# GUIDANCE FOR COUNTY AND LOCAL AGENCIES CONDUCTING SPECIAL AIR QUALITY STUDIES

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Colorado Department of Public Health and Environment
Air Pollution Control Division
Technical Services Program

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COLORADO
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# Introduction

Often local or county health departments are faced with citizen or governmental requests for air pollution monitoring. The purpose of this guidance is to assist local agencies in addressing these issues. Although monitoring is often viewed as a first response to complaint situations, it may not provide an adequate solution. Other measures may resolve complaint situations more expediently than monitoring. Therefore, Section I of this report discusses a number of complaint situations, and potential means of resolving the problem without the expense and delay of air quality monitoring. If, after review of Section I, a monitoring effort is still desired, Section II discusses designing short-term, focused special studies involving particulate matter, gaseous and meteorological monitoring. This guidance describes issues that need to be addressed when planning such studies, or when requesting assistance from the Colorado Air Pollution Control Division (APCD).

## Section I. Is Air Pollution Monitoring Necessary?

When a local agency receives a request for air quality monitoring, the first step is to determine the reason for the request, and consider whether air monitoring is a viable solution to the problem. Many air quality monitoring requests are based on citizen experiences with a nuisance source. In many cases, enforcement of existing regulations, or additional air pollution emission control measures are a more effective and timely solution than air quality monitoring. Efforts should also be made to determine if air monitoring in the area already exists that would address the issue and if air quality permits exist for the source.

Some examples of nuisance situations that may lead to requests for air quality monitoring are:

- Odors
- Dust from Dirt Roads
- Diesel Emissions from Trucking Operations or Bus Lots
- Dust from Feedlot Operations
- Emissions from Gravel Pits and Mining Operations
- Complaints Related to a Specific Source
- Nuisance Issues

Air quality monitoring may also be sought when there is a concern for air quality impacts from an area-wide activity. Examples are:

- Oil and Gas Operations
- Neighborhood Impacts from Local Industry
- Air Quality Impacts from Expanding City Boundaries / Development.

These situations and possible responses are discussed below.

## Odors

Air quality monitoring generally measures the concentration of a specific chemical compound. Air monitoring does not directly answer the question of how odorous the situation may be. A human observer (inspector) is often a more timely and effective response. An inspector may conduct an assessment using a nasal ranger or olfactometer. If there are doubts about the compound involved, the use of a portable emergency response sensor may be helpful. A large number of compounds can contribute to odor perception. Odor perception also varies widely among individuals. The transitory nature of odors makes it almost impossible to "capture" them in a routine monitoring program. It can also be difficult for inspectors to "catch" an odor situation, as wind direction can shift over time. For these reasons, it is more helpful to collect anecdotal information about when the odors occur: time of day, season, wind direction, wind speed, other weather conditions at the time of the odors, etc. It is often very useful for complainants to keep a log of the odor situation. An inspection of the suspected source may also be useful. Discussing the situation with the source may provide alternative solutions, such as

voluntary control measures, which may include enclosing the odor source area, using deodorant chemicals, or installing engineering control measures.

## Dirt Roads

Dirt roads may emit particulate matter as $PM_{10}$ and $PM_{2.5}$. $PM_{10}$ is an abbreviation for particles with an aerodynamic diameter of 10 microns or less. The term $PM_{2.5}$ is used to denote particles with an aerodynamic diameter of 2.5 microns or less. Over the years, the Air Pollution Control Division has experienced little success in air quality monitoring efforts related to fugitive particulate matter emissions. This is because the standards for particulate matter ($PM_{10}$, $PM_{2.5}$) are expressed as 24-hour or annual averages. Most locations in the state show compliance with these standards. However, compliance with the federal standards does NOT mean that fugitive dust issues are not significant and bothersome to citizens during portions of the day. Generally, fugitive emission control measures are a better means of addressing these concerns. Unfortunately, the Air Pollution Control Division cannot always compel sources to implement these control measures. For example, entities maintaining dirt roads cannot be ordered to produce a fugitive emissions control plan unless traffic is greater than 200 vehicles per day in attainment areas and 150 vehicles per day in non-attainment areas per Air Quality Control Commission (AQCC) Regulation 1 https://www.colorado.gov/pacific/cdphe/aqcc-regs. Land development projects must be greater than or equal to 25 continuous acres and/or 6 months or longer in duration to implement a fugitive dust control plan per AQCC Regulation 3 https://www.colorado.gov/pacific/cdphe/aqcc-regs Thus, in many situations, dust issues may be resolved or at least reduced by encouraging best management practices. The Division has a list of recommended practices available upon request.

Actions that have been helpful in the past include:

- Urging Complainants to Photograph the Situation
- Sending an Inspector To the Area
- Increasing / Implementing Road Watering
- Application of Surfactants to the Road Surface
- Gravelling the Road Surface
- Paving the Road
- Reducing Speeds of Vehicles On Road
- Having Trucks Cover Beds When Hauling Earth Materials
- Limiting the Size of Truck Loads
- Treating Truck Loads With Water or Chemical Surfactants
- Wheel-Washing Stations to Minimize Dirt Carry-out Onto Paved Roads
- Street Sweeping To Remove Materials on Roads
- Scraping or Compaction of Road Surfaces.

## Diesel Emissions from Truck or Bus Operations

Operations involving large numbers of fleet vehicles, when conducted in proximity to residential areas, may cause problems. In addition to air quality issues, traffic, noise, and nighttime lighting may be concerns. In these cases, air quality monitoring is usually not an

effective answer. This is due to the fact that the federal particulate standards are expressed as 24-hour or annual averages. Most areas of Colorado are in compliance with these standards. Therefore, it is unlikely that the fleet area will show violations. In the absence of violations, it is difficult to compel the source to address the situation. Therefore, generally one must seek voluntary compliance. Sometimes there are local ordinances related to vehicle idling and noise. Often, enforcement of these ordinances can lead to dramatic reductions in emissions from the operation.

