil and gas industry. Spent casings may be found in close proximity of the flare stack.

### Slide 19

**Firearms and Explosives Use:  
Exploding Target Shooting**

- Ignitions may be near the detonation point.
- Commercially manufactured or homemade.
- Classified as an explosive.
- Explode upon impact of projectile sending out hot particles.



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#### ❏ Play Video

**Title #1** Impact reactive targets.

**Summary** Video of impact reactive targets.

**Time** (0:05)

**Audio**

#### ❏ Play Video

**Title #2** Binary exploding targets.

**Summary** Video of binary exploding targets.

**Time** (0:11)

**Audio**

- Two types of exploding targets.
  - Impact reactive targets.
  - Binary exploding targets.
- Weather conditions at time of tests: Temperature 76°F (24.6°C), relative humidity 26.3%, winds 3 mph (4.5km/hr).
- As a first responder, what might you look for to protect?
- The burning material is native grass collected from the area in which tests conducted.

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- Most ignitions will occur near the detonation point depending on the size of the exploding target. Look for and protect the following:
  - Exploding targets at the ignition area.
  - Shredded plastic from a container.
  - Debris (size may vary depending on if the material was completely consumed).
  - Homemade targets (may include signs of duct tape, soda bottles, plastic baggies, or other container types).
  - Ammonium nitrate prills (white pellets the size of a pin head).

### Slide 20

#### Fireworks

- Evidence may be found near the ignition area.
- Protect these items until the investigator arrives.



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- Specific cause may include aerial and ground fireworks, etc.

### Slide 21

#### **Power Generation/Transmission/Distribution: Power Lines**

- Fires may originate in close proximity to the power lines or poles.
- Photograph from a safe distance prior to the arrival of utility repair crews.

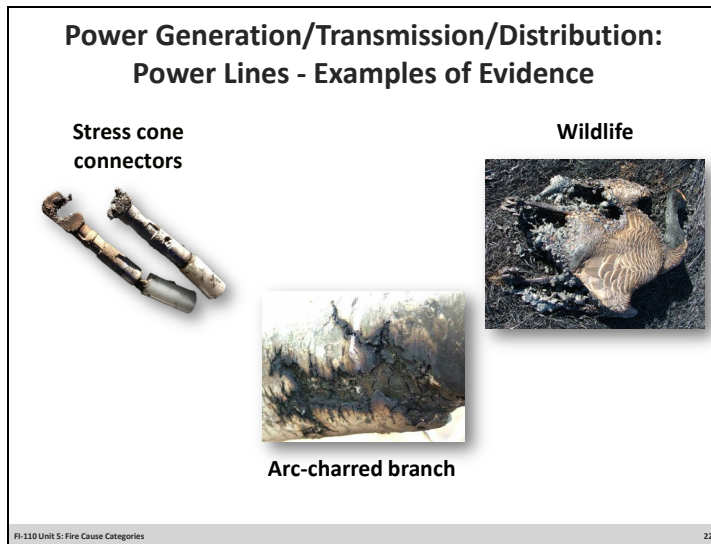


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- Specific cause may include:
  - Electrical transmission/distribution systems
  - Oil/gas production/transportation
  - Solar utility system
  - Wind turbine/windmills utility systems

### Slide 22



- Photo left: connector between stress cones failed, causing sparks to fall to ground.
- Photo center: electrical current burn scars remain on a tree that had fallen over multiple power lines.
- Photo right: remains of a goose with electrical charring.



### Slide 23

#### Power Generation/Transmission/Distribution: Power Lines

- Photograph the condition of the power lines or any other relevant evidence.
- Document and report the removal of equipment or evidence by utility repair crews.



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#### **Safety around power lines is paramount!**

- Don't go near a damaged power line until the utility repair crew has cleared the area safe to work.
- Photograph and document prior to the utility repair crew's arrival from a safe distance.
- Photograph and document power pole identification numbers if available to aid in location clarity.

### Slide 24

#### **Power Generation/Transmission/Distribution: Wind Turbine Failures**

- Gear boxes
- Brakes
- Bearings
- Blades
- Generators
- Lightning strikes



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- Photo obtained from the internet. Credit: Austin Prickett, March 28, 2018.
- A wind turbine in Oklahoma caught fire and the subsequent sparks caused a 5 acre (2 ha) grass fire.

