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**Note: All data files can be downloaded via the navigation menu on the left.**

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## Northern Front Range Air Quality Study

Welcome to the home of the Northern Front Range Air Quality Study on the internet. Please note that this site contains summarized information concerning the study with large, detailed information available to download. **This site is best viewed at 800 x 600 resolution or better, and with the most**

**recent version of Netscape or Microsoft Internet Explorer.**

Photo courtesy of Colorado Department of Public Health and Environment.  
Map on previous page courtesy of Colorado Department of Transportation.

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The Northern Front Range Air Quality Study was instituted by the Colorado State Legislature through House Bill 95-1345 ([House\\_Bill\\_95\\_1345.pdf](#)) and amended through House Bill 96-1179 ([House\\_Bill\\_96\\_1179.pdf](#)). The legislation delineated an independent, objective, scientifically peer-reviewed study of air pollution along the Northern Front Range of Colorado to be managed by Colorado State University and funded through contributions from nearly 40 groups (private industry, local and national organizations, local state and federal agencies). The \$4 million Study was conducted in three phases: Phase 1- Winter of 1996, Phase 2- Summer of 1996, and Phase 3- Winter of 1997. The final Study results were delivered to the Governor and the General Assembly on July 1, 1998.

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**Dr. Douglas R. Lawson**, NFRAQS Technical Project Manager  
Phone (303) 275-4429

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**Sponsors**

ARCO Coal Company  
Associated Governments of Northwest  
Colorado  
Center for Energy and Economic  
Development  
City and County of Denver  
Colorado Office of Energy Conservation  
Colorado Interstate Gas Company  
[Conoco, Inc.](#)  
[Coordinating Research Council](#)  
[Coors Brewing Company](#)  
Cyprus Amax Mineral Company  
[Denver Nuggets Limited](#)  
Eastman Kodak Co.- Colorado Division  
[Englewood/Littleton Wastewater](#)  
[EPRI](#)  
Fort Collins Consortium:  

- Anheuser Busch
- [City of Fort Collins](#)
- [Colorado State University / CIRA](#)
- Hewlett-Packard
- [Larimer County](#)

Kennecott Energy Company  
KN Energy  
Lockheed Martin  
Metro Denver Wastewater  
[Natural Fuels Corporation](#)  
Pacific Power Corporation  
[Phillips Petroleum Co.](#)  
[Platte River Power Authority](#)  
Public Service Company of Colorado  
[Regional Air Quality Council](#)  
[Rocky Mountain Hearth Products Association](#)  
Seneca Coal Company  
[State of Colorado](#)  
Total Petroleum  
Trigen Colorado Energy Company  
Ultramar / Diamond Shamrock  
[U.S. Department of Energy](#)  
[U.S. Environmental Protection Agency](#)

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## Participating Groups

Aerosol Dynamics, Inc.  
[Air Resource Specialists, Inc.](#)  
[Colorado Department of Public Health  
and Environment](#)  
[Colorado School of Mines](#)  
[Colorado State University](#)  
[Desert Research Institute](#)

ENSR  
[EPRI](#)  
General Motors R&D Center  
Midwest Research Institute  
[National Institute for Standards and Technology](#)  
[National Oceanic & Atmospheric Administration](#)  
[National Renewable Energy Laboratory](#)  
[Regional Air Quality Council](#)  
[Sonoma Technology, Inc.](#)  
[U.S. Environmental Protection Agency](#)

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**Committee Information**  
**Northern Front Range Air Quality Study**



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## Technical Fact Sheet

March, 1996

Significant progress has been made toward improving air quality in the state of Colorado due to the efforts of its citizens and implementation of certain air quality control programs. To continue improvement of our air quality and to assure that air quality standards are achieved and maintained, accurate information about the nature of Colorado's unique air pollution problems must be acquired and evaluated to implement sound and cost-effective air pollution control strategies. In addition, current strategies must be evaluated to see if they are achieving clean air using the most effective methods.

The State has been the beneficiary of a number of studies in the past that have provided information for use by policy makers. The Governor, the General Assembly, members of the regulatory community and the private sector have acknowledged that additional source attribution studies must be accomplished in order to determine the sources and interaction of air pollutants along the Northern Front Range of Colorado. We still do not fully understand what sources contribute to the Denver area's "Brown Cloud" and the atmospheric conditions that are responsible for its formation. In recognition of these needs, the Governor signed into law HB95-1345, which authorized the Northern Front Range Air Quality Study (NFRAQS), an independent, peer-reviewed scientific study of air quality, to be managed by Colorado State University.