Possible responses to the situation include:

- Re-Routing Vehicle Traffic Away from Sensitive Areas
- Enforcement of Idling and Noise Ordinances
- Ensuring that Vehicle Emission Controls Are Well-Maintained
- Fencing the Area So That Fleet Vehicles Are Less Visible
- Controlling Noise and Light Levels during Nighttime Hours.

## Feedlot Operations

These operations may be annoying due to odors. In these cases, the sources of the odors are generally known. Air quality monitoring cannot quantify the odor levels. Management of manure is often a key. In the case of fugitive particulate matter, best management practices may be helpful. Swine feeding operations are regulated, as described in AQCC Regulation Number 2 (https://www.colorado.gov/pacific/cdphe/aqcc-regs). Although this regulation does not apply to other animal operations, it contains suggested controls that could be effective in other situations.

Possible actions are:

- Ensure Proper Aeration of Compost Piles
- Use Sprinkler Systems to Control Dust
- Covers and Emission Handling Systems for Wastewater Impoundments
- Incineration /Combustion of Gaseous Emissions
- Control of Gaseous Emissions by Biofilters or Wet Scrubbers
- Conduct Carcass Handling in Enclosed Areas
- Carcass Incineration, Burial, or Off-Site Disposal to Limit Odors
- Development of an Odor Management Plan.

## Gravel Pits and Mining Operations

Gravel pits and mining operations are often a concern due to fugitive particulate emissions. Many of these companies have air emission permits that require a fugitive dust control plan. Therefore, the first response should be an inspection, to see if the source is in compliance with the plan. If observation shows that visible dust is blowing off-site and is greater than 20% opacity, it might be possible for the APCD to require the source to modify its plan.

Emission control measures for these sources are detailed in AQCC Regulation Number 1 https://www.colorado.gov/pacific/cdphe/aqcc-regs. Some possible actions are:

- Re-vegetation/ mulching of exposed areas
- Watering areas
- Applying Chemical Stabilizers to Areas
- Using a Synthetic Cover Over Some Areas
- Furrowing Exposed Areas
- Compacting Exposed Areas
- Minimizing Area Exposed At One Time
- Planting Wind Break Vegetation
- Use of Berms
- Restricting Vehicles to Established Roads
- Enclosure or Coverage of Storage Piles
- Watering or Chemical Stabilization of Storage Piles
- Limiting Fine Materials in Storage Piles
- Limiting Activity to Downwind Side of Storage Piles
- Minimizing Slope of Upwind Face of Storage Piles
- Replacing Haul Trucks With Conveyor Systems
- Restricting the Area That Can Be Blasted At One Time
- Removing Overburden Before Blasting
- Watering Down the Area after Blasting.

## Complaints Related To a Specific Source

Often, these are nuisance, fugitive emission, or odor complaints. However, occasionally other complaints are received, such as those related to the opacity of smokestack emissions. Sometimes, air quality monitoring at the site borders may help. However, more often it is quicker to assess the source for possible engineering and pollution equipment problems than it is to site neighborhood monitors.

Many of the actions mentioned previously may be effective in these cases.

## Nuisance Issues

Nuisance issues may be comprehensive, concerning a number of environmental conditions. Examples include operations that involve loud noises, traffic, bright lighting during night hours, vibrations, truck idling, and land uses viewed as incompatible by adjacent property owners. Often, air quality concerns may be part of this larger set of issues. However, if this is the case, it may be a situation where resolution of air quality complaints may still not resolve the underlying conflict. If the dispute is of this nature, air monitoring may not be effective. It may be better to bring some of the issues to the attention of the source accused of creating the nuisance, so that they can attempt to voluntarily change some of their procedures.

## Oil and Gas Operations

Oil and gas drilling and production may be of concern, either to individual property owners, or to nearby communities. Addressing nuisance situations in a preventative manner may

be more effective than monitoring. Many of the volatile organic compounds emitted by these operations are considered air toxic compounds, and do not have ambient air quality standards. Also, monitoring can be expensive to conduct. The State has conducted such monitoring in certain geographic areas. Presentation of monitoring results from other areas, with similar sources, may answer public questions. Most complaints occur during the drilling and hydro-fracturing ("fracking") stages of development. These are short-term processes, so it is likely that they will be completed before air monitoring equipment can be installed. Inspections are the fastest way to respond to these problems. It may be possible to issue citations for odor, smoking flares, or detectable leaks.

### Neighborhood Impacts from Local Industry

In these cases, air quality monitoring is unlikely to show violations, or to allow the quantification of specific air emissions sources. Many point sources of pollution over specific thresholds are required to report their emissions to the APCD. For these situations, obtaining a list of nearby sources and associated emissions may be more helpful than monitoring, as it may more quickly answer community questions about what is being emitted.

### Air Quality Impacts from Expanding City Boundaries / Development

As communities expand into rural or lightly-populated areas, concerns may arise about air quality. It is possible to monitor air quality to quantify these effects. However, it would be expensive and time-consuming to do this in every growth area of the state. There are some existing areas that have done this sort of monitoring. There is also likely to be air quality monitoring data available from an area similar to the area of concern. It may be useful to obtain these data from other areas, and present them as an example of what may be occurring in the area of concern. Air quality data are available from the Quality Assurance Unit of the Technical Services Program.

