

Reducing Ozone in the Denver Region



Recommendations for Future Action

**Submitted to
Regional Air Quality Council
and
Air Quality Control Commission**

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EXECUTIVE SUMMARY

Compliance with the National Ambient Air Quality Standard for ozone has emerged as a significant air quality challenge for the Denver area. After the U.S. Environmental Protection Agency (EPA) established a more stringent standard for ozone pollution in 1997, elevated levels of the pollutant in 1998 raised concerns and prompted the Regional Air Quality Council (RAQC), the Air Quality Control Commission (AQCC) and the Colorado Department of Public Health and Environment (CDPHE) to pursue efforts to increase the public's awareness of ozone pollution and to seek voluntary actions to reduce ozone-causing pollution.

The RAQC, launched the Voluntary Ozone Reduction and Awareness Program in 1999 in cooperation with CDPHE and many other public and private partners. Over the past five years, the program has accomplished a wide range of public education and awareness activities and has worked with the public and private sector to implement a host of voluntary emission reduction efforts.

Despite these efforts, the Denver region still remains extremely close to EPA's new 8-hour ozone standard. High readings during the summer of 2002 at the Rocky Flats monitor have left the region with little room below the standard. While long-term trends for ozone precursor emissions continue to look positive, it is evident that additional short-term actions are needed to ensure compliance with the standard.

Governor Bill Owens directed the RAQC and AQCC in August to consider additional, short-term measures that could be implemented to further reduce ozone-causing emissions and help prevent the Denver region from violating the federal standard in 2003 and beyond. These actions are particularly critical at this juncture since EPA is expected to make nonattainment designations in early 2004 that likely will be based on 2001-2003 data.

The RAQC and AQCC invited interested stakeholders to participate in a series of meetings to consider additional measures. The process began with an all-day workshop where information was presented on technical aspects of ozone formation in the Denver region, sources of ozone precursor emissions, upcoming regulatory requirements, and past activities. The workshop participants also broke into small groups to discuss additional actions that could be taken to reduce emissions from various source categories. This list of potential measures was then narrowed to those with the most likely chances to succeed at two subsequent meetings.

A list of short-term actions recommended by the participants for consideration by the RAQC and AQCC is summarized below. Some of the recommendations will require actions by private companies, others by government agencies, including the RAQC,

AQCC, and CDPHE. Some of the public sector actions can be implemented with existing resources and funding, others will require additional sources of public or private funding to accomplish them fully. None of the recommendations require legislative action since they are voluntary and short-term in nature, though further regulatory or legislative consideration may be necessary.

Recommended additional measures:

Motor Vehicles and Fuels

1. **Implement a High-Emitting/Smoking Vehicle Identification and Repair Pilot Program**
2. **Use the Smart Sign at Speer and I-25 to identify hydrocarbon emissions**
3. **Continue voluntary RVP reduction program**
4. **Encourage early introduction of low sulfur gasoline in the Denver market**
5. **Encourage use of alternative fuels that reduce VOCs through education, use of current incentives, and voluntary fleet purchase requirements.**
6. **Promote alternatives to driving, especially on ozone alert days**

Area Sources

7. **Voluntarily restrict the availability of solvent based paints in June and July, reschedule the use of solvent based paints to another time of year and encourage the use of low VOC water based paint products for necessary June /July painting projects.**
8. **Promote a gas can changeout program that will replace portable gas containers with lower-polluting cans and nozzles.**

Public Outreach and Education

9. **Implement a “Citizens Choose Clean Air” public outreach campaign to educate citizens about ozone pollution.**
10. **Increase outreach to regional public information staff**
11. **Continue the “Put a Cap on Ozone” Gas Cap Replacement Program**

12. **Create a partnership with the Colorado Department of Transportation to assist with public communication efforts.**
13. **Increase media advertising to reach more citizens with information about ozone pollution and potential actions.**
14. **Conduct additional promotional events to target specific sources and increase public education**
15. **Conduct an Ozone Reduction Program awareness survey to gauge the success of public information and education efforts**

, **Point Sources**

16. **Consider revisions to Regulation No. 7 that address VOC emissions from stationary sources**
17. **Begin working with the oil and gas industry to characterize potential emission sources and to reduce emissions from oil and gas development**
18. **Promote pollution prevention efforts that focus on reducing VOC emissions**

, **Ozone Research**

19. **Develop an ozone research plan**

, **Ozone Planning**

20. **Develop an Early Action Compact for Ozone with EPA to defer any potential nonattainment designation**

INTRODUCTION

EPA's 8-Hour Ozone Standard

The U.S. Environmental Protection Agency (EPA) established a new, more stringent standard for ozone in 1997. Ozone is formed in the atmosphere through the reaction of volatile organic compounds (VOC) and nitrogen oxides (NO_x) in the presence of sunlight. The new standard is set at a level of 0.08 parts per million (or 80 parts per billion) averaged over an 8-hour period. To take into account extreme and variable meteorological conditions that can influence ozone formation, a violation of the standard occurs when the 3-year average of the 4th maximum values at an individual monitor exceeds the federal standard. Due to rounding of monitoring values, a violation occurs when the 3-year average is equal to or greater than 85 ppb.

EPA's new 8-hour standard was subject to significant legal challenge that was ultimately decided by the U.S. Supreme Court. The Supreme Court issued a decision in February 2001 that affirmed EPA's standard-setting process for the new ozone standard. The D.C. Circuit Court subsequently dismissed all remaining legal challenges to the standard in March 2002 and ruled EPA could move forward with implementing the standard. EPA is in the process of finalizing an implementation plan that will be proposed shortly.

In a recent court settlement with national environmental organizations, EPA committed to make nonattainment area designations for the new standard by April 2004. The recommended designations by states will be due to EPA by April 2003 and will be based on data for the 3-year period 2000-2002. However, it is anticipated EPA will consider data from the 2003 ozone season when finalizing the designations in 2004.

Impact on the Denver Area

The Denver region has been monitoring its status with EPA's 8-hour standard over several years. Historical data showed the Denver region would be close but still below the new standard. However, unusually high levels of ozone during the summer of 1998 put the area in jeopardy of violating the 8-hour standard and created concern among state and local officials for maintaining continued compliance in the future.

In response to this concern, the Regional Air Quality Council (RAQC) and the Colorado Department of Public Health and Environment (CDPHE) established a voluntary ozone awareness and reduction program in 1999. This was the first time the region had focused significant public attention on summertime air pollution issues. The program has expanded since 1999 with additional public awareness and pollution reduction activities.

Elevated ozone concentrations during the summer of 2002 have brought the region within one percent of the federal standard (3-year average of 84 ppb at the Rocky Flats monitor). While the region remains in attainment with the standard, elevated ozone levels in 2003 could push the region into nonattainment when EPA makes final designations in 2004. This would be a significant setback to the region's efforts to achieve attainment with all federal standards and to maintain state and local control over its air quality efforts.

