Safety Zone and Escape Route Guideline Update

Spring 2018

Background: When fires are burning on slopes or under the influence of winds hot gases can extend 5 to 10 times further than radiant heating from flames—thereby requiring larger safety zones.

Safety Zones on Slopes: Current science suggests that safety zones located on slopes greater than 25% (14°) should be 2 to 6 times greater than for flat ground. When slope exceeds 40% (22°) the safety zone should be 6 to 10 times larger than for flat ground.

Safety Zones and Wind: Winds are often the primary driving factor for rapid, high intensity fire spread. Measurements suggest that for fires burning under the influence of winds greater than a 5-7 mph the safety zone size should be increased by 2-3 times over that for flat ground. For stronger winds the increase can be 6 or more times.

Escape Routes: Most entrapments occur not in safety zones, but rather as fire crews are traveling to their safety zone. This implies that: 1) crews are not evacuating soon enough and 2) they are not accurately estimating escape route travel time. Recent studies of human travel rates over rough terrain suggest that the best escape routes are flagged, not overly steep (e.g. less than 20% (11°) in both uphill and downhill directions), and when possible are cleared of vegetation that impedes travel.

Operational Implications: Safety zone and escape routes should be assessed based on the relevant period under consideration. For example, if a crew is working in a specific area for the coming shift their safety zone should be assessed within the context of the expected fire behavior for that shift adjusted for confidence in the weather forecasts. If confidence in the weather forecast is high there is less need to consider historical worst case conditions. However, if a division supervisor is assessing safety zones within the context of expected work on their division for several days or longer then they should adjust the safety zone size appropriately based on historical weather and terrain extremes (i.e. lower confidence implies that larger sizes would be more appropriate).

Management Implications: Line officers must recognize that some fire management tactics and fire conditions will require large safety zones (in some cases much larger than expected). If appropriate safety zones do not exist naturally, they must be constructed. Such action comes with its own set of risk factors and ecological impacts. If adequate sized safety zones cannot be constructed and don't exist than alternative tactics that reduce risk to firefighters should be considered.

Tools:

WindNinja Mobile: Google play or itunes
WindNinja: www.firelab.org
Fire Weather Alert: https://weather.firelab.org/fwas/
WiSE (safety zone app): contact bwbutler@fs.fed.us
Severe Fire Wx Potential Map: https://m.wfas.net/dev/

Summary:

Escape Routes

-Use trigger points
-Keep trail steepness to less than 20% (11°)
-Flag path
-Clear large obstructions and vegetation

Safety Zones

Wind 0 - 5 mph, slope 0 – 25% SZ Size = 3 to 5 x flame ht

Wind > 5 mph, slope > 30% (17°)
-Vegetation < 10 ft tall, SZ size = 4 to 10 x Veg Ht
-Vegetation > 10 ft tall, SZ size = 2 to 5 x Veg Ht
-Increase SZ size as slope, wind or fire intensity increase

Feedback: This work is preliminary and represents the best synthesis of the science. Feedback from firefighters, incident team members and line officers is critical to this effort. If you have comments, ideas, or criticism, please contact Bret Butler. Email: bwbutler@fs.fed.us Tel: 406 329 4801

SSD = 8 x vegetation height x Δ

Slope-Wind Factor (Δ)			
	Terrain Slope (%)		
Wind Speed (mph)	Flat (< 15%)	15-30%	>35%
Light (0-6)	1/0.7/0.7	1/1/1	4/2/2
Moderate (7-15)	2/1/1	4/2/1	6/3/2
Strong (>18)	4/2/2	6/3/2	8/3/2

-Green is for fuels < 10' tall, Orange is for fuels >10' tall, **Red is for fuels > 40' tall**
-SSD is Safe Separation Distance

Example 1: 3' tall sage brush, 22% slope, 11 mph wind –> Δ is then 4 from table
SSD = 8 x 3 x 4 = 96' If the Safety Zone were circular this would be the radius for an area of 0.5 acres.

Example 2: 20' tall juniper, 38% slope, 20 mph wind Δ is then 3 from table
SSD = 8 x 20 x 3 = 480' this would be an area about 16 acres in size. 3/2018