



Colorado Department
of Public Health
and Environment

Colorado Air Pollution Control Division, Technical Services Program

Memorandum

To: Prescribed Fire Smoke Permit Holders and Smoke Air Quality County Contacts within the Front Range Ozone Non-Attainment Area or in Teller or El Paso County

From: Coleen Campbell and Sarah Gallup

CC: Dan Ely, Chuck Machovec, Pat Reddy, Emmett Malone, Mike Silverstein, designated Colorado smoke liaisons, and USFS RO smoke contacts

Date: 8/5/10

Re: **Prescribed Fire Smoke Permits, Use of Ozone Alert Information**

Form A, general conditions, air pollution emergencies or alerts

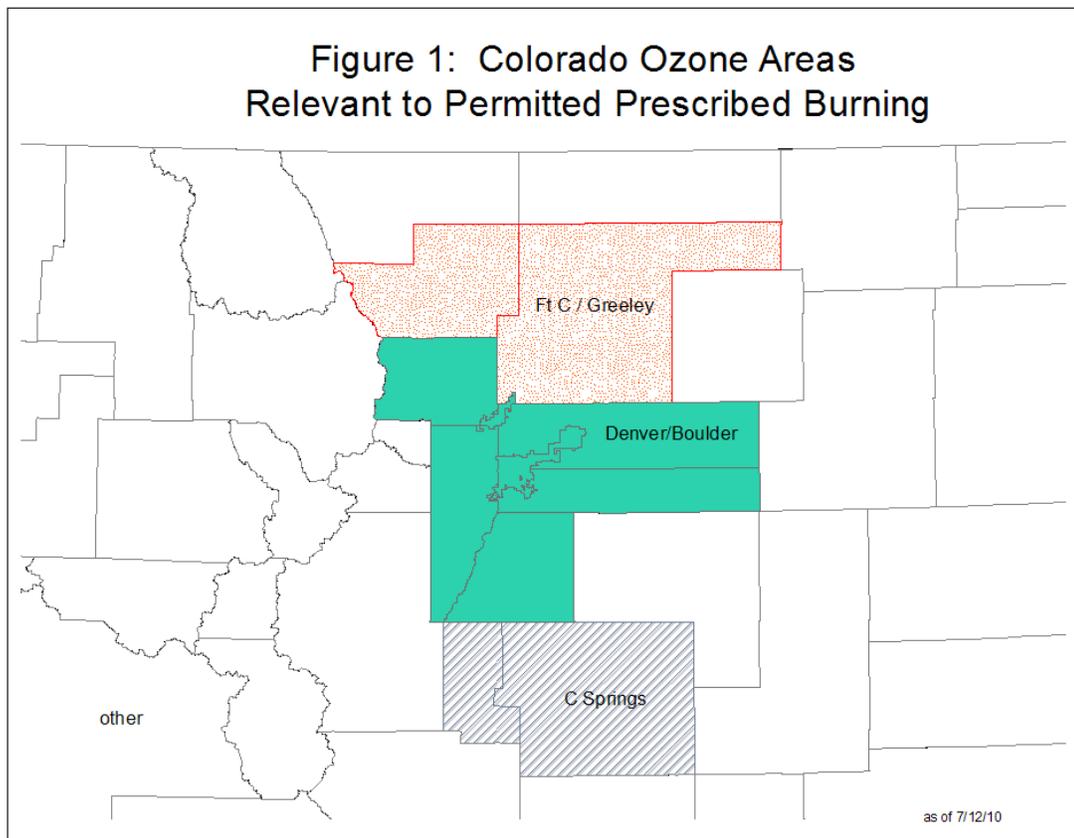
What determines whether an ozone alert applies to a specific burn and day?