## Conclusion

In conclusion, air quality monitoring may not be the best solution for complaint situations. In the past, the APCD has conducted Chemical Mass Balance (CMB) analyses on filters collected during ambient air quality monitoring of a suspected source. However, often these CMB analyses do not yield much usable information. For example, the chemical composition of fly ash, emissions from dirt roads, street sand, surface dust blowing from fields, and fugitive emissions from surface mining operations tends to be similar, because these sources all come from materials of the earth's crust. Thus, CMB analyses may be unable to chemically distinguish the contribution of the source in question. Also, CMB is not useful in areas where pollutant concentrations are well below the national standards.

If a complaint situation seems to indicate the need for air quality monitoring, please discuss this with the Technical Services Program of the Air Pollution Control Division, so that we can indicate what would be most effective.

# Section II. Development of an Air Pollution Monitoring Plan

If, after taking the actions described in Section I, air monitoring is still recommended, then a plan needs to be developed. The plan should specify the time period and goals of monitoring, the pollutants to be monitored, and the equipment to be used. It should clearly describe the roles of all the parties involved (local government, APCD, the U.S. EPA, etc).

The steps in planning a special air pollution monitoring study are:

1) Define the problem to be addressed
2) Identify key pollutants of interest
3) Choose a monitoring method
4) Identify air pollution monitoring equipment needed
5) Determine where to obtain equipment
6) Choose air monitoring locations and determine study schedule
7) Choose laboratory analytical services
8) Plan for data processing
9) Locate study funding sources
10) Submit a draft monitoring protocol to the Air Pollution Control Division
11) Conduct the air monitoring
12) Check the quality of the data
13) Summarize the results
14) Report the results

## 1. DEFINE THE PROBLEM TO BE ADDRESSED

The first step in designing a study is to identify the issue that needs to be addressed. Funding of the effort must also be addressed in the early stages of project development. APCD may sporadically fund special studies, depending upon the situation, and the availability of equipment and resources. However, this is rare, as most of our resources must go to our permanent monitoring sites.

As part of defining the problem, it is important to consider questions such as:

- When does the problem occur? (Time of day, time of year, etc).
- What sampling schedule or frequency would increase the probability of "catching" the problem situation while sampling?
- Is the concern for overall concentrations of particulate matter, or for a specific pollutant?
- Where does the problem occur?
- Would an air quality measurement study be the best way to address the problem?
- Would other methods be more effective? (See Section 1).
- Does any air monitoring already exist in the area that could help define issues?

If analysis of the problem indicates that local air quality measurements may be helpful, it is time to go to the next step, identifying the key pollutants of interest.

## 2. IDENTIFY KEY POLLUTANTS OF INTEREST

Once the air quality problem has been defined, it is important to consider **which** air quality parameters to measure. One way of doing this is to do some research regarding the air pollution source of concern. Are there specific pollutants that it emits in significant quantities? Are there any pollutants that might serve as "fingerprint" pollutants unique to the source of interest?

For particulate matter studies, it is important to determine the size range of the particulate matter to be measured. For example, sources of fugitive emissions that are geological in nature (tailings, coal piles, haul road emissions, gravel pit emissions, street sand, etc) are often assessed for compliance with the state and federal air quality standards for $PM_{10,}$ and sometimes they are also assessed for compliance with the standards for $PM_{2.5}$. Sources that emit particulate matter from combustion (power plant smokestacks, diesel bus emissions, tailpipe emissions, metals processing emissions) generally emit $PM_{2.5}$. In certain situations (ambient lead measurements, metals from tailings piles, etc), the total suspended particulate matter (TSP) concentration may be of interest. It is important to determine the particulate diameter range of interest, because this affects the choice of monitoring method.

## 3. CHOOSE A MONITORING METHOD

After determination of the pollutants of interest, it is necessary to choose the measurement method, and the study equipment. The APCD generally recommends that the method chosen be a standard Environmental Protection Agency (EPA) monitoring method, such as the EPA-approved "reference" or "equivalent" methods. The EPA "TO" (toxic organic) methods are used for hazardous air pollutants such as volatile organic compounds, aldehydes, etc. The EPA "IO" (inorganic) methods are used for hazardous air pollutants such as metals in particulate matter, etc. In some cases, an EPA method may not be available for the pollutant of interest. In these cases, the Occupational Safety and Health Administration (OSHA) or National Institute for Occupational Safety and Health (NIOSH) may have developed usable methods. The American Society for Testing and Materials (ASTM) has also developed standardized methods for environmental pollutants.

There are a number of important elements to consider when choosing a monitoring method. One key element is the detection limit for the proposed method. It is essential to choose a method that can measure the pollutants at the concentrations of concern. For example, many NIOSH methods are designed to detect pollutants at levels that would be a health threat to workers. The NIOSH standards are often significantly higher than EPA standards for the same pollutant. (This is because EPA is considering the total population and long term exposure, while NIOSH considers healthy workers exposed for eight hours, and generally sets higher allowable pollutant levels). Thus, for some methods, such as OSHA or NIOSH ones, it may be necessary to alter the sampling protocol in order to detect the pollutants at a low enough concentration.

Another element to consider is the availability of equipment for the method, and the need for any support services. Many particulate monitoring methods require that a laboratory conduct weighing or chemical analyses of the sample filters.

For particulate pollutants, one should also consider whether a filter-based or "continuous" method is preferable. The filter-based methods allow for chemical analyses of the particulate matter "caught". However, they require processing by a laboratory, leading to potential delays of days or weeks before obtaining results. Some of the newer particulate monitors, such as the Beta Attenuation Method (BAM) or Tapered Element Oscillation Method (TEOM) give instantaneous readings. However, it is not possible to do chemical analyses of BAM or TEOM results.