RAQC/AQCC Response to the Governor's Direction

Governor Bill Owens and EPA Administrator Christine Whitman formally recognized the Denver region's attainment of all federal air quality standards in a ceremony in August 2002. This action made Denver the first region of the country to achieve such a distinction. The Governor also recognized that EPA's 8-hour ozone standard presents a significant challenge in maintaining this achievement. He directed the RAQC and Air Quality Control Commission (AQCC) to convene a process involving interested stakeholders and to identify additional actions that can be implemented in the short-term to reduce ozone levels and stave off nonattainment.

The RAQC and AQCC responded by sponsoring three stakeholder meetings in October and November, including an all-day workshop in early October. More than 70 people participated in the meetings, representing industry, academia, environmental organizations, local governments, air quality agencies, and other interested parties. The stakeholder participants developed a list of potential short-term actions that were narrowed to the consensus recommendations presented later in this report.

DENVER REGION OZONE STATUS

High ozone concentrations generally occur in the Denver region on days that are hot, cloud-free, and with stagnant to light winds. Most high-ozone events occur on days when high temperatures are above 90 degrees and when light, up-slope winds occur at the surface and mountaintop level. The absence of cloud cover and thunderstorms promotes ozone formation. Conversely, typical late-afternoon thunderstorms and associated cloud cover retard the formation of ozone and help keep ozone concentrations at levels below the federal standard. Highest ozone levels usually occur in June and July and sometimes early August.

The Colorado Department of Public Health and Environment operates 13 ozone monitors along the Front Range. Nine of these monitors are located in the Denver nonattainment area, with the other three in Colorado Springs, Ft. Collins, and Weld County. Highest ozone concentrations in the Denver area generally occur at monitors located along the foothills. Historically, the NREL monitor on Table Mountain in Golden and the Rocky Flats monitor in northern Jefferson County consistently record the highest levels. In addition, the Highland Reservoir and Chatfield monitors in Douglas County and the South Boulder Creek monitor in southern Boulder County have also recorded elevated concentrations at times.

High ozone concentrations can occur on any day of the week, including weekends. Over the last five years, 69% of the 8-hour ozone levels above 75 ppb have occurred on weekdays while 31% have occurred on weekend days. Of the days above 90 ppb, 67% have occurred on weekdays and 33% on weekends.

CDPHE meteorologists have forecasted ozone alerts since 1999. Alerts are called when ozone levels in the region are anticipated to reach 75 ppb or greater. These forecasts are based on monitoring data, weather forecasts, and ozone forecast models. In 1999, eight ozone alerts were issued, followed by 26 in 2000, 13 in 2001 and 20 in 2002.

Table 1 summarizes the 4th maximum ozone values at all monitors in the state since 1996. The summer of 1998 was an unusual season, with the 4th maximum levels at NREL and Rocky Flats above 90 ppb and values at several other monitors above 80 ppb. In 1999, 2000, and 2001, values returned to normal levels, with 4th maximum values less than 80 ppb at most monitors and in the low 80's for NREL and Rocky Flats.

Table 2 indicates the highest values at selected ozone monitors during the summer of 2002. There were three days in July (1st, 19th, and 20th) when ozone readings exceeded 90 ppb at one or more monitors in the region. The NREL monitor recorded values above 90 ppb on these three days, but the 4th maximum value at the monitor was only 81 ppb, which is consistent with historical levels at the monitor.

The Rocky Flats monitor had an unusual pattern and number of high ozone days, when compared with other monitors. While the monitor recorded a value above 90 ppb on July 19 when high values were recorded throughout the region, the monitor also recorded values in the high 80's on four days in early and late June, days when other monitors did not register exceptionally high values.

Table 3 summarizes the 3-year averages of 4th maximum values at selected monitors for 1998-2000 to 2000-2002. Because of the high values recorded in 2002, the Rocky Flats monitor has become the area of most concern since the 2000-02 average is 84 ppb, only one percent less than the violation level of 85 ppb. In 2003, the region would violate the standard if the 4th maximum at Rocky Flats is greater than 84 ppb. There is greater cushion below the standard at the other monitors.

Table 1

4th Maximum 8-Hour Ozone Values

Site Name	AIRS #	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002 *</u>
		8-hr. O3 4th Max. (ppm)	8-hr. O3 4th Max. (ppm)	8-hr. O3 4th Max. (ppm)	8-hr. O3 4th Max. (ppm)	8-hr. O3 4th Max. (ppm)	8-hr. O3 4th Max. (ppm)	8-hr. O3 4th Max. (ppm)
Welby	08-001-3001	0.074	0.071	0.083	0.071	0.062	0.064	0.068
Highland	08-005-0002	0.073	0.065	0.084	0.075	0.076	0.077	0.076
S. Boulder Creek	08-013-0011	0.075	0.072	0.089	0.075	0.072	0.071	0.078
Carriage	08-031-0014	0.068	0.066	0.085	0.068	0.071	0.072	0.073
Chatfield Res.	08-035-0002	0.079	0.075	0.081	0.075	0.080	0.077	0.083
USAF Academy	08-041-0013	0.057	0.059	0.062	0.064	0.072	0.070	0.072
Arvada	08-059-0002	0.073	0.070	0.089	0.072	0.076	0.074	0.073
Welch	08-059-0005	0.069	0.068	0.080	0.066	0.068	0.064	0.069
Rocky Flats North	08-059-0006	0.083	0.076	0.092	0.080	0.081	0.082	0.088
NREL	08-059-0011	0.082	0.075	0.095	0.080	0.083	0.081	0.081
Fort Collins	08-069-1004	0.066	0.064	0.072	0.063	0.070	0.067	0.072
Greeley	08-123-0007	0.070	0.069	0.075	0.069	0.069	0.074	(Shut down)
Weld County Tower	08-123-0009	---	---	---	---	---	---	0.080

* thru August 2002.

NOTE: An area is considered to be in attainment of the National Ambient Air Quality Standard when the 3-year average of the annual 4th highest daily maximum 8-hour ozone concentration is less than or equal to 0.08 ppm. Due to rounding, a value of 0.085 ppm or greater would constitute an exceedance of the 0.08 ppm standard.