### Slide 25

#### Railroad Operations and Maintenance: Ignition Sources

- Exhaust carbon
- Brake failure
- Track maintenance
- Flares
- Warming fires
- Debris burning
- Other mechanical malfunctions





- Specific cause may include:
  - Brakes
  - Derailment
  - Dynamic grid failure
  - Exhaust particles
  - Rail grinding
  - Right-of-way vegetation maintenance
  - Track replacement
  - Hot work: welder/grinder/torch/cutter and other mechanical failure

## Unit 5: Fire Cause Categories

### Slide 26

#### Railroad Operations and Maintenance

- Carbon material from exhaust systems



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#### ☐ Play Video

**Title** Locomotive Infrared

**Summary** Video is of a locomotive observed in Alberta, Canada in 2001 using an infrared camera.

**Time** (0:54)

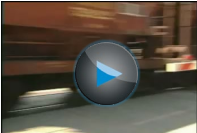


**No Audio**

## Unit 5: Fire Cause Categories

### Slide 27

**Railroad Operations and Maintenance**

- Multiple fire origins may result when brakes or exhaust systems fail.



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- Some fire origins related to exhaust carbon may occur at greater distances.

#### ☐ Play Video

##### **Title** Locomotive Fire

**Summary** The first video shows the engine with the exhaust column bending and a small wildfire starting. This fire occurred on 5/3/2005 in NE Minnesota. The videos were made by a TV news station out of Duluth that was doing a story to cover the last train shipment of iron ore from a mine being closed in the area.

**Time** (0:18)

**No Audio**

The significance of this video is that the fire starts immediately adjacent to the engine as it passes and not after passage of the train. It also shows the windblown exhaust column to give an idea of where the embers could land.

#### ☐ Play Video

##### **Title** Locomotive Fire.

**Summary** The second video is of the same train and shows several larger fires immediately after passage.

**Time** (0:22)

**Audio**

Significance of this is to not assume that only one ember was successful and that multiple starts may quickly burn together, making the ignition area more challenging to find. The wind generated by a train as it passes may have an effect on fire spread. The fuels were dry cured grass and brush.

### Slide 28

#### Railroad Operations and Maintenance: Track Grinding

- May be found on mainlines, not common on short lines.



- Left photo: Worn rail that may be a good candidate for track grinding.
- Right photo of a grinding unit obtained from the internet. Credit: TrainBoard.com; Milne.

#### ☐ Play Video

##### **Title** Rail

**Summary** Rail grinding operation that took place on April 8, 2004 in Maine USA. This grinding unit is approximately 500 feet (150m) in length. The train carries approximately 30,000 gallons (115,000L) of water.

**Time** (2:26)

**Audio**

### Slide 29

#### Recreation and Ceremony: Campfires

- Unattended
- Improperly extinguished
- Abandoned



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- Protect the area around campfire ring and any other associated physical evidence.
  - Photo obtained from the internet. Credit: Shutterstock.
- Specific cause may include:
  - BBQ
  - Bonfire
  - Campfire
  - Ceremonial fire
  - Gas cooking stove
  - Luminary and outdoor oven

### Slide 30

#### Smoking

- Discarded cigarettes are often erroneously blamed for wildland fires.
- Air temperatures need to be high and relative humidity low.



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- Observe and protect possible evidence.
- Not all roadside fires are caused by discarded cigarettes. Environmental conditions must be right for a cigarette to ignite the fine fuels along the highway right-of-way.

#### ☐ Play Video

**Title** Ignition of broadleaf grass

**Summary** Ignition of broadleaf grass (bluegrass) during research trials.

**Time** (0:06)

**No Audio**



### Slide 31

#### Misuse of fire by a Minor: Examples

- Many children experiment with fire.
- Often these fires are located near residences and areas of play.
- Children may try to suppress the fire themselves.
- Burned objects, fireworks, or matches may be present.



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- Attempt to identify or describe any children near the scene.
- Specific cause may include:
  - Lighter/matches
  - Glass refraction/magnifying glass and flint/friction
- Age category may vary by jurisdiction.

### Slide 32

**Misuse of fire by a Minor: Motivation**

- Curiosity
- More serious cry for help



The image shows a young boy with brown hair, wearing a yellow and white striped t-shirt and dark shorts, sitting on the floor. He is looking down at a small box of matches in his hands, appearing to be playing with them. The background is plain white.

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- A cry for help may have been caused by other more serious issues e.g., physical abuse.
- It is important to identify the responsible child and have them referred to appropriate authorities for counseling.

### Slide 33

#### Arson: Examples of Ignition

- Hot set
- Time-delay device
- Multiple fires
- Origins near roadsides or trails

Protect tire and footwear impressions and any other evidence.