Overview: Per Colorado Air Quality Control Commission Regulation No. 9 and as a standard condition of smoke permits, burning may not occur when an ozone alert is in effect for the area of the burn. For purposes of ozone and smoke the state is currently divided into four zones shown on the map on the next page. What is required in each is described in the body of this memo. For the Front Range from Fort Collins to Colorado Springs, from May 1 through September 15 burners must check an air alert website before each day of ignition. In the rest of the state, if there is an ozone alert APCD smoke staff will take the initiative to contact potentially affected burners.

This note refines an email sent to each permittee in the proposed ozone non-attainment area on 3/17/10. The previous memo did not address geographic subareas within the Front Range non-attainment area, nor forecasting beyond the current 24-hour period.

Ozone monitoring, alerts, and consequences for smoke all are evolving rapidly. We at APCD will use this year's experiences with ozone alerts and prescribed fire to learn what procedures may need to change for summer 2011.

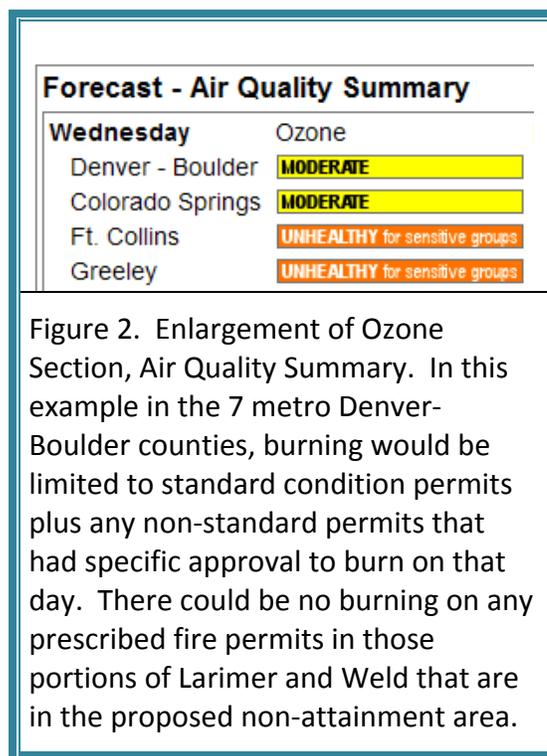
This memo uses the format we anticipate for our forthcoming program manual that will replace the FAQs on our website.



Requirements:

Area 1, Denver / Boulder: For burns in any part of the Counties of Adams, Arapaho, Boulder, Broomfield, Denver, Douglas and/or Jefferson, for any burn day between May 1 and September 15 inclusive, it is the permittee’s responsibility to check APCD’s air alert web page, http://www.colorado.gov/airquality/colorado_summary.aspx. (Some other APCD web pages and the alert hotline at 303 758 4848 include the some of the same information, and may be used instead.) Look at the webpage’s section that lists forecasted air quality by location for ozone, which in Appendix 1 is location 1 on a sample of the webpage. Refer to the ozone forecast for Denver - Boulder for the day when you plan to light. That section of the forecast is shown in Figure 2.

If the forecasted adjective for Denver -



Boulder is unhealthy for sensitive individuals (orange) or worse (AQI >100), then no burning may occur.

If the forecasted adjective for Denver - Boulder is moderate (yellow), then you may burn using standard permit conditions. If you have a non-standard permit that provides for more acres per day than standard conditions at any ventilation adjective, contact APCD's prescribed fire staff about whether ignition is approved for that day.

If the forecasted adjective for Denver - Boulder is green (good), then you may burn within the terms of your permit.

For each day you do light, 1) print and 2) keep a copy of the ozone forecast that does allow you to burn.

Area 2, Fort Collins / Greeley: Only [parts of Weld and Larimer](#) are within the ozone area. Fort Collins and all of Rocky Mountain National Park, for example, are included.