CDPHE-APCD Technical Services Program

Table 2
Highest Ozone Values at Selected Monitors
2002

Monitor	1st Max	2nd Max	3rd Max	4th Max
NREL	<i>20-Jul</i>	<i>19-Jul</i>	<i>1-Jul</i>	<i>18-Jul</i>
20th & Quaker, Golden	92	91	91	81
Rocky Flats	<i>19-Jul</i>	<i>29-Jun</i>	<i>8-Jun</i>	<i>9-Jun</i>
16600 W. Highway 128	92	89	88	88**
S. Boulder Creek	<i>19-Jul</i>	<i>30-Jun</i>	<i>9-Jun</i>	<i>29-Jun</i>
1405 1/2 S. Foothills Pkwy	86	80	79	78
Highlands Res.	<i>1-Jul</i>	<i>19-Jul</i>	<i>12-Jun</i>	<i>28-Jun</i>
8100 S. University Blvd.	86	86	76	76
Chatfield	<i>1-Jul</i>	<i>19-Jul</i>	<i>28-Jun</i>	<i>20-Jul</i>
11500 N.Roxborough Park Rd.	94	89	83	83
** Another 88 ppb level was recorded on 6/30/02				

Table 3
3-Year Average of 4th Maximum Values
1998-2002

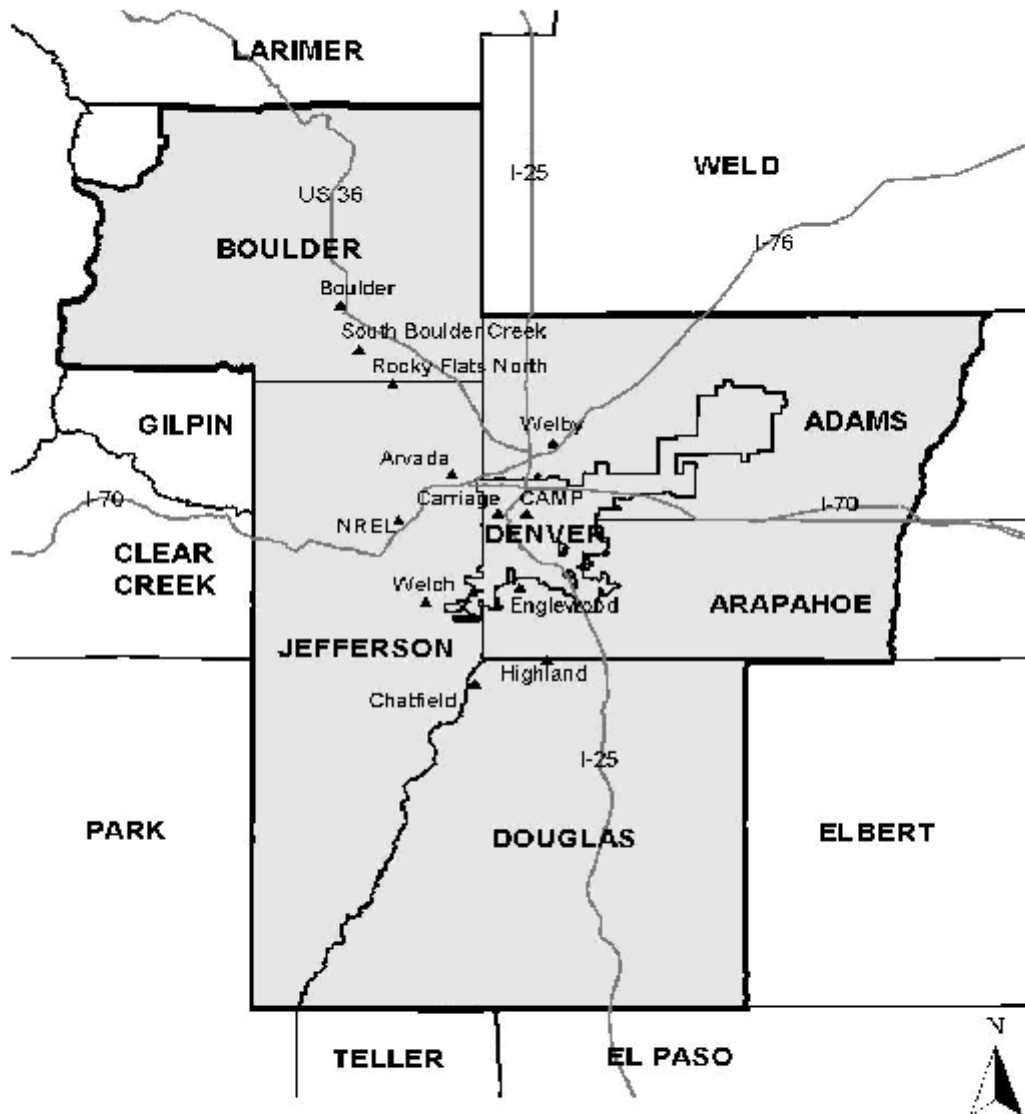
Monitor	1998	1999	2000	2001	2002	98-00	99-01	00-02	2003
						Ave.	Ave.	Ave.	Allow.
NREL	95	80	83	81	81	86	81	82	92
RFN	92	80	81	82	88	84	81	84	84
SBC	89	75	72	71	78	78	73	74	105
HLD	84	75	76	77	76	78	76	76	101
CHAT	81	75	80	77	83	79	77	80	94
** violation occurs when 3-year average exceeds 85 ppb									

In addition, elevated 8-hour ozone readings have also been recorded at times in Rocky Mountain National Park. The highest ozone concentration in 2002 in the Park was 93 ppb, while the 4th maximum was 87 ppb. Six days recorded ozone values of 85 ppb or greater. Most of these days corresponded with days when high ozone concentrations were also recorded elsewhere in the Denver region. For five of these six days, 8-hour ozone concentrations in RMNP were as high as or higher than values in the remainder of the Denver region.

During the previous four years, the high ozone concentrations in RMNP ranged from 80 ppb (2001) to 90 ppb (2000), while the annual 4th maximum values ranged from 70 ppb (2001) to 80 ppb (1998).

Figure 1

Map of the Denver Metropolitan Ozone Attainment/Maintenance Area and Monitoring Sites



SOURCES OF OZONE IN THE DENVER REGION

Ozone is formed in the atmosphere through the combination of VOC and NOx emissions in the presence of sunlight. While it takes both pollutants to form ozone, ozone photochemistry is extremely complex and in some areas VOC emissions are more important for ozone formation while in other areas NOx emissions are more important. In the Denver region, it appears the area is VOC-limited with respect to ozone formation, meaning that VOC emissions are more important for causing high ozone concentrations. As a result, control efforts have focused on reducing VOC emissions as a way of reducing peak ozone concentrations.

VOC Sources

VOC emissions come from a wide range of sources, many of them individually small. While motor vehicles and industrial sources appear to be the principal contributors, even simple, every-day activities like vehicle refueling, lawn mowing, and house painting can be important contributors. Some VOCs are more reactive in the atmosphere than others, and therefore they are more important for ozone formation. Reactivity data show that vehicle exhaust and petroleum-based compounds are the major contributors to ozone formation.