The original legislation required that the NFRAQS be carried out in the winter of 1995-1996. However, after thorough review of the existing schedule and funding resources, the eight-member Technical Advisory Panel, chaired by Senator Tom Norton and Representative Shirleen Tucker, recommended that the Study be extended to allow for better planning and coordination of resources. In the meantime, a small monitoring effort took place at an existing air monitoring site in the northeastern Denver area, and it ran for a seven-week period through February 1996. The data collected at this site will provide information that will be used to help design the major study effort, which will take place from November 1996-February 1997. In addition, a small summer study in 1996 will collect visual and chemical air quality data, coupled with meteorological information, so that summer pollution episodes can be compared with winter "Brown Cloud" occurrences.

After a series of meetings, the NFRAQS Technical Advisory Panel has chosen three policy questions to be addressed by the Study:

- What are the sources of carbon particles found in Denver's "Brown Cloud", which on average account for about 60 percent of the fine particle fraction?
- Is the Denver area ammonia-rich with regard to formation of ammonium nitrate and ammonium sulfate particles? The answer to this question will determine

which control strategies will be most effective and least costly in reducing formation of airborne particles in the Northern Front Range region.

- What are the sources of visibility-reducing PM2.5 particles, many of which are formed through a series of complex reactions in the atmosphere?

Colorado's strategies for improving air quality will be strongly influenced for years to come by results from the NFRAQS. Several private and government sponsors, from both local and national groups, have joined hands to sponsor what will be the most comprehensive urban air pollution study conducted in the Intermountain West.

Fund-raising efforts for the Study are underway. The total budget is estimated to be \$2.5 million. The NFRAQS Technical Advisory Panel strongly urge that potential sponsors provide additional funding so that sufficient data can be collected to answer the policy-relevant questions listed above. Cooperation from all sponsors and participants will ensure maximum payback and credible results in this independent, peer-reviewed scientific study. For questions regarding participation in the NFRAQS program, please call Mick Snapp at (303) 730-6761. For questions regarding technical information, call Dr. Douglas Lawson, the NFRAQS Technical Project Manager, at (970) 491-8271.

## **MEMORANDUM OF UNDERSTANDING**

**July 1996**

BETWEEN PARTICIPANTS AND SPONSORS By signing below,  
\_\_\_\_\_ ("participant") hereby agrees that participant shall keep confidential all information obtained in connection with the Northern Front Range Air Quality Study ("the Study") unless the participant is required by law to provide information. However, participant may reveal and discuss such information with members of the Quality Control Committee, External Peer Review Committee, Technical Advisory Panel, those employees of Colorado State University who are involved with the Study on an ongoing basis, and those persons who will be under contract for the collection, analysis and/or interpretation of data as part of the Study (those who also have signed this Memorandum). Data collected by the Colorado Department of Public Health and Environment and the National Oceanic and Atmospheric Administration can be made available to anyone who requests it. Participant shall not, without the prior written consent of the Technical Advisory Panel, disclose any information regarding the Study in any manner whatsoever. The expiration date of this Memorandum of Understanding is July 1, 1998.

Signature \_\_\_\_\_

Printed Name \_\_\_\_\_

Date \_\_\_\_\_

Desired Password for Web Access \_\_\_\_\_

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## **PURPOSE**

This attachment to the Memorandum of Understanding (MOU) states principles and guidelines under which the Study participants will work together toward achieving the objectives of the Northern Front Range Air Quality Study (NFRAQS). This MOU is directed to those who will be under contract for the collection, analysis and/or interpretation of data collected as part of the Study. The purpose of this MOU is to ensure that there is a clear understanding regarding conduct of participants in the Study, the exchange of information, and the analysis, interpretation and presentation of the Study results to the general public. Participants are defined as those who receive funding or support for the purpose of collecting data during the Study, those who have access to such data, or those who analyze data that have been collected by others during the NFRAQS.

## **BACKGROUND**

### ***OBJECTIVES OF THE STUDY***

The Study shall be an independent, objective, scientifically peer-reviewed effort, with the following aims:

- Determining the sources of the air pollution in the Northern Front Range region, including sulfate, nitrate, and other particles, sulfur dioxide, carbon monoxide, nitrogen oxide gases, ammonia and volatile organic compounds;
- Collecting discrete data necessary to support decision-making concerning the technical feasibility of achieving the state visibility goals established pursuant to section 25-7-106.1 and in the development of State Implementation Plan provisions for the attainment and maintenance of federal ambient air quality standards for the Northern Front Range region;
- Identifying the fraction of the particulate matter with an aerodynamic diameter less than or equal to a nominal ten micrometers ("PM10") which is represented by particulate matter with an aerodynamic diameter less than or equal to a nominal two-and-one-half micrometers ("PM2.5");
- Determining what portion of the PM2.5 fraction is attributable to various sources and source categories;
- Measuring the stationary and mobile source contributions to carbon monoxide pollution to determine whether any distinction may be made among different sources of pollution. Such measurement shall include the analysis of existing data and information.
- Identifying, to the extent possible and feasible, the sources of the precursors of particulate matter pollution, including ammonia sources; and

- Gathering ambient air samples from locations throughout the Northern Front Range region to document sub-regional air pollution exposure levels.

