Importance of Weather to Fire Behavior

Success in prescribed burns is directly related to how well you understand and are able to predict fire behavior. The safety of all personnel also depends on fire behavior knowledge.

Topography, fuels and weather are the elements that most affect fire behavior. All three elements variables can influence each other.

Weather is the most variable of these elements in both space and time. Therefore it is critical that you have an understanding of what the weather will do before you ignite a prescribed fire.

This guide is designed to give you a basic understanding of many important weather elements to be aware of, including wind, relative humidity, mixing height and transport winds. This guide will also introduce you to critical fire weather patterns to be on the look out for before you conduct a prescribed burn.

Finally, this guide will introduce you to the products and services the National Weather Service provides to the fire community.

It can not be overemphasized: A basic knowledge and awareness of weather is essential for making critical fire management decisions.

Effects of Wind on Fire Behavior

Predicting wind speed and direction is a must so that fire will burn in a predetermined manner. Wind can have several effects on wildland fire behavior:

- Carries away moisture-laden air and thus hastens the drying of wildland fuels
- Aids combustion by increasing the supply of oxygen
- Increases fire spread by carrying heat and burning embers to new fuels – Spotting
- Bends the flames closer to the unburned fuels, preheating the fuels ahead of the fire front
- The direction of the fire spread is determined mostly by direction of the wind
- Influences the amount of fuel consumed by affecting the residence time of the flaming front of the fire. The stronger the wind, the shorter the residence time and the less fuel is consumed
Wind Tips

Light and variable winds create poor burning conditions and an unpredictable direction of spread.

High wind speeds may reduce fuel consumption, increase chances of escape, and increase risk of spotting.

Conducting burns when winds are forecasted to change direction is not advised.

A stable/consistent wind direction throughout the burn will avoid unpredictable fire behavior.

RH Tips

Fine fuels such as grass will burn with the same intensity when the RH is 45-60%.

Cooler fires result when the RH is 45-60%.

Northwest winds typically produce low RH values across South Texas.

Gusty winds will promote mixing of drier air aloft, resulting in decreasing RH values.

Relative humidity can effect both fuels and fire behavior in several ways:

- As RH increases, fuel moisture increases.
- Affects rate of spread. (as RH decreases rate of spread can increase)
- Some fuels will not burn adequately if RH is too high.
- Fire becomes difficult to control if RH is too low.
- Fires of different intensity can be achieved by selecting different times of day or night for a certain RH.

The general relative humidity prescription for a successful burn is: 25 - 60%.
The transport wind is simply the average wind between the surface and the mixing height. In other words it is the average wind of the mixing layer, and the wind that will influence where the smoke column will go and how it will disperse.

The transport wind is simply the average wind between the surface and the mixing height. In other words it is the average wind of the mixing layer, and the wind that will influence where the smoke column will go and how it will disperse.

Mixing Height is defined as the maximum height in which rapid vertical mixing takes place in the atmosphere. It is the top of the mixing layer, which usually extends from the surface upward to a layer where the temperature begins to increase with height. There are visual clues you can observe to tell whether the mixing height is high and an indication of unstable conditions or low and an indication of stable conditions.

The image on the top left is an example of higher mixing heights (unstable). Clouds and smoke columns will rise to great heights. Gusty winds may be occurring at the surface as well as good visibilities. The image on the top right is an example of lower mixing heights (stable). Low clouds may be observed during these conditions. Smoke columns will be low (usually less than 1500 feet). Winds at the surface may be light and steady. In addition, poor visibilities in haze or fog may be observed.

The image on the top left is an example of higher mixing heights (unstable). Clouds and smoke columns will rise to great heights. Gusty winds may be occurring at the surface as well as good visibilities. The image on the top right is an example of lower mixing heights (stable). Low clouds may be observed during these conditions. Smoke columns will be low (usually less than 1500 feet). Winds at the surface may be light and steady. In addition, poor visibilities in haze or fog may be observed.

Mixing Height Tips

Preferred mixing heights for prescribed burns are 1700-6000 feet.

Mixing heights will be lowest in the morning (sometimes only a few hundred feet), but will typically rise during the mid to late morning of an average day.

Mixing heights behind shallow cold fronts in South Texas can be less than 1000 feet.

Transport Wind Tips

Lighter transport winds will allow smoke to achieve heights closer to the mixing height, while stronger winds will spread the smoke out at lower heights.

If mixing heights are low and transport winds too low then the smoke might not disperse from the surface.