For burns in those portions of Larimer and Weld County that are in the Front Range proposed non-attainment area and for any burn day between May 1 and September 15 inclusive, it is your responsibility to check APCD's air alert web page, http://www.colorado.gov/airquality/colorado_summary.aspx. Look at the webpage's section that lists forecasted air quality by location for ozone, which in Appendix 1 is location 1 on a sample of the webpage, and also is featured in Figure 2 above. Refer to the ozone forecasts for both Fort Collins and Greeley for the day when you plan to light.

If the forecasted adjective for either Fort Collins or Greeley is unhealthy for sensitive individuals (orange) or worse (AQI >100), then no burning may occur.

If the forecasted adjective for either Fort Collins or Greeley is moderate (yellow) and the other is also moderate (yellow) or is good (green), then you may burn using standard permit conditions. If you have a non-standard permit that provides for more acres per day than standard conditions at any ventilation adjective, contact APCD's prescribed fire staff about whether you may burn. They are likely to need to discuss particulars with APCD's forecaster on duty.

If the forecasted adjective for both Fort Collins or Greeley is green (good), then you may burn within the terms of your permit, whether or not the permit has standard conditions.

Area 3, Colorado Springs: For burns in El Paso and/or Teller County: Although El Paso and Teller Counties are outside the proposed non-attainment area, burn bosses still must take the initiative to check for ozone alerts for any burn day between May 1 and September 15.

Go to http://www.colorado.gov/airquality/colorado_summary.aspx. Any alerts for the current 24-hour period are listed within the Air Quality Advisories box under 'Other Areas.' See location 2 on Appendix 1, which is enlarged in Figure 3 below. Click on the linked text in this box and read any details. An alert will describe which geographic area it covers,

typically using county boundaries. For example, alerts centered around Colorado Springs usually apply to all of El Paso and Teller Counties.

Other Areas:

Blowing Dust Advisory for Western and Southwestern Colorado from 1:00 PM until Midnight Wednesday, 2010. Issued by the Colorado Department of Public Health and Environment at 9:30 AM Wednesday June 16, 2010. Blowing dust is possible across areas of Western and Southwestern Colorado Wednesday afternoon and evening as strong winds blow across dry areas of Colorado, Arizona, and New Mexico. Winds gusting 40 to 50 mph in these areas may contribute to blowing dust. Grand Junction, Rifle, Montrose, Pagosa Springs, Delta, Cortez, Durango, Telluride, and nearby areas may be affected. The blowing dust will end during the evening, but there could be elevated levels of Particulates into the early morning hours. This will be dust settling out of the atmosphere that had been suspended in the atmosphere earlier in the day and transported long distances after the winds have subsided below levels needed to cause blowing dust. If significant blowing dust is present and reducing visibility to less [\(click for more...\)](#)

Scale - Visibility Standard	
0 - 50	GOOD
51 - 100	MODERATE
101 - 200	POOR
201 - 300	EXTREMELY POOR
	WEATHER NOT A FACTOR

Figure 3. Alert summary and link for burns outside the Front Range recommended ozone non-attainment area

The alert text will also distinguish between the forecast for the remainder of the current day versus the next morning. If the air quality for the time period of ignition is forecasted to be 'Good' or 'Moderate,' burning is allowed. In the following example, ignition the next morning [Tuesday] is

approved.

Ozone is expected to remain Unhealthy for Sensitive Groups on Monday [today]. The return of cool weather will return ozone levels to the Good category on Tuesday [tomorrow].

Area 4: For burns elsewhere in Colorado: APCD staff will advise you about alerts and you are not required otherwise to take the initiative to check APCD's air alert web page. If you are advised to check the website and want to burn, follow the procedural instructions for Area 3, Colorado Springs.

Background and History: Ozone is O₃, or three linked oxygen molecules. It is a strong oxidant. Ozone causes damage when one of its molecules breaks off and combines with molecules in cells. Ozone oxidizes living tissue. In plants, high ozone levels cause browning of leaf tips. For people, excessive ozone weakens human immune systems and facilitates the development of lung infections. Much like particulate pollution, "High ozone levels have been linked to increases in the severity of asthma attacks and other respiratory health problems, especially for children and the elderly."

