

**IMPROVE  
STANDARD OPERATING PROCEDURES**

**SOP 126**  
Site Selection

**Date Last Modified**  
**09/12/96**

**Modified by:**  
**EAR**

**SOP 126** Site Selection for the IMPROVE Aerosol Sampling Network.

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**Technical References**

none

## 1.0 PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) outlines site selection criteria for installation of IMPROVE protocol aerosol samplers.

The IMPROVE aerosol sampler collects ambient aerosols on a variety of substrates for analysis of elemental and ion and carbon species involved in visibility impairment. The data collected provide information for calculating trends in visibility and tracking sources of visibility impairment in Class 1 areas.

The IMPROVE aerosol sampler collects ambient PM<sub>2.5</sub> aerosols at a flow rate of twenty three liters per minute twice per week, on Wednesdays and Saturdays. The sampler is designed simply and ruggedly to withstand ambient field conditions, and for ease of operation and maintenance.

IMPROVE aerosol samplers are generally sited in conjunction with other IMPROVE protocol monitoring equipment such as camera sites, nephelometers, and transmissometers. The aerosol sampler siting protocols closely reflect those of ARS for automatic camera sites and transmissometers.

To assure consistent quality data and to minimize data loss, aerosol sampling sites are selected to meet most if not all of the following criteria.

- Located to monitor the same air mass being monitored by associated IMPROVE network equipment
- Removed from local sources such as diesel, wood smoke, automobile, road dust, construction, etc.
- Site meets EPA siting requirements for regional aerosol sampling, including inlet height, no interference in air flow from trees or buildings in a 30° cone above the sampler, minimum of 270° of free air flow around the sampler.
- Located at a site where aerosols are representative of regional, not local, visibility conditions.
- Is secure from potential vandalism.
- Has available servicing personnel (operator).
- Is accessible all months of the year, or all months of interest.

This SOP serves as a guideline to facilitate the following:

- Location of potential sites.
- Evaluation of potential sites.
- Selection of the most appropriate site from the potential sites.
- Finalization of the selected site.

## **2.0 RESPONSIBILITIES**

### **2.1 Project Manager**

The project manager shall:

- Prepare project specific siting and operational objectives, guidelines, and considerations.
- Select the most appropriate site for the aerosol samplers based on the criteria described in the SOP.

### **2.2 Field Specialist**

The field specialist shall:

- Initiate the search for potential sites by sending pertinent siting criteria and associated siting materials to a local contact.
- Maintain communications with to local contact during the field survey of potential sites. Verify that all potential sites have been identified and thoroughly evaluated, and that all materials are returned for review in a timely fashion. The actual field survey may be performed by the local contact, the field specialist, or both.
- Review potential sites with the project manager.
- Obtain permission from private or public land owners for permanent access to the aerosol sampling site.
- Obtain permission to perform any special site preparation that may be required.
- Work with the local contact or sponsoring agency to identify a site operator and local primary contact to service the equipment.
- Maintain careful records in permanent files and in the site database on all site selection information.

### **2.3 Local (On-Site) Contact**

The local contact shall:

- Review the technical and monitoring requirements provided by the field specialist.
- Identify potential sites.
- Maintain communication with the field specialist during the field survey of potential sites.
- Photograph and document potential sites. Provide a set of processed 3"x5" photos showing each potential site, and the views from the sampling site toward the north, the south, the east, and the west. The contact should keep one set of prints for on-site review.
- Document the selected site location(s) on a topographic map.
- Identify and contact local landowners, primary contacts, and operators regarding site installation and routine maintenance requirements.

### **3.0 REQUIRED EQUIPMENT AND MATERIALS**

The following materials are required to complete the site selection process:

- Maps
- A camera to take photographs of the proposed site and surrounding areas.
- A list of monitoring requirements and associated IMPROVE protocol monitoring equipment.
- A list of local sources affecting the air in the area of interest.
- Information about the availability of AC power and telephone service for associated monitoring equipment.

### **4.0 METHODS**

This section describes the site selection process and includes three (3) major subsections:

- 4.1 Locating Potential Sites.
- 4.2 Reviewing and Selecting Potential Sites.
- 4.3 Finalizing Site Selection.

#### **4.1 Locating Potential Sites**

Site selection begins with the process of locating potential sites in the monitoring area of interest. The following steps detail the process:

**OBTAIN SITING CRITERIA** Obtain specific siting criteria from the project manager. The siting criteria may include regional or site specific program objectives, meteorological conditions of the monitoring area, and/or other considerations.

The site should not be located in areas subject to unusual aerosol transport conditions. There should be no local pollution sources or unusual meteorology. The aerosol at the site should be representative of the regional air mass.

**LOCATE POTENTIAL SITES** Locate potential sites from maps and through consultation with local contacts familiar with the monitoring area of interest.

SEND SITING  
PACKAGE TO  
LOCAL  
CONTACT

Send the aerosol sampler siting package to a local contact familiar with the proposed monitoring area. The siting package includes the following:

- Information on aerosol samplers and monitoring (Figure 1)
- Siting protocols for aerosol monitoring (Figure 2)
- A roll of 35mm film or a disposable 35mm camera.
- Photographic log (Form 1)
- Potential aerosol monitoring site information (Form 2 )

## Figure 1 IMPROVE Aerosol Sampler Information

IMPROVE is a cooperative program of the National Park Service, Forest Service, Bureau of Land Management, Fish and Wildlife Service, and Environmental Protection Agency, whose primary purpose is to monitor visibility and particulate components in Federal Class I areas (includes most national parks and wilderness areas and many national monuments). The 1977 Clean Air Act requires Federal Land Managers to protect the visibility in Federal Class I areas from manmade pollution.