RAQC and CDPHE staff have prepared emission inventories for VOC sources in the Denver region. The inventories use reported data, source emission factors, and activity factors to estimate the contribution of various source categories to regional VOC emissions. The emission inventory contributions from broad source categories are summarized in the table below:

Source category	Tons per Day	% Contribution	Comments
Point sources	147	44%	Includes flash gas emissions from oil and gas facilities in southwest Weld Co. (20%)
On-road motor vehicles	101	30%	52% vehicle exhaust, 40% evaporative; 8% diesel
Non-road vehicles	45	13%	80% gasoline related
Area sources	42	13%	Gasoline refueling (3%); architectural coatings (3%); solvents; consumer products; adhesives; sealants
Total	335		

Flash gas emissions from oil and gas facilities in southwest Weld County have only recently been identified as a potentially significant source of regional VOC emissions. As a result of new reporting requirements required by Regulation No. 3, more data on these sources will become available to verify the emission estimates.

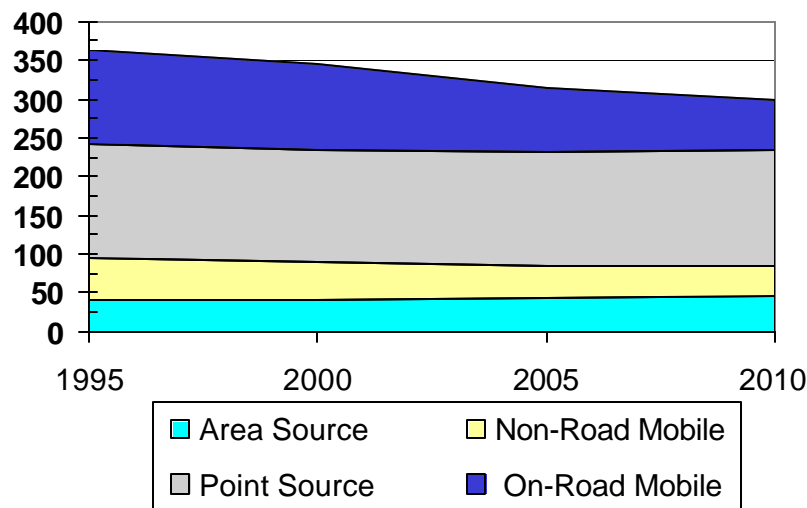
Data from ambient air quality studies can also shed light on the relative contribution from various sources. Data from a recent study in California suggests that 70% of the ozone-forming VOC emissions come from gasoline-powered vehicle exhaust and another 5% from gasoline vapors. A disproportionate amount of ozone precursor emissions from motor vehicles come from a smaller number of high emitting vehicles.

Future Emission Projections

RAQC and APCD staff have also estimated future trends for VOC emissions in the Denver area. These trends take into account future growth projections for the region (population, households, employment, vehicle miles traveled) as well as new and existing federal and state control programs that will reduce emissions over time.

Based on these projections, VOC emissions are expected to continue to decline for the foreseeable future. As the chart below illustrates, total anthropogenic emissions are estimated to decline from almost 350 tons per day in 2000 to about 300 tons per day in 2010, a decrease of almost 15%.

Figure 2. VOC Emission Trends



Most of this decrease is attributed to reductions in on-road mobile source emissions resulting from cleaner motor vehicles and fuels influencing the vehicle fleet. On-road mobile source emissions are expected to decrease by nearly 44% between 2000 and 2010. The projections are based on EPA's new MOBILE6 emissions model and takes into account increasingly stringent standards that have resulted from the Clean Air Act

Amendments of 1990 and EPA's new Tier 2/gasoline sulfur standards that begin to take effect in 2004.

Non-road mobile source emissions are also expected to decrease as a result of past and future small engine standards established at the federal level. Point source emissions are estimated to remain relatively constant over the short-term, while area sources are expected to increase by about 10% as a result of overall growth in regional population and households.

CURRENT VOLUNTARY OZONE REDUCTION AND AWARENESS PROGRAM (1999-2002)

During the summer of 1999, the Regional Air Quality Council (RAQC) launched the Voluntary Ozone Reduction and Awareness Program in cooperation with CDPHE, local governments, businesses, and citizens. The program's goal is to raise ozone awareness and education throughout the metro Denver region by educating citizens, local governments, and businesses about steps they can take to help reduce ozone pollution.

During the past four years many activities and ozone awareness messages have been initiated. These have raised the public's awareness of summertime air pollution problems and reduced ozone-causing emissions. The breadth of these activities is summarized below:

- T An ozone alert system designed to warn people in advance of potential high ozone days and to encourage changes in ozone-contributing behaviors (1999-2002);
- T Voluntary reductions in the Reid Vapor Pressure of gasoline through a partnership with the petroleum refining industry (1999-2002);
- T "*Stop at the Click*" program to reduce gasoline vapor emissions during vehicle refueling through a partnership with the Colorado/Wyoming Petroleum Marketers Association to distribute stickers for gasoline pumps throughout the region (1999-2002);
- T Working with metro-area local governments to make operational changes to reduce VOC emissions and to educate citizens regarding ozone pollution (1999-2002);
- T Distribution of press releases and news articles for placement in newspapers, and on radio and television stations and working with the news media to inform them about ozone pollution (1999-2002);
- T Informational presentations to a variety of groups, including Denver-area environmental transportation coordinators, transportation management organizations, local chambers, etc. (1999-2002);
- T Ozone-related brochures, flyers, bookmarks, refrigerator magnets and other information (including web-based information) distributed to citizens, local governments, businesses, and libraries (1999-2002);

- T *“Put a Cap on Ozone”* gas cap replacement program, including employer-hosted gas cap fairs, in partnership with Colorado Department of Transportation, Envirotest, and NAPA Auto Parts (2000-2002);
- T Public service announcements on drive-time radio (2000-2001);
- T Smart Sign, using remote sensing technology, placed at seven locations around the metro area, to identify high-emitting vehicles and inform motorists of emission-related engine problems (2000);
- T Working with associations of landscape contractors and building owners/managers to highlight emission reduction opportunities with their members (2000);
- T Car care clinic, in partnership with Conoco and NAPA Auto Parts, that evaluated a car’s performance and identified potential emission-related problems (2001);
- T *“Mow Down Pollution”* lawnmower exchange in cooperation with six metro-area Home Depot stores and Black and Decker (2002); and
- T Public service announcements at the highest volume metro-area movie theaters (2002).

RECOMMENDATIONS FOR FURTHER SHORT-TERM ACTIONS

The Regional Air Quality Council and Air Quality Control Commission hosted a series of three meetings, including an all-day workshop, where interested stakeholders discussed the sources of ozone precursors in the Denver area. The participants have identified potential short-term strategies that could be considered to reduce ozone precursor emissions as early as the summer of 2003.

Motor Vehicles and Fuels

1. Implement a High-Emitting/Smoking Vehicle Identification and Repair Pilot Program

High emitting and smoking vehicles contribute disproportionately to all of the region's air quality problems, including VOC emissions that are the prime cause of elevated ozone levels during the summer. Many believe identifying and repairing these vehicles can have a significant impact on ozone-causing emissions in the region.