### "Next Generation" Monitors

The APCD generally recommends the use of "EPA reference methods", or "EPA equivalent methods". These are instruments that meet rigorous quality requirements, and have been approved for use by EPA. However, in recent years, new monitoring methods, known as "Next Generation" methods, have been developed. These are generally smaller, lower-cost monitors than the EPA reference and equivalent models. These are discussed further in Appendix 2.

## 4. IDENTIFY AIR POLLUTION MONITORING EQUIPMENT NEEDED

Each air pollution monitoring method generally requires certain sampling equipment. The availability of equipment may determine the choice of monitoring method. A key consideration in the choice of equipment is the availability of a sampler shelter or line power. Some particulate and gaseous monitors must be housed indoors, while others can be located outside. The majority of particulate monitors require line power, but some methods use battery-powered samplers. Often it is possible to obtain information about equipment capabilities and requirements by contacting the manufacturer. Many manufacturers will fax literature to prospective customers, or may have web sites where information can be downloaded.

The study may need concurrent meteorological data. For some studies, it may be possible to avoid the need for a meteorological tower by obtaining data from nearby locations that already have meteorological monitoring, if it is representative of conditions at the study site(s). Meteorological conditions can vary significantly due to gentle variations in terrain. Representative meteorological data can provide meaningful insight on where sampled mass is coming from and where it will travel to in the immediate area of the meteorological tower. Local agencies may be aware of local data sources unfamiliar to APCD. Possible sources of meteorological data are airports, radio and television station weather networks, college and research institution networks, and meteorological stations operated by federal agencies involved in agriculture or fire suppression. To obtain information regarding some of these sources, whether these data are valid to use for the study, and for an assessment of whether existing meteorological data is representative of the study site(s), contact the Technical Services Program of the APCD. In the event that meteorological variables are monitored, the

study will need to consider instrument sensitivity, and the best height for taking the meteorological measurements.

## 5. DETERMINE WHERE TO OBTAIN EQUIPMENT

Often a local agency may not possess the air pollution measurement equipment needed for a particular study. There are a number of possible ways to obtain equipment. Borrowing from APCD may be possible, if spare equipment is available. Sometimes the EPA Region 8 office may have equipment to loan to the study. Universities or other local agencies may be able to provide equipment or support. Other alternatives are equipment purchase or equipment rental. Equipment rental is a viable alternative for short-term studies, but the local agency needs to investigate the costs of rental versus purchase. Generally, purchase is less expensive if the study exceeds three or four months in length.

## 6. CHOOSE AIR MONITORING LOCATIONS AND DETERMINE STUDY SCHEDULE

When sampling methodology and equipment are known, it is time to consider the sampling locations and overall schedule for the study. Generally air pollution monitors for source specific monitoring are sited at the expected location of maximum air pollution impact. Sometimes additional sites, out of the zone of influence of the source of interest, are monitored for comparison purposes. In locating possible monitoring sites, considerations include: local meteorology, results of any air quality modeling analyses, logistics such as sampler security and power availability, and the absence of local obstructions to wind flow. For criteria pollutants, the agency should generally follow EPA siting requirements for the pollutant of interest. (See Title 40, Code of Federal Regulations, Part 58, Appendix E). However, sometimes it is necessary to violate certain site requirements in order to obtain data most relevant to the specific situation.

The study schedule also needs to be determined during this early planning stage. An important decision is the period of time for which data will be collected. Sometimes, only a few weeks or months will be required in order to determine air quality status of the area. In other cases long term data collection is needed. A few particulate monitoring methods are continuous, but most involve taking discrete samples on filters. For the filter methods, it is necessary to determine a monitoring schedule. Samples are generally run from midnight to midnight over a twenty-four hour period, to conform to EPA sampling protocol. It should be kept in mind that the averaging period for health-based ambient air quality standards varies by pollutant. Sometimes other run times are chosen. Usually samples are not taken every day for filter-based, whole air or cartridge-based samples. Some other schedule, such as once every two, three, or six days, is used. The sampler operator's availability to change the filters is also an important consideration.

## 7. CHOOSE LABORATORY ANALYTICAL SERVICES

Often, particulate monitoring methods involve use of a sample filter, which must be processed by an analytical laboratory. At a minimum, pre and post-sampling filter weighing

following EPA method protocols is necessary. Sometimes specific chemical analyses for parameters such as silica or metals may be required. Local agencies are advised to obtain the services of a laboratory experienced in the required analyses. This usually means finding a contract laboratory.

A number of factors determine the choice of the laboratory. Experience in the particular analyses required, laboratory detection limit for the pollutants of interest, availability to process samples with a quick turnaround time, and of course cost all play a role. Local agencies are advised to develop an outline of the services they will require, and then go out for bid to a number of laboratories. The bid specifications should include the following items:

- total number of samples that will be processed.
- specification of analytical method.
- minimum detection limit performance required for the study.
- turnaround times for pre and post- sample processing
- sample media required, and whether the lab or agency will provide it.
- delivery protocol for samples (overnight shipping, routine shipping, driver delivery, use of ice, etc).
- quality control measures that the laboratory should conduct (sample re-weighings per batch, number of blank samples, duplicate samples, and spike samples processed per batch, etc).

Many laboratories can provide a service quote on a very quick basis if faxed a two or three page outline of the services required. Addresses of some sample laboratories known to APCD are provided in Appendix 1.

Gaseous analyzers generally operate continuously, with output to an electronic data logging device. While laboratory analysis is not needed, calibration gases are often required. Gases must be purchased from gas supply companies. Often, gases must meet certain EPA requirements.