- An example of a hot set is an arsonist that used a lighter (butane type) to ignite grass alongside a roadway.
- Law enforcement involvement and cooperation is required.
- Definition: At common law, the malicious, and willful burning of another's dwelling, outhouse, or parcel; by most modern statutes, the intentional and wrongful burning of someone else's, or one's own, property. Frequently requires proof of malicious or wrongful intent.
- Check with your local law enforcement agency/legal council for the most applicable definition used in your area.
- Specific cause may include a device, hot set, or other.

### Slide 34

**Arson**

- Fire agencies throughout the world have encountered issues with firefighter arson.
- An unfortunate reality.




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- May not be a regular occurrence, but it does happen, and we need to be aware of it, such as John L. Orr.
- Fire in this slide was a result of a firefighter in Alberta, Canada, who lit 18 wildland fires and subsequently was charged and convicted of arson.
- If you become aware of firefighter arson, you may be faced with reporting it to your supervisor.

### Slide 35

**Other Causes**

- Spontaneous combustion
- Electric fences
- Glass refraction
- Illegal substance manufacture\*
- Structure\*



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- Photo of a structure fire that spread into the surrounding grass.
- \*No individual slides on the following provided, but may be discussed:
  - Illegal substance manufacture
  - Structural caused wildfires

#### **Note to Instructor**

Each agency may have various cause classifications and general cause categories. Those discussed in this unit, are examples used by one agency.

### Slide 36

#### Other Causes: Spontaneous Combustion

- Green chip/slash piles
- Hay bales
- Saw dust



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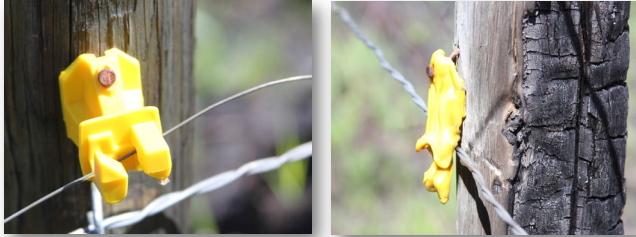
36

- Identify and protect the general origin area. Do not suppress the ignition area.

### Slide 37

#### Other Causes: Electric Fences

- Fires may originate adjacent to or along the fence line.
- Failure of equipment.
- Rodents may chew through battery lines connecting to the fence.
- Vegetation may contact the wire directly.



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- Images taken to compare burnt vs. unburnt on the electric fence.
- Melting was due to fire passage. However, can be valuable to photograph prior to landowner replacing which may occur before an investigator arrives.
- It is not all about what started the fire, but also determining what did not start the fire.

### Slide 38

#### Other Causes: Glass Refraction/Magnification

- Clear glass or plastic bottles with liquid can act as lenses.
- Hot, sunny, windy days are when this is most likely.
- Grooved and damaged bottles may reduce spot intensity.



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- Some tests have shown that a wind speed of 15mph (20km/h) is required to obtain ignition.
- Information obtained from a study done by Colin Ho (University of Newcastle, Australia). “*Can Water Bottles, Acting as a Focussing Lens for Sunlight, Ignite Tinder & Start a Forest Fire?*”, 2014.



### Slide 39

#### First Responder: Examples

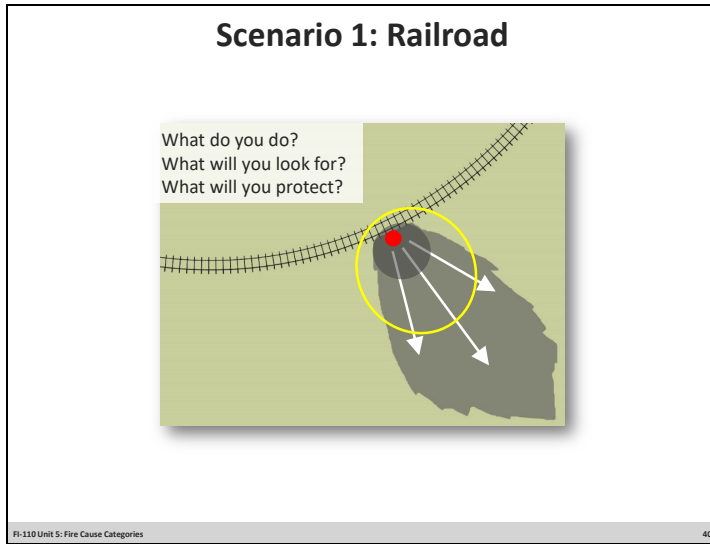
The following examples are for discussion purposes. You are the first responder.

