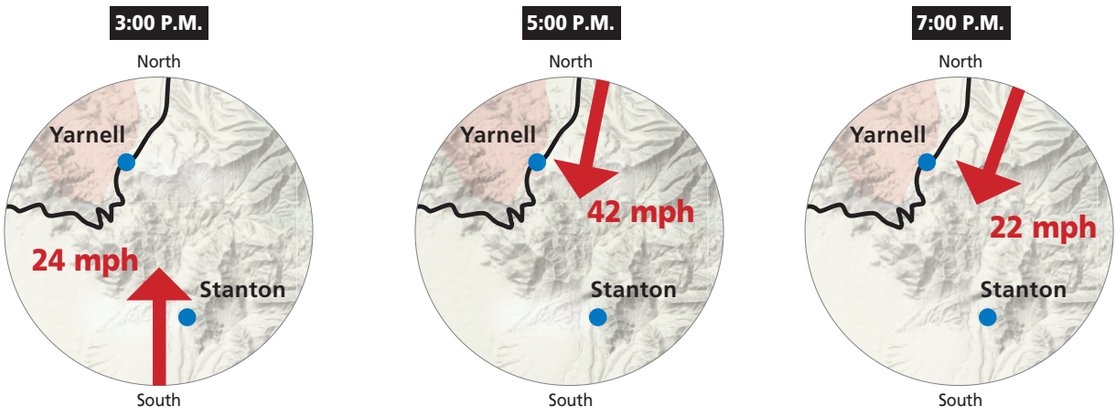
## SUNDAY'S SHIFTING WINDS

Data from a weather station in Stanton, near Yarnell, shows how the peak wind gusts on the day of the disaster changed speed and direction dramatically during the afternoon.




THE REPUBLIC

# More than 1 factor spawned tragedy, wildfire experts say

## Fuels, thunderstorm likely contributed to deadly fire condition

**By Shaun McKinnon**
The Republic | azcentral.com

The Granite Mountain Hotshots were fighting the Yarnell Hill Fire on Sunday in scrubby chaparral, terrain that has a record of killing firefighters. When the weather changed, it turned a bad situation deadly.

The combination of fast-burning fuels and a wind-blown thunderstorm likely contributed to conditions that took the lives of 19 Prescott-based firefighters, experts said Monday. The same set of circumstances has led to tragedy before, but the experts say no two fires are alike.

"There's not just one factor that leads to a tragedy like this," said Dick Mangan, a former wildfire program manager for the U.S. Forest Service and owner of Blackbull Wildfire Services, a Montana-based consulting firm. "Everything kind of comes together and you get a perfect storm of things that can go wrong."

Authorities refused to speculate Monday about what led to the deaths of the 19 firefighters in the Yarnell Hill Fire. The experts said it is possible the crew was caught in a "burnover," trapped by flames that abruptly changed direction and engulfed the firefighters.

Burnovers were implicated in almost all of the deadliest wildfires over the past 100 years, according to records from the National Interagency Fire Center.

The components for such a disaster were present Sunday on the edges of the Yarnell Hill Fire, which was burning through hilly chaparral, a landscape of low-lying brush and trees that can flare up easily when heated by an approaching fire.

Late in the afternoon, storm cells began to develop and weather observations near Yarnell showed a significant shift in wind direction and speed. Gusts topped 40 miles per hour as a thunderstorm moved across the area. Such storms, however short or fast-moving, can produce erratic, localized winds that can fan flames and help spread a fire rapidly.

"When a thunderstorm comes in, the wind kicks around in a way you can never tell where it's coming from," Mangan said. "And with those flashy fuels, it's easier to get trapped."

Hotshot crews are deployed in already dangerous locations in a wildfire, often the hottest parts of a fire, which is how they got their name. They are sometimes working away from other crews and must monitor conditions on the ground constantly, prepared to move ahead of the fire if it flares up. They undergo special training, but also rely on experience.

"You can talk about how wind shifts occur and maybe how the thunderstorms come overhead, but it's a completely different thing when you're there actually seeing it and experiencing it," said Rick Swan, a retired deputy chief of the California Department of Forestry and

Fire Protection. “When the wind starts changing direction, you see that. If you’re trained, you’re paying attention.”

Some of the procedures firefighting crews follow today grew out of the 1990 Dude Fire near Payson, which killed six firefighters when flames exploded amid a rapidly developing thunderstorm. The fire has been studied intently by fire experts and government agencies. The lessons drawn from it still guide wildland firefighting.

“Those things are ingrained in our head,” Swan said. “No matter where you’re at, you’re constantly re-evaluating your situation, the wind, the topography, the fuel types. You’re always reassessing where you are, where you have to be, the amount of time you have to get there, all to make sure you’re safe.”

Crews constantly battle other obstacles, such as smoke so thick that views are obscured, or mountains that interrupt radio signals, isolating firefighters from command posts or others relaying information. Confusion on the fire line can be as deadly as the fire itself.

Firefighters learn from the start that fire needs three elements to burn: fuel, heat and oxygen. If any one of those elements grows, a wildfire can become more unpredictable. Denser or drier fuel can spread flames more rapidly. Rising heat can cause fuels to ignite faster. Winds can spread flames and cause a fire to blow up.

One of the most volatile types of terrain for a wildfire is chaparral, covered with lower-lying vegetation rather than the tall pines of higher elevation.

“The fuel is much more responsive to changes in humidity or even short-term drought,” said Mangan. “You get flashier, faster-moving fires, and the margin for error is greater.”

Fire-training manuals use campfires as an example. The twigs or brush used to start a campfire burn fast, sometimes with flames flashing upward. The kindling heats up the bigger logs, which eventually start to burn and last for a while. Some kinds of chaparral are like acres of kindling, small-diameter vegetation that ignites and spreads fire quickly.

The weather adds another volatile element. Winds can shift as a storm moves in and can push flames in a new direction, sometimes before a fire crew can react. If the winds are strong enough and the fuel volatile enough, a burnover can occur, a situation firefighters can’t control.

That’s why fire crews pay such close attention to weather forecasts and fuel models that predict how vegetation burns, Mangan said.

“That’s why you have to have a good lookout,” he said. “You watch for changes in wind, in smoke direction, watch for thunder cells. It shouldn’t be instantaneous. Even in the hills you should have a couple of minutes.”

Constantly updated models measure moisture content and other factors, such as the potential energy in a stand of trees or in brush. But the onset of unexpected winds or a sudden downdraft from a storm, Mangan said, “will blow the models out of the sky.”