## ***PARTIES***

The parties in this Study are the Governing Board, the Technical Advisory Panel (TAP), the Quality Control Committee (QCC), and Colorado State University (CSU). The Governing Board consists of the Governor of the state of Colorado, the President of the Colorado State Senate, and the Speaker of the House of Representatives. The membership of the Technical Advisory Panel, as specified in House Bills 95-1345 and 96-1179, is as follows: one member from the state Senate, one member from the House of Representatives, one member from the Department of Public Health and Environment, one member from the Regional Air Quality Council, one member representing recognized environmental groups, three members from industry groups significantly affected by air pollution control strategies required along the Front Range area, one member each from the motor vehicle and petroleum industries, and two members with expertise in air quality studies. The Quality Control Committee is comprised of individuals representing entities that contribute time, expertise, and funding to support the Study. The number of members on the QCC is not limited. CSU serves as the contractor to the state and also as Technical Project Manager for the Northern Front Range Air Quality Study. The roles of each of the parties are as follows:

### **Governing Board**

- Appoints members of the Technical Advisory Panel and designates its chair
- Contracts with the President of Colorado State University to request proposals for and oversees the Study
- Secures funding for the Study
- Defines the goals and work products of the Study
- Contracts for the implementation of the Study
- Approves the work plan and budget for the Study
- Approves the final report
- Acts as final arbiter in disputes between and among those connected with the Study

### **Technical Advisory Panel**

- Reviews the work plans and budgets for the Study
- Approves expenditures for the Study
- Makes technical recommendations to the Board and Contractor
- Reviews RFPs for the for the Study
- Reviews contractor and subcontractor reports and products
- Reviews and approves data reports and analyses and interpretation of data that are to be presented to outside groups and/or to the general public
- Reviews and approves the final report

## **Quality Control Committee**

- Serves in an advisory and review capacity
- Gives technical support and expertise to the Technical Advisory Panel and Colorado State University concerning the scope and status of work and the conduct and results of the Study
- Provides input without interfering with the accomplishment of the goals set forth in Section 1 of House Bill 95-1345, without delaying the start or completion of the Study

## **Contractor/Technical Project Manager (Colorado State University)**

- Oversees the Study in compliance with the Statute
- Receives funding from the state to conduct the Study
- Develops and proposes work plans and budgets for the Study
- Develops Requests for Proposal (RFP) processes, selects and contracts with subcontractors as necessary to conduct the Study, according to direction from the Board and Technical Advisory Panel
- Performs necessary administrative, management, monitoring and coordination tasks
- Manages and distributes funds as necessary to conduct the Study, according to the approved work plan and budget
- Coordinates public information activities through its public relations office and serves as spokesman for the Study
- Establishes and convenes a design team of nationally recognized scientific experts to provide technical input and guidance to the study
- Establishes and convenes an external peer review committee to review the RFPs and bids received in responses to those RFPs
- Provides staff support to the Technical Advisory Panel and participates in meetings of the Quality Control Committee
- Assures preparation of the final report

## **PARTICIPANT COOPERATION**

The purpose of the NFRAQS in obtaining the results of the research conducted by the Study participants is to make those results available for the use and beneficial application by the General Assembly, policy makers and the general public, and to further advance the state of scientific and technological knowledge regarding air quality of Colorado's Northern Front Range. Each participant in this Study will contribute toward the acquisition and analysis of scientifically useful and policy-relevant data. As part of its contribution of this Study, each group will provide needed data to the CSU Technical Project Manager in a timely manner as outlined in House Bills 95-1345 and 96-1179. Because several groups will be involved in this Study, the utmost cooperation and courtesy will be required by participants before, during and after the field measurements are completed.



If sufficient data of high quality are obtained during the Study periods, CSU may sequester selected data from as many as two episodes for model verification purposes at a later date. The data, however, will be available for source apportionment analyses as part of the Study objectives.