## 8. PLAN FOR DATA PROCESSING

After air pollutant data are collected, they need to be processed into final, quality-assured format. For gaseous or meteorological monitoring, data are generally stored in a computer or data logger as hourly averages. The local agency will need to plan some time for downloading these data, and data validation. The data validation step involves looking at the analyzer maintenance records and results of periodic analyzer quality control checks. (These checks involve running special test gases or doing electronic tests, as recommended by the equipment manufacturer.) The agency may then remove any data that reflect periods of analyzer maintenance or malfunction.

For particulate matter studies, generating final data involves combining laboratory records regarding pollutant concentration with field records on instrument flow rate. The

flow rate data need to be corrected for pressure and temperature. Usually, this is done by inputting data into a specially-designed computer database.

Each study schedule should allow at least two weeks for these final data processing steps. The local agency needs to plan to conduct this data processing, or to request assistance from APCD. Generally, the equipment contains data collection software, but sometimes Excel, or Access or another software program, is necessary to process data.

## 9. LOCATE STUDY FUNDING SOURCES

After the study has been designed, an overall cost estimate can be developed. The next task is to find a way to fund the investigation. While the APCD can sometimes loan equipment and may provide personnel training and support, local agencies must generally find their own funding for laboratory services. Unfortunately, APCD is generally not budgeted for additional special samples that go beyond our routine monitoring network. Sometimes local agencies pay laboratory costs from EPA grants or from special APCD grant funds. If APCD assistance is possible, we generally require that a Memorandum of Understanding (MOU) be developed to clarify roles and responsibilities. Information concerning some of these possible funding sources is given in Appendix 1.

## 10. SUBMIT A DRAFT STUDY PROTOCOL TO APCD

Agencies wishing to conduct a special study should submit a draft study protocol to the APCD. The protocol should follow the outline of steps listed in Table 1, with a brief description of the decisions regarding study methodology, schedule, etc. Include study costs and funding sources used to meet them. Emphasis should be placed upon the contributions the local agency can provide to the study (providing sample operator, locating sites, and more), and any areas of assistance the agency requests APCD to provide (loaning air samplers, providing calibration services, data reduction, etc).

The study protocol may be brief (2-5 pages in length), but should clearly describe any resources sought from APCD. All protocols should be submitted to the Program Manager of the Technical Services Program. Local agencies should feel free to contact APCD for technical assistance during the protocol drafting stage.

## APCD RESPONSE TO PROTOCOL

After receiving the Protocol, the APCD will inform the applicant as to our ability to provide any assistance requested for the special study. If unable to provide assistance, APCD may make suggestions as to other funding sources, equipment sources, or other sources of potential assistance. APCD will also provide comment on the protocol. It is strongly recommended that agencies obtain APCD approval of the monitoring protocol, prior to beginning air monitoring. This is to avoid or minimize any potential questioning of the study results. Even if the monitoring is not being conducted for regulatory purposes and there is no legal need to obtain APCD approval, an endorsement from APCD of the methodology used

in the monitoring study is always a good idea, as it will provide more confidence in the results.

## 11. CONDUCT THE AIR MONITORING

The next step is to conduct the air monitoring project. Monitors cannot be simply left in place to run and collect data. They must be visited on a regular basis to check their status, download data, or change out sampling media. The draft study protocol should describe these check visits, and contain data sheets to be filled out, to document the status of the equipment.

The project will need to choose a station operator. Often, this is a member of the study design team. In some cases, it will be another person. In the case of stations that are at a significant distance from the design team, an individual that lives near the study area can be hired.

## 12. CHECK THE QUALITY OF THE DATA

After the study has been completed, the study team must review the data. It is best if this review is done by an individual other than the station operator. This provides more objective data review, as the reviewer was not involved in day-to-day station operation. As part of the review, calibration and quality control records for the equipment are checked, as well as the records of any independent audits that were conducted. Data sheets filled out during operator visits are reviewed, as is each data point. If samples were processed in a laboratory, the laboratory should have supplied records of its internal quality checks, showing that the laboratory equipment was functioning properly during the analysis of the project samples.

During this review, any inaccurate or questionable data should be invalidated. A final set of data known to have been collected when the sampling equipment was operating correctly is developed.

## 13. SUMMARIZE THE RESULTS

After the study data set has been finalized, results need to be summarized. Recommended ways of summarizing results include statistical analyses, comparisons to monitoring from surrounding or similar areas, graphs, and charts. In addition to summarizing the pollutant concentrations measured, it is also useful to summarize the meteorological conditions encountered during the study.

## 14. REPORT THE RESULTS

After the study data set has been summarized, it needs to be put into a form for public presentation. This form could be a study report, a slide show, graphs of sampling results, or some kind of world-wide web presentation. The summary format depends upon the study audience, and the most effective way to summarize the results.

The summary should discuss any limitations of the study. For example, the study may have only covered a short period of time. It may not have been possible for the study to sample all locations of interest. Meteorological conditions in the study may not have been typical, or may not have been conducive to capturing maximum pollutant impacts.

## APCD CONTACTS

This section is current as of January, 2016. Supervisors and managers may change over time. In the event that an individual below is not available, contact the APCD and ask for the current Technical Services Program Manager to provide updated information.