The RAQC and Colorado Department of Public Health and Environment (CDPHE) have developed a proposal to conduct a High-Emitting/Smoking Vehicle Identification and Repair Pilot Program next summer. The proposal has been submitted for a Congestion Mitigation/Air Quality Grant, which will fund half of the proposed \$450,000 program. A decision on the CMAQ grant is expected in December.

The implementation of this program is scheduled to begin next spring. The High-Emitter Identification Pilot Program is a pilot of a longer-term, full-scale RSD4000 - Remote Sensing with High-Emitter Identification Strategy. The primary difference is that the pilot program is a short-term, voluntary effort that can be implemented next season, while the full-scale program would be mandatory, needs legislative authority and would take several years to implement fully.

High-Emitter Identification Pilot Program (HEIPP)

This element of the High-Emitting/Smoking Vehicle Identification and Repair Program will be developed and operated in partnership between RAQC and CDPHE. The HEIPP will identify high-emitting vehicles of HC or CO through the use of a remote sensing device that measures tail pipe pollutants as vehicles pass by a remote sensing van on the side of the road. The proposed program kick-off is March 2003 and it will operate for 6 months.

Remote sensing units will be used to attempt to identify 2,000 high-emitters of HC or CO in the Denver region's gasoline powered fleet. Owners of vehicles that are identified as high-emitters will be notified that their vehicle may have an emissions problem. They will be offered a free confirmatory I/M240 test at CDPHE centers and Envirotest stations to ensure that their vehicle is a high-emitter. Of the vehicles that volunteer for confirmatory testing, the first 250 that fail for high HC will be offered free diagnostic testing from CDPHE, a repair voucher for up to \$500 redeemable at participating repair facilities, and a rental vehicle for the time their vehicle is in the repair shop.

We estimate that the average cost of repairs will be \$300 per vehicle. A percentage of vehicles that accept the repair voucher will be required to return six months after the vehicle is repaired for a final follow-up test to assess the durability of repairs.

The owners of the remaining vehicles that fail the confirmatory test will be encouraged to make repairs to the vehicle. We anticipate that approximately 100 – 200 of these vehicle owners will voluntarily repair their vehicle. We will be working with local repair shops to offer incentives to these vehicle owners to entice them to repair their vehicles.

In addition to the high-emitter identification effort, a car care clinic will be held by the RAQC and CDPHE in the spring to provide motorists the opportunity to learn about ways to improve their vehicle's performance, reduce emissions, and improve air quality. We will educate vehicle owners how proper car maintenance saves them money by increasing gas mileage and helps the Denver region's air quality by reducing tailpipe emissions.

Smoking Vehicle Education Campaign

The goal of the Smoking Vehicle Education Campaign is to educate local governments about the problems associated with smoking vehicles and convince them to implement a smoking vehicle program to require visibly smoking vehicles to be repaired or retired. Preliminary data from Environmental Systems Products' (ESP) Virginia Pilot Operation shows that approximately 60% of smoking, particle phase high-emitters might also be high-emitters of CO>3% and HC>2000 ppm.

The program developed by the RAQC stakeholder group recommends using local law enforcement to pullover and ticket smoking vehicles. If local law enforcement resources are limited, local governments could use other trained field staff, such as code enforcement, to identify smoking vehicles. Those vehicles identified by the trained field staff would be mailed a summons to appear in court due to violation of the local government's smoking vehicle ordinance. We estimate that if all counties and municipalities in the Denver area participate in this program, roughly 1,200 smoking vehicles could be repaired and 200 could be retired on an annual basis.

During the stakeholder process, some local governments indicated they did not have a smoking vehicle ordinance in place. As a part of our efforts to convince local governments to implement a smoking vehicle program, RAQC staff will develop a model ordinance to assist with program implementation. The proposed program kickoff is March 2003 and it will run indefinitely dependent on CMAQ funding.

2. Use the Smart Sign at Speer and I-25 to identify hydrocarbon emissions

The University of Denver currently operates a Smart Sign on the southbound I-25 off ramp at Speer Boulevard. The Smart Sign combines an innovative variable message sign with a remote sensing device to display individual vehicle emissions information to passing motorists 24 hours per day, 7 days a week. The goal of this effort is to educate motorists about their vehicle's tailpipe emissions and encourage them to make repairs if it has poor emissions.

The Smart Sign currently identifies high emitters of carbon monoxide. Dr. Don Stedman, the sign's inventor, indicates that the system can be changed to identify high emitters of hydrocarbons as well.

During its first deployment from May 1995 to August 1996, the sign gathered 4 million readings for more than 250,000 individual vehicles. The more than 4 million readings were distributed as 86% 'Good', 10% 'Fair' and 4% 'Poor'. In an evaluation of the effectiveness of the Smart Sign (*Evaluation Report for ITS for Voluntary Emissions Reduction-1997*), research showed that 2% of the weighted population (1.6% of the overall fleet) had taken some form of action due to the sign. The evaluation extrapolated this to estimate that over 4,400 voluntary repairs occurred due to the sign.

3. Continue voluntary RVP reduction program

Evaporative emissions of gasoline during refueling and vehicle operation are another significant source of VOC emissions during the summer months. Reid Vapor Pressure (RVP) is a measure of the volatility of gasoline and its ability to release vapors to the atmosphere.

Since 1999 all major suppliers of gasoline in the Denver area have participated in a voluntary Reid Vapor Pressure (RVP) reduction program to reduce the volatility of summertime gasoline. The refiners have all agreed to reduce the RVP of their gasoline supplied in the Denver market in June, July and August by at least 0.5 pounds per square inch (psi) under current regulatory limits.

Participating refiners are Conoco, Frontier Oil, Phillips Petroleum, Sinclair Oil, and Valero Energy. These five refiners supply nearly all the gasoline in the Denver market.

Since 1990, the regulatory RVP limit for gasoline sold in the Denver region is 9.0 psi (10.0 psi for ethanol-blended gasoline), based on waivers granted by U.S. EPA. Since 1999, refiners have achieved the following RVP levels as part of the voluntary program:

Year	Non-ethanol	Ethanol-blended
1999	8.15	n/a
2000	8.2	9.4
2001	8.1	9.3
2002	8.2	9.4

As the table shows, the refiners have exceeded the commitment to reduce RVP by 0.5 psi. The RVP levels in 2002 resulted in an estimated seven ton per day reduction in regional hydrocarbon emissions (based on MOBILE6).

Because of its implementation success, the industry and others recommend continuing the voluntary RVP reduction program.

4. Encourage early introduction of low sulfur gasoline in the Denver market

By 2007 refiners serving the Rocky Mountain market are required to produce gasoline containing no more than 30 ppm sulfur content. This low sulfur gasoline is part of EPA's new Tier 2 gasoline/tailpipe standards that will result in significant reductions of NOx and VOCs in new cars and light-duty trucks. The low sulfur gasoline will enable advanced emission control systems to operate more efficiently in reducing emissions.