## **DATA ANALYSIS AND INTERPRETATION**

In a cooperative study, it is expected that the responsibility for many tasks will be divided between the participants, with joint authorship of reports. Good-faith efforts will be made to reach consensus on technical issues. If necessary, at the request of the Technical Project Manager or the Technical Advisory Panel, the participants will use mediation by the Governing Board to aid in reaching consensus. In the event that differences are unresolvable, different viewpoints will be included in reports, along with a clear identification of the researcher or institution associated with each viewpoint.

## **REPORTING**

The final report will be prepared by the Study subcontractor(s). Before release of the report, a good-faith effort will be made to accommodate the concerns of all participants. A draft of the draft final report will be reviewed by the external peer review committee or others as requested by the Technical Advisory Panel. The report will be released to the general public after it has been reviewed and approved by the CSU Technical Project Manager and the Technical Advisory Panel.

Prior to presenting papers or findings regarding the Study at scientific meetings, in the peer-reviewed literature or to the general public, the participants will provide the Technical Project Manager and the Technical Advisory Panel with a four-week period to review and comment on the papers or presentations. Any contractors, participants or members of the Technical Advisory Panel will follow the protocol described above for advance review of papers and presentations. Three working days' advance review by the Technical Advisory Panel shall apply to press releases pertaining to the Northern Front Range Air Quality Study.

## Northern Front Range Air Quality Study Emission Data

This link will take you to our Emissions Inventory Maps (provided by DRI). [NFRAQS Emissions Inventory Map Page.](#)

The links below take you to a detail page of data files for the corresponding portions of the Emissions Data.

### **Gridded Emission Inventory by Source Type and Pollutant**

Gridded NFRAQS emissions inventory by source type and pollutant. The source types are airport, area, mobile and wood and the pollutants are CO, NOX and SO2. Zip and individual files available via the links below:

Complete Archive of Emission Inventory by Source Type and Pollutant  
(Complete\_Archive.zip)

Individual Data Files-

Airport Sources	<a href="#">Airport_Sources.txt</a>	<a href="#">Airport_Sources.xls</a>
Area Sources	<a href="#">Area_Sources.txt</a>	<a href="#">Area_Sources.xls</a>
Mobile Sources	<a href="#">Mobile_Sources.txt</a>	<a href="#">Mobile_Sources.xls</a>
Wood Sources	<a href="#">Wood_Sources.txt</a>	<a href="#">Wood_Sources.xls</a>
CO- Airport	<a href="#">CO_Airport.txt</a>	<a href="#">CO_Airport.xls</a>
CO_ Area Sources	<a href="#">CO_Area.txt</a>	<a href="#">CO_Area.xls</a>
CO- Mobile Sources	<a href="#">CO_Mobile.txt</a>	<a href="#">CO_Mobile.xls</a>
CO-Wood Sources	<a href="#">CO_Wood.txt</a>	<a href="#">CO_Wood.xls</a>
NoX- Airport Sources	<a href="#">NoX_Airport.txt</a>	<a href="#">NoX_Airport.xls</a>
NoX- Area Sources	<a href="#">.txt</a>	<a href="#">.xls</a>
NoX- Mobile Sources	<a href="#">.txt</a>	<a href="#">.xls</a>
NoX- Wood Sources	<a href="#">.txt</a>	<a href="#">.xls</a>
SO <sub>2</sub> Airport Sources	<a href="#">.txt</a>	<a href="#">.xls</a>
SO <sub>2</sub> Area Sources	<a href="#">.txt</a>	<a href="#">.xls</a>
SO <sub>2</sub> Mobile Sources	<a href="#">.txt</a>	<a href="#">.xls</a>
SO <sub>2</sub> Wood Sources	<a href="#">.txt</a>	<a href="#">.xls</a>

### **Gridded Emission Inventory by Point Source**

CDPHE emission inventory point source dbase table. It is organized by grid cell where cell #1 is the lower left corner, #78 is the lower right corner, #4213 is the upper left corner and #4290 is the upper right corner. Files contained in this archive are:



## Study Data: Phase 1 - Winter 1996

Winter 1996 Request for Proposal (RFP): [[Adobe Acrobat format](#)] [[Text format](#)]  
[[Word 95 Format](#)] [[Word 97 Format](#)]

<i>File Name</i>	<i>[.txt file]</i>	<i>[.xls file]</i>	<i>[.dbf file]</i>	<i>[.zip file]</i>
AIRS Particulate Hourly Data	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	
AIRS Hourly Data	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	
ARS Aethelometer	<a href="#">.txt</a>			
ARS Aethelometer Data	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	
ARS Nephelometer	<a href="#">.txt</a>			
ARS Nephelometer Data	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	
CDPHE January, 1996	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	
CDPHE February, 1996	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	
DRI Mass Babs Data	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	
DRI Welby Filter Data	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	
NWS Upper Air Data	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	