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## TABLE 1. OUTLINE FOR AIR STUDY PROTOCOL FOR APCD

## 1. DEFINE THE PROBLEM TO BE ADDRESSED

- Brief Description of the Concern That Prompts the Study
- Describe How the Collection of Air Monitoring Data Addresses the Issues
- Describe How the Data Will Be Used

## 2. IDENTIFY KEY POLLUTANTS OF INTEREST

- List Pollutants To Be Monitored

## 3. CHOOSE A MONITORING METHOD

- Indicate Monitoring Method(s) To Be Used for the Study

## 4. IDENTIFY AIR POLLUTION MONITORING EQUIPMENT NEEDED

- List Make and Model of Equipment Needed
- Note How Many Samplers Will Be Needed
- Discuss Whether Meteorological Monitoring Will Be Needed
- Discuss Whether Other Meteorological Data Are Available
- List Any Filters or Adjunct Supplies Needed

## 5. DETERMINE WHERE TO OBTAIN EQUIPMENT

- List Any Equipment To Be Purchased
- List Any Equipment To Be Rented
- List Any Equipment To Be Borrowed
- Describe Any Other Equipment Sources

## 6. CHOOSE AIR MONITORING LOCATIONS AND DETERMINE STUDY SCHEDULE

- List Air Monitoring Locations, With Location Maps or Descriptions
- Include Pictures of Each Location, and Views In the 4 Cardinal Directions, if possible
- Describe Any Work Needed To Prepare Sampling Location (Obtaining line power, sample platform, etc)
- Describe Study Period and Sampling Schedule

## 7. CHOOSE LABORATORY ANALYTICAL SERVICES

- List Laboratories Participating in Study
- Describe Laboratory Work To Be Performed

- List Quality Assurance Methods Laboratory Will Use (Calibrations, duplicates, blanks, spikes, etc.)
- Describe Sample Handling Protocols and Delivery Method For Samples

## 8. PLAN FOR DATA PROCESSING

- Include list of data to be collected, and their format (as hourly averages on computer, laboratory filter weights, records of instrument checks, etc.)
- Describe steps that will be taken to get data into final format
- Determine role of each group in final data reporting (local agency, lab, APCD, etc.)
- Request any data processing assistance needed.

## 9. LOCATE STUDY FUNDING SOURCES

- Include Study Budget, With Costs of Each Item
- List Revenue Sources for Study
- List Financial Contributions of Local Agency
- List Any Financial Contributions Being Requested From APCD
- Describe In-Kind Donations To Project

## 10. SUBMIT A DRAFT STUDY PROTOCOL TO APCD

- Summarize the study goals, and how the study will meet them
- Discuss contributions the local agency is making (personnel, funding, etc).
- Include any requests that the study has for the APCD (personnel, equipment, funding, etc)

## 11. CONDUCT THE AIR MONITORING

- Equipment is installed and calibrated
- Sample operator visits site frequently for status checks, equipment maintenance, and sample collection
- Audits of the equipment performance are conducted
- Equipment is audited, or checked, prior to site shut down

## 12. CHECK THE QUALITY OF THE DATA

- Review all calibration, audit, maintenance and site visit records
- Invalidate any data that are problematic
- If data are “corrected” in any way, develop explanation / justification for this
- Develop a finalized data set

## 13. SUMMARIZE THE RESULTS

- Develop statistical summaries of the results (maximum, minimum, average concentrations of pollutants)
- Develop statistical summaries of the meteorological conditions during the study
- Create graphs, charts, diagrams, etc to summarize results

## 14. REPORT THE RESULTS

- Develop a means of reporting the data to the public, interested parties, etc.

# APPENDIX 1

## RESOURCES FOR DEVELOPMENT OF AIR QUALITY SPECIAL STUDY PROTOCOLS

Disclaimer: This list of manufacturers, web sites, and products is provided to aid local agencies in locating resources for conducting air quality monitoring studies. Mention of a trade name or product here does not constitute endorsement by the Colorado Air Pollution Control Division. Web sites are correct as of January 2016, but links may change over time.

# Monitoring Methods

## Sources of Standard Test Methods for Air Pollutants

1. **American Society of Testing and Materials (ASTM)**. Maintains a web site "store" from which one can electronically purchase and download copies of measurement protocols for a number of parameters, including air quality measurements. There is a charge for all downloads.
   Web address: http://www.astm.org/Standard/index.shtml

2. **U.S. Environmental Protection Agency (EPA).** The web site has a number of sections devoted to various standard "reference" and "equivalent" methods for criteria pollutants, as well as other measurement protocols for hazardous air pollutants.

   Listing of Reference and Equivalent Methods for Pollutants with National Ambient Air Quality Standards. Web address: http://www.epa.gov/ttn/amtic/methods.html

   TO (Toxic Organic) Compendium. Web address: http://www.epa.gov/ttn/amtic/airtox.html.

   IO (Inorganic) Compendium. Web address: http://www.epa.gov/ttn/amtic/inorg.html

   EPA Test Methods Index. Web address: http://www.epa.gov/fem/links.htm

3. **National Institute of Occupational Safety and Health (NIOSH).** The Web site provides free, downloadable versions of NIOSH air monitoring protocols.

   Web address: http://www.cdc.gov/niosh/docs/2003-154/default.html

4. **Occupational Safety and Health Administration (OSHA).** The Web site provides free, downloadable versions of OSHA air monitoring protocols.

   Web address: http://www.osha.gov/dts/sltc/methods

## Monitoring Equipment

## Possible Sources of Air Monitoring Equipment

1. **Colorado Air Pollution Control Division**. May have equipment to loan to local agencies. Contact the Technical Services Program Manager for equipment availability.