1. What will you do to support the investigation?
2. What items of interest will you be looking for?
3. What will you identify and protect as the general origin area?



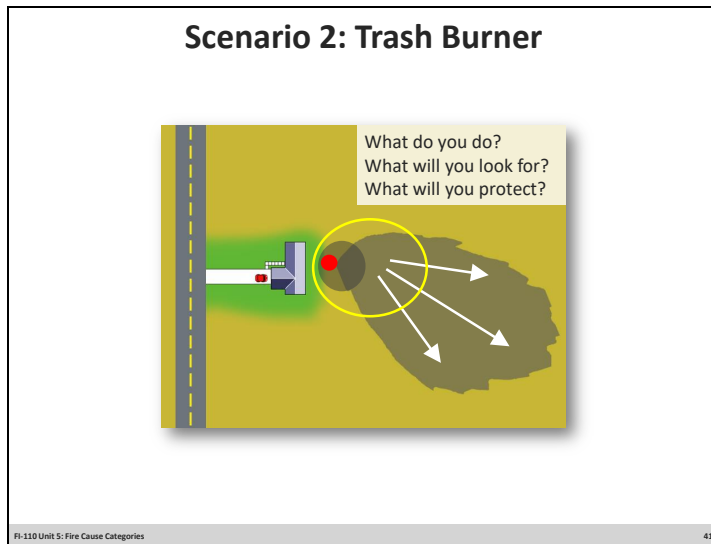
- ☐ Instructors must know their specific state/provincial laws and agency policies for the scenarios presented in slides 40-43.
- ☐ Explain when or how a wildland fire investigator is to be requested.
- Photo above from the Netherlands. First responders suppress a suspected arson fire.

### Slide 40



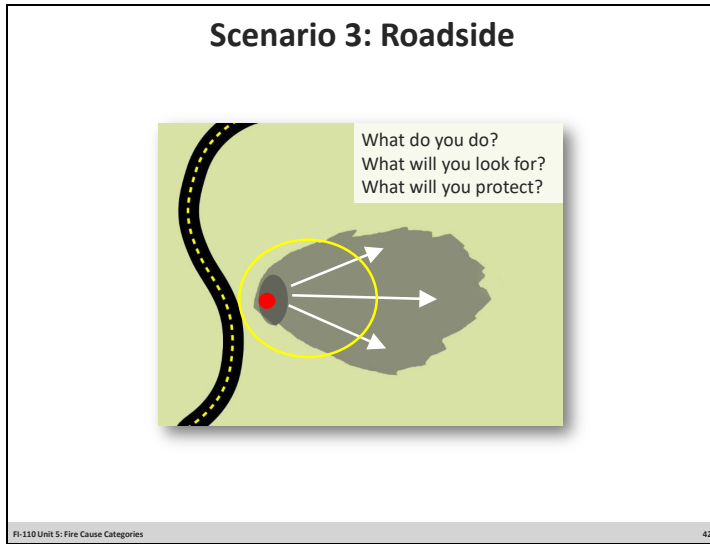
- ☐ Pose the following questions to students:
- What will you as a first responder do?
  - What items of interest will you be looking for?
  - What will you identify and protect as the general origin area?

### Slide 41



- ☐ Pose the following questions to students:
- What will you as a first responder do?
  - What items of interest will you be looking for?
  - What will you identify and protect as the general origin area?

### Slide 42



- ☐ Pose the following questions to students:
- What will you as a first responder do?
  - What items of interest will you be looking for?
  - What will you identify and protect as the general origin area?

### Slide 43

**Scenario 4: Hiking Trail**

The diagram shows a green landscape with a brown winding line representing a hiking trail. A yellow circle highlights a specific area on the trail where a fire incident has occurred, marked by a red dot. Three white arrows point from the red dot towards the surrounding green area, indicating the spread of the fire. A text box in the upper right corner of the diagram contains the following questions:

- What do you do?
- What will you look for?
- What will you protect?

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- ☐ Pose the following questions to students:
- What will you as a first responder do?
  - What items of interest will you be looking for?
  - What will you identify and protect as the general origin area?

## Unit 5: Fire Cause Categories

### Slide 44

**Objective**

- Introduce the basic causes of wildland fires.



FI-110 Unit 5: Fire Cause Categories 44

- ☐ Review unit objective.
- Photo of Type 3 (light) helicopter. Hot exhaust ignited grass and subsequently the aircraft.