This summer, BP America announced the introduction of the low sulfur gasoline earlier than required for premium grade gasoline in Denver and other national markets. The early introduction of this gasoline will allow these areas to realize the emission reduction gains in newer technology vehicles sooner than would otherwise be the case.

It is recommended the RAQC and AQCC work with other refiners and gasoline marketers to encourage voluntary early introduction of low sulfur gasoline in the Denver market so that more market penetration will occur. Consumers also need to be encouraged to consistently use the low sulfur gasoline.

5. Encourage use of alternative fuels that reduce VOCs through education, use of current incentives, and voluntary fleet purchase requirements

Alternative fuels (such as CNG, LPG, E85, M85, electricity) can reduce tailpipe and evaporative VOC emissions beyond current motor vehicle emission standards. It is recommended that the use of the alternative fuels in original equipment manufactured vehicles be expanded by providing information to fleet operators and consumers on the air quality benefits of these fuels and on financial incentives that are currently available to support vehicle purchases. It is also recommended that large fleets establish voluntary minimum purchase requirements to expand the use of alternative fuels and ultra low-emission vehicles.

6. Promote alternatives to driving, especially on ozone alert days

As part of the ozone public outreach and education efforts, the program should promote and encourage alternatives to driving, especially on ozone alert days. Ideas include working with Telework Colorado to promote teleworking on ozone alert days, sponsoring additional Bike to Work days in July and August, and working with DRCOG's RideArrangers to expand the existing Rush Hour Relief program to include summer months as well as winter months.

Area Sources

7. **Voluntarily restrict the availability of solvent based paints in June and July, reschedule the use of solvent based paints to another time of year and encourage the use of low VOC water based paint products for necessary June /July painting projects**

High organic solvent content oil-based or alkyd paints represent about 20% of the architectural surface coatings gallons sold in the Denver metro area. These products are generally used to provide a high gloss and/or hard wearing surface on woodwork, and in bathrooms, kitchens or outdoor decks. In general, there are now equivalent water based products available.

The amount of VOC/gallon of solvent-based products are about 5 times that of water based paint products. Solvent-based products include, by weight, 21% hexane, 5-6% each of MEK and toluene, 3-4% each of ethylbenzene and xylenes, etc. Approximately 58% (or 10 tpd) of the 17 tpd attributed to Architectural Surface Coatings is from solvent based products. A contribution of 10 tpd is approximately 3% of the total anthropogenic VOC inventory.

A voluntary arrangement with paint suppliers and retailers and the house painting industry, as well as a public outreach program to the consumer, will be required to achieve the potential reductions.

8. **Promote a gas can changeout program that will replace portable gas containers with lower-polluting cans and nozzles.**

A central theme in possible controls considered for lawn and garden, recreational boats or equipment and construction equipment is controlling spillage during refilling with a portable gas container. Further investigation, however, based on a report, Inventory of U.S. Emissions from Portable Gas Containers, University of California, Riverside, CA (2001) indicates that 90% of the current portable gas container population is residential, and approximately 80% of the VOC emissions are from evaporation and permeation, while the remaining 20% are from spillage. Evaporative emissions of gasoline include approximately 4% toluene, 2% each of xylene and hexane and 1% ethylbenzene, which are all very reactive compounds in the atmosphere. Chemical treatment of the can and a redesigned non-spill nozzle can reduce the emissions by approximately 75%. The estimated emissions from portable gas containers in the Denver metro area is approximately 12 tons per day.

A well-promoted public outreach program could encourage homeowners and recreational vehicle owners to change out their gas cans with lower-polluting cans and nozzles. Funding and support from suppliers and retailers would be needed to implement such a program.

Public Outreach and Education

9. Implement a “Citizens Choose Clean Air” public outreach campaign to educate citizens about ozone pollution

The ***Citizens Choose Clean Air*** campaign is a voluntary program that will build upon recent efforts to educate metropolitan Denver citizens about simple choices they can make throughout their day to reduce ozone pollution. This program was developed as a result of the Ozone Workshop. Information on the State of Utah’s “Choose Clean Air” campaign was presented at the workshop and later used as a guideline to develop Denver’s ***Citizens Choose Clean Air*** program.

The program will provide wallet-size cards listing several actions citizens can take to help reduce ozone pollution. The program will emphasize the idea that people do not have to dramatically change their lifestyle to make a difference. It is the small, individual actions we take that can result in an air quality benefit.

The cards will list actions ranging from keeping your vehicle well maintained to avoiding mowing your lawn until after 6 p.m. Citizens can then look at their card each day and decide what action suits their lifestyle. For example, public transportation does not work for everyone, so those people can choose to refuel their gas tank after work instead of riding the bus or light rail. Each action item will have a point value assigned to it (1–10 points). Citizens can make a personal goal to reach, for example, 10 points each week.

The cards, in addition to an explanation of the program, will be mailed out to media, citizens, local governments, and businesses. Also, the cards will be available to download on the RAQC’s web site. The RAQC will have a web page dedicated to this campaign so that anyone can access information about the program.

The program will launch in time for the 2003 summer ozone season, which begins June 1, 2003. The distribution of the wallet-sized cards can be coordinated with Earth Day 2003.

10. Increase outreach to regional public information staff

Regional public information professionals offer a tremendous resource to assist with public education and information efforts. These professionals maintain communication and education processes with area citizens that can help expand the ozone information program.

Outreach and education to regional public information staff includes two components: an informational meeting and a web page dedicated to helping public information staff obtain the resources they need to efficiently communicate ozone-related issues to the public.

The Ozone Public Information Meeting will invite professionals who are responsible for educating the public on local and regional health and environmental issues to learn about ozone pollution. The meeting will provide a basic overview of the causes and health effects of ozone and how citizens, businesses, and local governments can help reduce it.

In addition to the overview, information will be provided on different ways these professionals can help communicate these issues more effectively and efficiently. Information packets will be assembled and handed out to each participant to use as a resource to educate the public on ozone-related issues.

Participants of this meeting should include, but are not limited to, public information staff from the Colorado Department of Public Health and Environment (CDPHE), municipalities in the seven county metropolitan Denver region, Denver Regional Council of Governments (DRCOG), Envirotest Systems Corp., the American Lung Association, Environmental Transportation Coordinator groups, and other interested parties. The public information meeting will be held in April 2003 to provide adequate time to prepare articles for newsletters, web sites, and cable access television stations.

The RAQC will also provide a web page to serve as a tool kit to those professionals interested in educating the public about ozone pollution and ways to reduce it. The web page will include the following:

- ozone facts and figures
- news articles ready for insertion into employee and citizens newsletters, web sites, and cable bulletin boards
- up-to-date information on the Denver region's ozone status
- access to press releases
- tips on how to reduce regional ozone pollution
- access to graphics that can be copied into newsletters and web sites

The public information web page will be launched before the date of the PIO meeting so that a demonstration can be provided at the meeting.