2. **Hire an Air Quality Monitoring Contractor** The study could be conducted by an air quality contractor, who is hired to provide the equipment and collect the data. Some contractors that have done work in Colorado are listed below. Please note that APCD is not able to endorse any particular company.

| | |
|---|---|
| Advanced Monitoring Methods | Web Address: http://www.advm2.com/ |
| AECOM | Web Address: http://www.aecom.com/ |
| Air Resource Specialists | Web Address: http://www.air-resource.com/ |
| Air Sciences | Web Address: http://airsci.com/ |
| CH2M Hill | Web Address: http://www.ch2m.com/corporate/ |
| DJ Gile, Inc | Web Address: http://www.djgile.com/index.php |
| Golder Associates | Web Address: http://www.golder.com |
| IML Air Science | Web Address: http://www.intermountainlabs.com/air.html |
| McVehil-Monnett Associates | Web Address: http://www.mcvehil-monnett.com/ |
| MSI/Trinity | Web Address: http://www.metsolution.com/ |
| Pinyon Environmental | Web Address: http://www.pinyon-env.com/ |
| RTP Environmental Associates | Web Address: http://www.rtpenv.com/ |
| Steigers Corporation | Web Address: http://steigers.com |
| Tetra Tech | Web Address: http://www.tetratech.com/ |
| T and B Systems | Web Address: http://www.tbsys.com/ |
| TRC | Web Address: http://www.trcsolutions.com/ |

3. **Equipment Rental**. It may be possible to rent equipment for the study period. Some rental company links are given below. Sometimes an instrument manufacturer will rent out some of its equipment on a short-term basis.

   Equipment Rental Companies

   Argus-Hazco. Web address: http://argus-hazco.com/store/index.cfm

   On-Site Instruments Web address: www.on-siteinstruments.com

   Ashtead Technology Web address: www.ashtead-technology.com

   Other equipment rental companies may also be found on the world-wide web.

   It may also be possible to rent equipment from its manufacturer. Some manufacturers that may rent equipment are listed below.

   ABB Process Analytics Web Address: http://www.abb.com/

   Arizona Instrument Web Address: http://www.azic.com/

   BGI/Mesa Labs Web Address: http://bgi.mesalabs.com

   Casella Web Address: http://www.casellasolutions.com

   DKK-TOA Corporation Web Address: http://www.toadkk.co.jp/english/

   Eastern Research Group Web Address: http://www.erg.com/

   Ecotech Web Address: http://www.ecotech.com/

   Environics Web Address: http://www.environics.com/

   Environnement S.A. Web Address: http://www.environnement-sa.com/

   Grimm Technologies, Inc. Web Address: http://www.dustmonitor.com/

   Horiba Instruments Inc Web Address: http://www.horiba.com/us/en/

   Met One Web Address: http://www.metone.com/

   New Star Environmental Web Address: http://www.newstarenvironmental.com/

   Opsis Web Address: http://www.opsis.se

| | |
|---|---|
| Peak Laboratories | Web Address: http://www.peaklaboratories.com |
| Seres | Web Address: http://www.seres-france.com |
| Tanabyte | Web Address: http://tanabyte.com |
| 2B Technologies, Inc. | Web Address: http://www.twobtech.com |
| Teledyne Advanced Pollution Instrumentation | Web Address: http://www.teledyne-api.com/ |
| Teledyne Monitor Labs, Inc | Web Address: http://www.teledyne-ml.com |
| Thermo Fisher Scientific, Inc. | Web Address: http://www.thermo.com |
| Tisch Environmental, Inc. | Web Address: http://www.tisch-env.com |
| URG | Web Address: http://www.urgcorp.com/ |

4. **U.S. EPA.** EPA Region 8 has a repository of samplers and other equipment. Contact them directly for information on what is currently available. The link on their website is: http://www2.epa.gov/region8/forms/region-8-contact-us

5. **Hydrogen Sulfide Monitor.**

   APCD has a Jerome 631X Hydrogen sulfide monitor that we occasionally loan to local agencies.

## Laboratories

## Possible Laboratories for Air Quality Analyses

1. Eurofins Air Toxics Limited
   180 Blue Ravine Road, Suite B
   Folsom, CA 95630
   Tele: 916-985-1000
   Fax: 916-985-1020

   Web Site: http://www.eurofins.com

2. SGS Accutest Mountain States
   4036 Youngfield Street
   Wheat Ridge, CO 80033-3862
   Tele: 303-425-6021
   Fax: 303-425-6854

   Web Site: http://www.accutest.com/working-with-us-locations-denver.htm

3. Microbac

   Has a number of locations, throughout the United States.

   Web Site: http://www.microbac.com/testing-services/environmental/

4. Eastern Research Group

   Corporate Headquarters:

   110 Hartwell Avenue
   Lexington, MA 02421-3136
   Phone: 781 674-7200
   Fax: 781 674-2851

   Web Site http://www.erg.com/

5. Inter-Mountain Labs

   IML does filter weighing for particulate sampling projects.

   555 Absaraka Street
   Sheridan, Wyoming 82801
   (307) 674-7506

Web Site: http://www.intermountainlabs.com/

6. Chester LabNet

   Chester LabNet does filter weighing for particulate sampling projects.

   12242 SW Garden Place
   Tigard OR 97223
   (503) 624-2183

   Web Site: http://www.chesterlab.net/

7. American Society of Testing and Materials (ASTM) maintains the International Directory of Testing Laboratories, which can be accessed for free on the world-wide web. It is possible to search the listing by location, laboratory name, or subject of interest.

   Web address: http://www.astm.org/LABS/search.html

## Possible Funding Sources

## Possible Grant Sources for Special Studies by Local Air Quality Agencies

1. **Colorado Air Pollution Control Division**. Occasionally funds are available through various grants. Supplemental Environmental Project funds are sporadically available. These are collected as part of environmental violation penalties, and are generally restricted to the geographic area where the violation occurred.

   Health Department Grant Web Site: https://www.colorado.gov/pacific/cdphe/all-funding

2. **Environmental Protection Agency Region 8**. Does regional administration for a number of EPA's national grants programs. The Environmental Justice Program has an annual grant competition for projects involving multiple environmental media (air, water, hazardous waste, etc) that involve rural, tribal, minority or low-income populations. May have funds available for other projects on a sporadic basis.