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## Study Data - Study Phase 2 - Summer 1996

### PLEASE READ:

Data files are available in 3 versions Text (.txt), Excel (.xls) and dBase (.dbf). The text files allow for viewing on line and download. Once downloaded, open the file as delimited text in a spreadsheet program such as Excel (be sure to specify the NFFLAGS column as text), it should view and print very well. Excel (.xls) and dBase (.dbf) versions of the files may also be downloaded but will not be accessible via your browser. ZIP links below will allow you to quickly download zipped versions of the corresponding documents (.xls or .dbf versions). However, you must have a zip program such as pkzip or winzip installed on your computer in order to open these zip files (<http://www.winzip.com>)

### Sites, Field Name, and Validation Flag Information (Necessary for the interpretation of study data and reports)

<i>File Name</i>	<i>[.txt file]</i>	<i>[.xls file]</i>	<i>[.dbf file]</i>	<i>[.zip file]</i>
ARS Legend	<a href="#">.txt</a>	<a href="#">.xls</a>	<a href="#">.dbf</a>	

CDPHE Legend (AIRS)	[.txt]	[.xls]	[.dbf]
DRI Legend	[.txt]	[.xls]	[.dbf]
NOAA Legend	[.txt]	[.xls]	[.dbf]

### Study Data Phase 2- Summer 1996

<i>File Name</i>	<i>[.txt file]</i>	<i>[.xls file]</i>	<i>[.dbf file]</i>
Summer 96 Data Zipped	<a href="#">[.txt]</a>	<a href="#">[.xls]</a>	<a href="#">[.dbf]</a>
AIRS Particulate Hourly Data	<a href="#">[.txt]</a>	<a href="#">[.xls]</a>	<a href="#">[.dbf]</a>
AIRS Continuous Hourly Data	<a href="#">[.txt]</a>	<a href="#">[.xls]</a>	<a href="#">[.dbf]</a>
ARS Aethalometer Data	<a href="#">[.txt]</a>	<a href="#">[.xls]</a>	<a href="#">[.dbf]</a>
ARS Welby Nephelometer Data	<a href="#">[.txt]</a>	<a href="#">[.xls]</a>	<a href="#">[.dbf]</a>
CDPHE 8 hour data			
CDPHE BETA PM10 Data			
DRI Ammonia Concentrations	<a href="#">[.txt]</a>	<a href="#">[.xls]</a>	<a href="#">[.dbf]</a>
DRI Nitric Acid Concentrations	<a href="#">[.txt]</a>	<a href="#">[.xls]</a>	<a href="#">[.dbf]</a>
DRI SO2 Concentrations	<a href="#">[.txt]</a>	<a href="#">[.xls]</a>	<a href="#">[.dbf]</a>
DRI Sequential Filter Sampler PM10 and PM2.5 Concentrations	<a href="#">[.txt]</a>	<a href="#">[.xls]</a>	<a href="#">[.dbf]</a>

### Study Data - Study Phase 3 - Winter 1996-1997

#### PLEASE READ:

Data files are available in 3 versions Text (.txt), Excel (.xls) and dBase (.dbf). The text files allow for viewing on line and download. Once downloaded, open the file as delimited text in a spreadsheet program such as Excel, it should view and print very well. Excel (.xls) and dBase (.dbf) versions of the files may also be downloaded but will not be accessible via your browser. ZIP links below will allow you to quickly download zipped versions of the corresponding documents (.xls or .dbf versions). However, you must have a zip program such as pkzip or winzip installed on your computer in order to open these zip files (<http://www.winzip.com>)

#### Data for Study Phase 3 - Winter 1996-1997

- [Emissions Inventory Data](#)
- [Site and File Information](#)
- [AIRS Data](#)
- [Air Resource Specialists \(ARS\) Data](#)

- [Auto Nitrate Data](#)
- [Colorado Department of Public Health and Environment \(CDPHE\) Data](#)
- [Cooperative Agricultural Meteorology System \(CoAgMet\) Data](#)
- [Desert Research Institute \(DRI\) Data](#)
- [Kodak Data Winter 1996 - 1997](#)
- [National Oceanic and Atmospheric Administration \(NOAA\) Data](#)
- [National Weather Service \(NWS\) Data](#)
- [RAWS Data](#)