Preferred transport winds for prescribed burns are 9-20 mph.
Critical Fire Weather Patterns to Avoid

Critical fire weather patterns are weather conditions which support extreme fire danger and/or extreme fire behavior. These conditions can cause unwanted ignitions or control problems with existing fires. Critical fire weather patterns can pose a threat to life and property. The National Weather Service (NWS) calls these weather conditions Red Flag Events. The NWS issues Red Flag Warnings and Fire Weather Watches for such events. Fire Weather Watches will be issued up to 72 hours in advance of a Red Flag Event when reasonably confident. A Red Flag Warning is issued within 24 hours of a Red Flag Event. Most Fire Weather Watches and Red Flag Events in South Texas are issued due to low RH with strong winds.

Red Flag Criteria for South Texas

**Inland Counties**
- RH at or below **30%**
- And
- 20-Foot winds sustained or frequently gusting at or above **25 mph**

**Coastal Counties**
- RH at or below **40%**
- And
- 20-Foot winds sustained or frequently gusting at or above **25 mph**

Other South TX Fire Weather Patterns to Look Out For

- Sudden changes in wind direction, speed and RH after cold front and sea-breeze boundary passages
- Fast moving low clouds just after daybreak (once morning inversion breaks these stronger winds can mix down to surface)
- Unexpected calm in the wind may indicate an approaching wind shift
- Thunderstorms above or close to the burn
- Dust devils or whirlwinds developing
- Upper level ridges (high pressure) can result in a hot/dry patterns
- The far western fringes of tropical systems in the western Gulf of Mexico can produce stable, subsident and dry conditions across South Texas.

Above: A lightning strike combined with a critical fire weather pattern to produce this wildfire on the Padre Island National Seashore in Nov. 2005
Fire Weather Planning

Forecasts are a great tool for input in decision-making related to pre-suppression and other planning. For specific hourly weather information check out our hourly weather graphs on the internet! (more info on page 6)

The following section describes in detail these products. All of these products can be found under the Fire Weather link on the WFO Corpus Christi website:

www.weather.gov/corpuschristi

Fire Weather Planning Forecast

- **CLOUD COVER:** TODAY: CLOUDY;tonight: CLOUDY;tomorrow: CLOUDY
- **PRECIP TYPE:** TODAY: RAIN;tonight: RAIN;tomorrow: RAIN
- **CHANCE OF PRECIP:** TODAY: 10%;tonight: 41%;tomorrow: 67%
- **SH WIND:** TODAY: 51 mph;tonight: 91 mph;tomorrow: 74 mph
- **SH WIND DIR (DEG):** TODAY: 10°;tonight: 89°;tomorrow: 16°
- **TRANSIENT WIND (KT):** TODAY: 17;tonight: 16
- **LAG:** 1

**FORECAST FOR DAYS 3 THROUGH 7:**
- **TUESDAY:**...CLOUDY with areas of light rain. LOWS IN THE LOWER 40S. HIGHS IN THE UPPER 50S. NORTHEAST WINDS AROUND 10 MPH.
- **WEDNESDAY:**...MOSTLY CLOUDY with a 20 percent chance of showers. LOWS IN THE LOWER 40S. HIGHS IN THE UPPER 50S. NORTHEAST WINDS AROUND 10 MPH.
- **THURSDAY:**...MOSTLY CLOUDY with scattered showers. LOWS IN THE LOWER 40S. HIGHS IN THE MID 40S. LIGHT WINDS.
- **FRIDAY:**...MOSTLY CLOUDY. LOWS IN THE UPPER 40S. HIGHS IN THE MID 40S. NORTH WINDS 10 TO 15 MPH.
- **SATURDAY:**...MOSTLY CLOUDY. LOWS IN THE UPPER 40S. HIGHS IN THE MID 40S. NORTH WINDS 10 TO 15 MPH.

As described in the Critical Fire Weather Patterns section, Fire Weather Watches (FWW) and Red Flag Warnings (RFW) are designed to provide land management personnel with appropriate notification of the likelihood weather conditions that support extreme fire danger and/or fire behavior. The RFW is issued on an as needed basis.

**Fire Weather Planning Forecast for Today, Tonight, and Tomorrow:**

- **20 ft Winds:** ≥ 25 mph
- **RH:** inland counties ≤ 30%
- **RH:** coastal counties ≤ 40%
Digital and Graphical Products

Specific hourly weather forecasts for a point are available on our website. On our main page just click the location on the map where you need the forecast. On the next page click the link for Hourly Weather Graph. These hourly forecasts for select weather elements are available out to seven days. Scrolling you cursor over the graph will give a readout at the bottom of the page for the time the cursor is over.

Regional views to fire weather elements for select times out to seven days are also available on our website. On our main page click on the link for Experimental Forecasts - Graphical. The click on the tab for Fire Weather.