(<http://www.wunderground.com/health/ozone.asp>) While asthmatics and children are at highest risk, other groups of concern include outdoor workers and athletes.

Although ozone itself consists only of oxygen molecules, the chemistry and physics of ozone formation in the Earth's lower atmosphere are complex. Key ingredients for the chemical reaction by which ozone is most often formed are sunlight, volatile organic compounds (VOCs) and oxides of nitrogen (NO_x).

Smoke emission factors for VOC and NO_x are both less extensively researched and lower than for more familiar smoke components like particulates or carbon monoxide. (See, for example, <http://www.epa.gov/ttn/chief/ap42/ch13/related/firerept.pdf>.) In the world of ozone precursors, however, fires can be major sources.

The overall role of fire emissions in ozone formation is not well understood. There are some indications that smoke enhances ozone formation and also some indications it inhibits ozone formation. In the instances where smoke is suspected of decreasing ozone formation, the smoke was very heavy and perhaps blocked the strong sunlight associated with ozone formation. While the jury is out, the Air Quality Control Commission has made it clear that staff should err on the side of caution about any relationship between ozone and the burning of wildland fuels.

Intent: Ozone pollution restrictions affect fires farther from population centers than do particulate restrictions (aka red/blue). Why is the scale for ozone so much bigger? Ozone accumulates on a regional scale and ozone photochemistry evolves over large distances downwind of the sources of the precursor emissions.

The geography of particulates generated at a fire is fairly simple. Overgeneralizing slightly, the particulates become part of the air mass where they were released, gradually dispersing to a more uniform concentration within the air mass until gravity or precipitation brings them back to earth days or weeks later. We tend to be most concerned about the particulates when they are still close in time and space to the fire or other source and therefore still relatively concentrated. The damage particulates cause is related directly to concentration, not to what chemical reactions they may participate in days and counties later. Key considerations include localized air drainage patterns, the lowest mile or so of air immediately above the fire, and what the weather is doing right now while the fuel is consuming.

All of this is different and simpler than ozone geography. Ozone precursors matter most not when they are close to the point of origin and most concentrated, but instead when they are sufficiently downwind of the source for ozone production to reach its maximum.

- The larger-scale flow patterns of the entire air mass matter. A burn in the mountains above Colorado's Front Range provides an illustration. A "chimney circulation" can create a rotor flow of precursors from smoke across portions of the Front Range. Solar heating of the mountains can create a thermal low that pulls air upslope from the plains into the foothills. Westerlies above the Divide can transport these emissions back over the plains where deep mixing brings them back again to the surface. Near the burn ozone levels may be low throughout ignition and stay low for the next day or two, but the emissions still make a significant contribution to high ozone levels downwind.
- Considering air flow horizontally rather than vertically, over the next couple days will the precursors become entrained in circulations that in summer tend to increase residence times over the northern Front Range or the entire state? Or will the entire air mass move on to the east instead?

The geographic scale at which ozone alerts should apply to prescribed fires is designed to balance the intent to minimize burn constraints that have a lower probability of mattering against the larger space and longer time in which ozone-precursor pollution is of concern plus the related lower certainty about the burn's relevant air flows.

Small-scale timing can matter for whether an alert will require cancelling a burn. Ozone levels tend to peak near sunset. Alerts are issued in late afternoon for the next 24 hours, covering both this evening and tomorrow's daytime.

- a) If high ozone levels are expected later tonight, then there will be an alert so that a developing problem won't be made worse.
- b) There will be an alert also if tomorrow's anticipated polluting activities are expected to generate enough ozone precursors before 4 p.m. to cause a problem any time tomorrow, including high levels that may not show up until tomorrow evening.