11. Continue the "Put a Cap on Ozone" Gas Cap Replacement Program

The RAQC and CDPHE first launched the "Put a Cap on Ozone" program in the summer of 2000 in conjunction with CDOT, Envirotest Systems Corp., independent emissions testing stations, and NAPA Auto Parts. Since then, the program has been expanded to include testing at employer sites around the Denver region. To increase participation, future gas cap fairs will target city- or county-hosted events that ensure several hundred vehicles driving through a particular site. The RAQC will kick-off the program next spring by hosting a Car Care Clinic and will continue conducting gas cap fairs throughout the summer of 2003.

12. Create a partnership with the Colorado Department of Transportation to assist with public communication efforts

The Colorado Transportation Resource and Information Partnership (COTRIP), headed by the Colorado Department of Transportation (CDOT), will partner with the RAQC to broadcast summer ozone alerts on CDOT's public advisory radio (530 AM) and post the alerts on the COTRIP web site at www.cotrip.org. It is estimated that more than 57,000 additional citizens per day will be reached using these two modes of communication.

There is a possibility that the ozone alerts may also be displayed on highway dynamic message boards throughout the metro Denver area. Current federal guidelines limit the use of these message boards to public safety announcements. However, CDOT has convened a committee to explore additional use of the message boards and possibly expand the type of messages currently allowed.

13. Increase media advertising to reach more citizens with information about ozone pollution and potential actions

An expanded media campaign would be very effective and focused, yet very expensive. The message would focus on what ozone is, why it is harmful, and simple ways people can help reduce it. Advertising with the media would focus on a very targeted audience and receive information about how many people were tuning in while the public service announcement (PSA) aired. However, the possibility of a media campaign would depend solely on additional funding sources. There are five main components to a local media advertising campaign: television, radio, print, web, and movie theater advertising. All of these components are outlined in more detail below.

Television

The cost of producing a 30-second, television PSA would cost about \$10,000. It would cost an additional \$200 per spot to air on a local television station. If the PSA ran for one month, one time per day Monday – Friday, on one station during ozone season, the total cost would be approximately \$14,000. The cost would increase by \$1,000 for each additional week it runs.

Radio

Radio advertising is more cost-effective, however, it is hard to know how effective radio advertising can be because people tend to switch radio stations when commercials begin. The cost for a 30-second radio PSA is about \$80 per spot during the 3 – 7 p.m. drive time and \$160 per spot during the 5 – 9 a.m. drive time. If the PSA ran for one month, one time per day, on one station during ozone season, the total cost would range from \$1,600 – \$3,200. The cost would increase \$400 – \$800 for each additional week it runs.

Print

Another media advertising outlet is print newspapers. This is a fairly expensive alternative and the risk exists of having the advertisement lost among all the others. The cost for a 30 column inch (half page) advertisement ranges from \$3,800 – \$4,500 per day, depending on what day the advertisement runs. The cost reflects the ad being run in both the Denver Post and the Denver Rocky Mountain News. For example, if the ad ran every Sunday in both papers during ozone season (13 days), the total ad campaign would cost approximately \$59,000.

Web site

Media web site advertising has become increasingly popular in the last couple of years. It is cost effective and easy to monitor how many hits a particular item receives. Web site advertising takes form in a web banner. The cost for running a

web banner on a television news station's web site for one month costs anywhere from \$1,500 – \$5,000. The banner would have a focused ozone-related message and when someone clicks on the banner, it directs them to the RAQC's web site for more information. The RAQC could create a separate page dedicated to anyone who clicks on the web banner.

Movie Theater

Advertising in movie theaters is another good way to reach a diverse audience without spending a lot of money. The cost for running a slide in the three largest movie theaters in the metro area, on every screen for one month is approximately \$4,000. The cost would be about \$12,000 to run the slides the entire ozone season.

The RAQC ran a slide in five metro area theaters for 6 weeks during the 2001 ozone season. It is estimated that nearly 800,000 people saw the ozone public service announcement.

14. Conduct additional promotional events to target specific sources and increase public education

Public promotional events are a great way to raise public awareness and educate citizens about ozone pollution. In June 2001, the RAQC partnered with Conoco and NAPA Auto Parts to host a free Car Care Clinic, which not only provided a free visual inspection to motorists, but educated citizens about the importance of a properly maintained vehicle. The RAQC plans on hosting another clinic in the spring of next year. In May 2002, the RAQC, in conjunction with the Home Depot and Black & Decker, hosted a lawnmower exchange, which provided discounts on zero-emission lawn equipment to citizens who retired old, gas-powered equipment. Not only were 200 pieces of lawn equipment retired, but the program educated citizens about the contribution of lawn equipment to ozone pollution.

With additional funding, the RAQC can team with other agencies and businesses to host additional promotional events. This can include another lawnmower exchange, more gas cap fairs, additional car care clinics, a gas can change out program, additional Ozone Bike to Work Days, and transit fairs. In order for people to change habits that will help reduce ozone, they must be educated about the problem and how to solve it. Promotional events act as a great tool to educate the citizens of the metro Denver region.

15. Conduct an Ozone Reduction Program awareness survey to gauge the success of public information and education efforts

There are a variety of options available to survey the level of awareness and effectiveness of the Voluntary Ozone Reduction Program. The options, which range in cost, are described in detail below. However, a survey may or may not be feasible before next ozone season due to cost.

One option is to conduct a random, state-wide public survey. There are companies that conduct these types of surveys every 6 – 8 weeks. Any organization can add a few questions to the survey, which is conducted by phone. The survey's respondents can be narrowed to metro-area citizens only. It is meant to give an organization an indication if follow-up research is needed. The cost is about \$1.25 per closed-ended question per person asked. Typically, 500 people will be randomly selected to participate in the survey. If an additional question follows, the cost is about \$1.25 for each response received. The total cost of a survey of this nature would cost between \$625 – \$1,000.

Another option to consider is a web survey. There are several companies that offer tools that allow a project manager to create a customized web survey. A project manager can e-mail the web site address to participants and ask them to answer a few questions about the program. The results will determine how effective a specific component of the voluntary outreach and education program is and to what extent people make changes on ozone alert days. The cost for this type of survey ranges from \$3,000 – \$6,500, depending on how many responses are collected. A survey of this nature would be used in conjunction with the "Citizens Choose Clean Air" campaign. The web site address in which the survey is hosted will be listed on the back of the outreach cards and citizens will be asked to visit the web site to answer questions about the program.

A third option, which is the most expensive, is to hire a research firm to conduct a very thorough and complete survey of the public's level of awareness of RAQC's Voluntary Ozone Reduction Program. This option is the most expensive and will take the most time to complete. The estimated cost for a random phone survey of this nature is \$15,000 - \$20,000.