   Web addresses:

   EPA Main Web Site: http://www2.epa.gov/aboutepa/

   Region 8 Home Page: www.epa.gov/about epa/epa-region-8-mountains-and-plains

   Region 8 Grants: www.epa.gov/region8/grants

   Region 8 Environmental Justice Program:

   www.epa.gov/region8/environmental-justice

3. **National Center for Environmental Research.** Part of the national Environmental Protection Agency. It operates a web site clearing house listing current research grant opportunities sponsored by EPA.

   Home page:
   http://www2.epa.gov/aboutepa/about-national-center-environmental-research-ncer

   Grants page: http://www.epa.gov/ncer/rfa

4. **United States Government.**

   Catalog of Domestic Federal Assistance web site lists federal grant programs for a number of projects, including environmental ones. Try searching for grants by agency – under Environmental Protection Agency.

   Web Site: https://www.cfda.gov/

# APPENDIX 2

## "Next Generation" Air Monitors – Strengths and Limitations

## "Next Generation" Air Monitors

Recent revolutions in technology, such as wireless internet and electronic miniaturization, have made possible the development of new air monitoring devices that are smaller and cheaper than the EPA "reference" and "equivalent" methods typically used by state and local air quality agencies. These methods may potentially offer significant advantages over traditional air quality monitoring instrumentation. Among these possible advantages are:

- More flexibility in monitor siting
- Lower cost
- The ability to deploy more monitors over an area
- Faster response times
- Ease of operation
- Reduction in analyzer maintenance requirements

For the reasons noted above, the Environmental Protection Agency is encouraging the consideration of many of these "Next Generation" monitors. However, the new technologies may also have significant limitations. The Air Pollution Control Division urges caution, and a thorough investigation, before a monitoring method that has not been approved by the EPA is chosen. The EPA has also developed a "Toolbox for Citizen Scientists" website that provides detailed information on the use, benefits and limitations of "Next Generation" monitors. The website includes test results of some small sensors as well. The website is at: http://www.epa.gov/heasd/airsensortoolbox/

Some important points to consider in making a technology choice are discussed below.

Detection Limit

The detection limit is the lowest amount of a pollutant that a monitor may measure. Some of the "Next Generation" monitors measure pollutants, but cannot detect levels as low as those measured by the traditional monitors. This can be a problem if a monitor cannot measure levels below the National Ambient Air Quality Standard (NAAQS) for its measured pollutant. For example, the NAAQS for particulate matter 2.5 microns or less is diameter ($PM_{2.5}$) is 35 micrograms per cubic meter of air for a 24-hour period. Some "Next Generation" particulate monitors can only measure particulate matter as a count per cubic meter of air or in milligrams per cubic meter of air. (One milligram is 1000 micrograms, so a monitor measuring with a one milligram per cubic meter detection limit can only detect particulate matter at levels that are 1000 times greater than the level of interest. This would not answer public concerns about whether current levels of particulate matter are in compliance with the NAAQS).

Sensitivity

Monitor sensitivity is related to the amount of change in concentration of a pollutant that a monitor can measure. As described above, a $PM_{2.5}$ monitor that can measure only to the nearest milligram will not be suitable for determining compliance with an air quality standard

that is in micrograms per cubic meter, one thousand times lower than one milligram per cubic meter.

Accuracy

There must be a way to determine that the pollutant monitor is measuring air pollution concentrations accurately. This is generally accomplished by subjecting the monitor to performance tests during the study. For example, it is possible to dilute concentrations of carbon monoxide in a gas cylinder with clean air, generating known levels of carbon monoxide in several samples. These samples are then supplied to the study monitor, and its response is noted. This is known as an "audit" of the analyzer. It is also possible to run a monitor side-by-side with another monitoring method, to compare the two.

The Air Pollution Control Division will not accept data from "Next Generation" monitors unless the accuracy of the monitor has been demonstrated. Some of the "Next Generation" monitors do not appear to be readily comparable to results from existing methods. Some do not have ways to demonstrate on-site, that the method is performing accurately.

Reliability

The EPA reference and equivalent monitoring methods have demonstrated reliable performance over years of use. Some of the "Next Generation" monitors are more subject to break-downs and maintenance issues. These could cause a study to lose too much data to be valid.

Precision

The EPA reference and equivalent methods have means of determining the "precision" of the method. "Precision" is the ability to generate a similar response to the same pollutant concentration over time. For the reference methods for gaseous pollutants, precision is assessed by offering the same pollutant concentration to the analyzer on a regular basis, and statistically assessing the "spread" of the reported results. Many of the "Next Generation" monitors do not have a formal way to assess precision. Obviously, the study does need to be concerned with whether or not an instrument "drifts" unacceptably over time. The manufacturer may have some information regarding this, or it may be possible to contact other users of the technology to ask what their experiences have been.

On-Site Calibration Capability

It is best to use monitoring methods that can be "calibrated" (adjusted to measure concentrations accurately) on-site, as the study begins. Many manufacturers may provide models that have been calibrated at the factory. However, this does not mean that the instrument is performing accurately when installed for the study. Local conditions may alter the instrument's response from what it was "at the factory". In Colorado, one of the most important conditions to consider is the atmospheric pressure of the monitoring location. Our

high altitude means that pressures here are much lower than at sea level. Many air monitoring technologies cannot respond accurately under the pressure conditions found at high altitude.

Another important variable to consider is the air temperature the sampling analyzer is exposed to. Many monitors need to be placed in an indoor temperature controlled location to function properly.

Conclusion:

Each monitoring technology has its advantages, and its disadvantages. These need to be carefully considered when choosing measurement methods for air pollution studies. Performance claims made by the manufacturer of an instrument should be regarded with some skepticism. There must be an objective way of demonstrating that the pollutant concentrations measured by a technology are reasonably accurate for the study purpose.


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