Sometimes the air mass is expected to change significantly overnight. There may be stronger wind, a frontal passage, lots of thunderstorms, or some other change that improves the ozone situation overnight. The forecasters may expect that even though tonight will have bad ozone, tomorrow won't. No one wants to be cancelling tomorrow's burn because only tonight had air problems. That is why the requirements described above that apply outside the Front Range non-attainment area make reference to the content of the text even though it's complicated.

Implementation Guidance:

Colorado's air alerts web page is updated once each day by 16:00 with information for the following 24 to 32 hours. An APCD meteorologist determines the ozone forecast after considering weather models, existing ozone levels, and expectations of what ozone formation is likely to occur during the forecast period.

The alert status is in effect for 24-hours. The outlook, however, extends to the end of the next day. See location 3 on Figure 1 above. An excerpted example follows that indicates it is likely an alert will be called for tomorrow even though there is not one today.

Last night's cold front has provided cloud cover that limited ozone formation today. Tomorrow sunshine returns allowing ozone levels to climb into the range of Unhealthy for Sensitive Groups.

Like multi-day weather forecasts, the outlooks are only best-estimate projections. They are therefore subject to revision when the next day's actual alert status is issued.

Another way to anticipate ozone alerts is to track some of the same weather parameters you may already use to look ahead at ventilation. Colorado's worst weather for ozone is light transport wind and high mixing heights in mid June - mid August. Hot days favor both

ozone formation and a high ventilation index. In that way anticipating ozone problems and favorable ventilation are similar. They are opposite in terms of wind, however. Strong transport winds give a higher ventilation index. But stagnant air promotes ozone formation. A summer high pressure system or a weak synoptic gradient as are common in Colorado in the summer make ozone alerts more likely.

As a potential burn day approaches you may want more air pollution alert forecasting information. If so you may contact the APCD smoke staff listed below. Within limits that respect the forecasters' workloads we will inquire about geographic specificity for the next day's possible alert and/or a longer time frame. APCD forecasters have many other duties, some of which are higher priority than fire. But if they have time the forecasters may be able to give you their best guess for each day for as long as a week out. We are experimenting with these requests to see what volume is manageable.

We are also still figuring out the mechanics of ozone alerts outside the Front Range. Experimental sampling and other research in recent years indicated ozone levels can be high in some parts of Colorado that didn't used to have monitors. In response, permanent ozone monitors were set out in more places around the state. That leads to us being sure that ozone alerts will start to occur for more places than the Front Range. For now we at APCD will take the initiative to tell you if an ozone alert occurs in an area outside the listed Front Range counties for which you are the contact person listed on the permit. If you are planning a warm season burn day, however, feel free to call us ahead of time to check on ozone expectations for the burn area. In the future we expect to work out a list-serve or other more automated alert, perhaps with subscription options that are geographically specific. First, though, we want to see more about what evolves with the ozone alerts themselves.

Authority: Air Pollution Control Commission [Regulation 9](#) IV C 1: "... permits are not valid during periods of publicly announced air pollution emergencies or alerts in the area of the proposed burn."

If you have questions or concerns about this memo or other aspects of the prescribed fire smoke permitting program, please call either of us: Coleen, 303-692-3224 or Sarah, 303-916-1260.

Appendix 1: Example Day, Air Quality Summary Web Page

Colorado Department of Public Health and Environment: Technical Services Program (TSP) - Windows Internet Explorer

http://www.colorado.gov/airquality/colorado_summary.aspx

File Edit View Favorites Tools Help

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Colorado Department of Public Health and Environment

Colorado Home > Department Home > Air Pollution Control Division > Technical Services Program Home

Air Pollution Control Division **Special Air Quality Statement**

Technical Services Home
Blowing Dust Advisory for Western and Southwestern Colorado from 1:00 PM until Midnight Wednesday, 2010. Issued by the Colorado Department of Public Health and Environment at 9:30 AM Wednesday June 16, 2010.