Point Sources

16. Consider revisions to Regulation No. 7 that address VOC emissions from stationary sources

AQCC Regulation No. 7 controls emissions of volatile organic compounds from a variety of stationary sources. The regulation establishes reasonably available control technology (RACT) requirements for stationary sources.

The AQCC has recently formed a subcommittee to discuss potential revisions to Regulation No. 7. Because the Denver area is close to the new 8-hour standard, any revisions to Regulation No. 7 should be carefully considered so that the Denver region's attainment status is not jeopardized. While revisions to Regulation No. 7 are being considered, the AQCC may also want to entertain revisions that strengthen requirements for stationary sources.

17. Begin working with the oil and gas industry to characterize potential emission sources and to reduce emissions from oil and gas development

Flash emissions from oil and gas development (at the well head) are a newly identified source of VOC emissions at approximately 66 tons per day (20% of the anthropogenic VOC inventory). Further research on these emissions and the potential control options (flaring, pressurized vessels) is recommended. Additional flash emissions come from compressor stations and gas plants - these emissions have not yet been accounted for. There are several control options available depending on the magnitude of the emissions. Facilities with large amounts of flashing emissions may choose to capture these emissions as a product as opposed to flaring.

Air Pollution Control Division inspectors have identified areas for further emission control from the natural gas industry. All natural gas categories could instigate or improve leak detection and repair (LDAR) programs. The current NSPS detection limit is 10,000 ppm, which could be reduced to 500 ppm based on the Conoco settlement. Uncontrolled glycol dehydrators at well heads, compressor stations and gas plants can be controlled by 90+% through the use of condensers, flares, or thermal oxidizers. Truck loading and unloading of product at loading racks could also be improved. During truck loading/unloading at well heads and compressor stations, the venting of overhead vapors occurs and vapor recovery would significantly reduce emissions. Finally, there is a loss of liquids from loading hoses at well heads, gas plants, and compressor stations. The use of dry break hoses would reduce the loss of liquids by 85-90%.

The RAQC and APCD should establish a working relationship with the oil and gas industry so that potential emission sources can be characterized more accurately and opportunities for voluntarily reducing emissions can be pursued.

18. Promote pollution prevention efforts that focus on reducing VOC emissions

The Colorado Department of Public Health and Environment has a well-established pollution prevention program that works with companies throughout the state to promote pollution prevention and waste minimization. The program provides grants to fund pollution prevention projects and offers technical assistance to small and medium sized businesses in the state.

Because of the concern of violating the ozone standard in the Denver area, CDPHE should focus a significant portion of its pollution prevention efforts and grant program on projects that will reduce VOC emissions in the Denver airshed.

Ozone Research

19. Develop an ozone research plan

Historically ozone has not been a major air quality concern in the Denver area and little original ozone research has been conducted in the Denver or Colorado Front Range region as a result. However, now that ozone, as it relates to EPA's new 8-hour standard, has emerged as a significant air quality challenge for the region, additional research is necessary to help guide possible future control efforts.

CDPHE and RAQC should convene a committee of knowledgeable air quality scientists, researchers, and policy-makers to develop a comprehensive ozone research plan for the Front Range region. The research plan should contain elements to help us better understand the causes of ozone formation in the Front Range, sources of ozone in the ambient air, and the potential effectiveness of controlling various source categories. The plan should lay out the objectives of the research so the study can be focused on answering the critical questions for understanding ozone in the Front Range. The research plan should take into account unique meteorological conditions in the Front Range, the mix of sources, current control efforts, and other variables that may be specific to the Front Range. The research plan should address ambient research, source profiles, emission inventory improvements, air quality modeling and other research needs.

The plan should contain an estimate of the cost to conduct the elements of the plan. The plan should also contain a schedule and time line for completing the study if and when funding is secured to implement the plan.

A research effort such as this will require additional funding beyond what is currently available in existing budgets. Therefore, the committee should identify potential and realistic sources of funding to implement the plan and recommend an approach for securing the necessary funding.

The committee should complete the research plan and present the plan and its recommendations for funding sources to the Regional Air Quality Council, Air Quality Control Commission, and CDPHE management by April 1, 2003.

Ozone Planning

20. Develop an Early Action Compact for Ozone with EPA to defer any potential nonattainment designation.

EPA is expected to make nonattainment designations for the 8-hour ozone standard in April 2004. These final designations likely will be based on monitored data for the period 2001-2003. For the Denver area, ozone data from 2003 and 2004 are expected to be critical determinants for the area's continued attainment of the federal standard.

For areas that currently approach or monitor exceedances of the 8-hour standard, EPA is offering a process for developing Early Action Compacts whereby air quality reductions

would be achieved earlier than would otherwise be required. In return, EPA would recognize the local area's commitment to early action by provisionally deferring the date of any nonattainment designation and related requirements, contingent upon the participating area meeting all terms and milestones of the compact. If the area demonstrates attainment of the standard by December 31, 2007, EPA will designate the area to attainment and no additional requirements will be imposed. An area can withdraw from the Compact process at any time and return to the traditional State Implementation Plan (SIP) process and requirements.

To qualify for an Early Action Compact, several planning and implementation milestones must be met:

<i>December 31, 2002</i>	<i>Compact and Memorandum of Agreement signed by local, State and EPA officials.</i>
<i>June 16, 2003</i>	<i>Local area identifies and describes the additional state and local control measures, if any, that will be considered during the local planning process, after taking into account existing Federal and state measures.</i>
<i>March 31, 2004</i>	<i>Local plan completed and submitted to the State for inclusion in the SIP. The plan shall include measures that are specific, quantified, permanent and federally enforceable when approved by EPA as part of the SIP.</i>
<i>December 31, 2004</i>	<i>State submits a SIP to EPA consisting of the local plan, including all adopted measures and a demonstration of attainment by December 31, 2007.</i>
<i>September 30, 2005</i>	<i>EPA takes final action on the submitted SIP.</i>
<i>December 31, 2005</i>	<i>Local area implements the local control measures that have been included in the SIP.</i>
<i>June 30, 2006</i>	<i>State submits an assessment that documents the local area's progress in implementing the plan and improving air quality.</i>
<i>December 31, 2007</i>	<i>The area must attain the 8-hour standard, based on 2005-2007 data. If the area attains the standard, EPA will withdraw any deferred nonattainment designation and replace it with an attainment designation. If the area fails to attain by this date, the nonattainment designation will become effective April 15, 2008 and a revised attainment demonstration SIP will be due by December 31, 2008.</i>

The stakeholder participants recommend pursuing the Early Action Compact at this time to preserve the area's options in the future. If the area violates the 8-hour standard in the near future, the Compact will allow the region to defer and ultimately avoid a nonattainment designation by implementing an effective local plan. On the other hand, if the area continues to attain the standard in 2003 and 2004, the region could choose to withdraw from the Compact before a SIP is submitted to EPA.