All Colorado Advisories

Front Range/Denver Advisories

Air Quality Today

Colorado Air Quality Summary

About Us

Intro to Reporting Systems

Air Quality Map View

Air Quality Report View

Open Burning

Smoke Management Program

Technical Reports

Permit Modeling

Emissions Inventory

Wildfire Information

Technical Services Contacts

Colorado Air Quality Summary

About the Air Quality Index (AQI)
Today's Air Quality Summary (detailed)

Front Range Air Quality Forecast Smoaks Outlook

Air Quality Advisories

Front Range:
Ozone will climb into the Moderate to Unhealthy-for-Sensitive Groups range Wednesday afternoon and evening with the highest concentrations in the Greeley and Ft. Collins area. Moderate concentrations may (click for more...)

Other Areas:
Blowing Dust Advisory for Western and Southwestern Colorado from 1:00 PM until Midnight Wednesday, 2010. Issued by the Colorado Department of Public Health and Environment at 9:30 AM Wednesday June 16, 2010. Blowing dust is possible across areas of Western and Southwestern Colorado Wednesday afternoon and evening as strong winds blow across dry areas of Colorado, Arizona, and New Mexico. Winds gusting 40 to 50 mph in these areas may contribute to blowing dust. Grand Junction, Rifle, Montrose, Paososa Springs, Delta, Cortez, Durango, Telluride, and nearby areas may be affected. The blowing dust will end during the evening, but there could be elevated levels of Particulates into the early morning hours. This will be dust settling out of the atmosphere that had been suspended in the atmosphere earlier in the day and transported long distances after the winds have subsided below levels needed to cause blowing dust. If significant blowing dust is present and reducing visibility to less (click for more...)

Key

Scale - Air Quality Index (AQI)

0 - 50	GOOD
51 - 100	MODERATE
101 - 150	UNHEALTHY for sensitive groups
151 - 200	UNHEALTHY
201 - 300	VERY UNHEALTHY
301 - 500	HAZARDOUS

Scale - Visibility Standard Index

0 - 50	GOOD
51 - 100	MODERATE
101 - 200	POOR
201 - 300	EXTREMELY POOR WEATHER LIMITED NOT AVAILABLE

Current - Air Quality Summary

Current - Air Quality Index (AQI) 3PM

Denver Metro	GOOD
Colorado Springs	GOOD
Ft Collins - Greeley	MODERATE
Grand Junction	GOOD
Other Areas	GOOD

Highest AQI (so far) Today 6/16/2010

Denver Metro	MODERATE
Colorado Springs	GOOD
Ft Collins - Greeley	MODERATE
Grand Junction	GOOD
Other Areas	GOOD

Highest AQI Yesterday 6/15/2010

Denver Metro	MODERATE
Colorado Springs	MODERATE
Ft Collins - Greeley	MODERATE
Grand Junction	MODERATE
Other Areas RIFLO	MODERATE

Denver's current visibility: **GOOD**

Ft. Collins' current visibility: **NOT AVAILABLE**
(VSI is calculated between 12PM and 4PM local time)

Forecast - Air Quality Summary

Wednesday

	Ozone	Fine Particulates	Carbon Monoxide
Denver - Boulder	MODERATE	GOOD	GOOD
Colorado Springs	MODERATE	GOOD	GOOD
Ft. Collins	UNHEALTHY for sensitive groups	GOOD	GOOD
Greeley	UNHEALTHY for sensitive groups	GOOD	GOOD

Thursday

	Ozone	Fine Particulates	Carbon Monoxide
Denver - Boulder	MODERATE	GOOD	GOOD
Colorado Springs	MODERATE	GOOD	GOOD
Ft. Collins	MODERATE	GOOD	GOOD
Greeley	GOOD	GOOD	GOOD

Denver's expected visibility (Wednesday): **MODERATE**

Denver's expected visibility (Thursday): **MODERATE**

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