The IMPROVE protocols were designed to obtain a complete signature of the composition of airborne particles in relation to visibility. Use of the four filter module IMPROVE sampler is "standard" protocol if all of the analytical measurements in Table 1 are needed. However, if only one or two of analytical measurements are needed, fewer modules are installed. Shown below are the standard types of measurements individually done using the IMPROVE sampler.

Module	Size Region	Filter	Analytical Measurement
A includes clock controller	fine particles	Teflon	mass, optical absorption, elemental (H, Na-Pb)
B	fine particles	nylon with denuder	nitrate, sulfate, chloride
C	fine particles	Quartz	organic and elemental carbon
D	PM-10 particles	Teflon	PM <sub>10</sub> mass

The standard IMPROVE particulate sampler consists of four modules, three filter modules for collection of PM<sub>2.5</sub> particles and one for collection of PM<sub>10</sub> particles. Twenty-four hour aerosol samples are collected twice per week (Wednesday and Saturday, midnight to midnight). Each filter module has solenoids and elapsed timers for exposing two filter cassettes between weekly sample changes by the site operator.

- A. Module A is a fine filter module in addition to being the "controller" module. Every fine filter module contains a cyclone (to separate out particles larger than PM<sub>2.5</sub>), elapsed timers, critical orifice flow control, flow gauges, inlet stack plus inlet head, etc. enclosed in a fiberglass box. The Module A controller also contains a digital 7 day cycle clock to control sample collection for all the filter modules at the site. The electrical system powers the vacuum pumps for each sampling module. The controller requires 120 Volt, 60 Hertz AC power, and at least 5 amperes of electrical power for each sampling module at the site. The module A controller measures 11" x 19" x 20" and weighs 60 pounds.
- B. The other two fine filter modules (B, C) are identical to the controller "A" except for the lack of a controller clock and independent electrical system. The fourth filter module, module "D" collects PM<sub>10</sub> aerosols rather than fine aerosols. Each non-controller module is controlled with a 24 volt signal from the module A controller. The filter modules B, C, and D measure 11" x 19" x 20" and weigh 35 pounds.
- C. Four vacuum pumps provide air flow through the filters, each measures 12" x 7" x 9" and weigh 25 pounds. Each pump draws about 2.5 amperes of power at 120 volts. The pumps draw 95% of the power used by the sampler. The pumps will operate best on the floor of the shelter. If the pumps are left outside, a pump house will be required to shelter the pumps.
- D. Five blue transport boxes (12" x 9" x 5"), each containing eight filter cassettes. These are mailed between Davis and the site to provide a weekly rotation of filters for sample changes..

## Figure 2 Siting Requirements for Regional Aerosol Monitoring

- A.** The site must be away from local sources of pollution
1. Vehicular Traffic (surface road, light traffic). For surface roads within 5 meters of the sampler elevation and with fewer than 3000 vehicles per day, the sampler should be 25 meters from the nearest lane and between 2 and 15 meters above the ground. However, the sampler may be located as close as 5 meters from the nearest lane as long as the stack height does not exceed 15 meters but is greater than the height derived from  
$$\text{Height} = -0.65 (\text{distance from road}) + 18.25$$
  2. Vehicular Traffic (surface road, heavy traffic). For surface roads within 5 meters of sampler elevation, with more than 3000 vehicles per day, the sampler should be located according to the following criteria.

3000 - 10,000 cars per day	sampler > 25 meters from road
10,000 - 20,000 cars per day	sampler > 50 meters from road
20,000 - 40,000 cars per day	sampler > 75 meters from road
more than 40,000 cars per day	sampler > 100 meters from road
  3. Vehicular Traffic (elevated road). For roads elevated more than 5 meters above the sampler, the sampler should be 25 meters or more from the nearest traffic lane.
  4. Combustion Sources. Avoid areas influenced by excessive diesel generator smoke, gasoline or diesel engine emissions, wood smoke, and incinerators.
  5. Dust Sources. The minimum distance from a potential source of dust (e.g. a landfill, agricultural operations, heavily used dirt roads, etc.) should be approximately one quarter mile.
- B.** The site must not have obstructions, such as trees or buildings, that would hinder sampling of regional representative aerosols.
1. The distance between obstacles (trees and buildings) and the sampler must be greater than twice the height the obstacle protrudes above the level of the sampler inlets. This is an angle less than twenty-seven degrees from horizontal (from the top of the stack to the top of the obstruction).
  2. There must be 270° of unrestricted airflow around the sampler and the predominant wind direction for the season of greatest pollutant concentration potential must be in this arc.
  3. There must be a minimum distance of 2 meters between the sampler and any solid barrier such as a wall, roof or the ground.
  4. The distance between the sampler and the drip line of trees that are obstacles should be at least 20 meters.
  5. The inlet must be located more than 1 meter vertically and horizontally away from any supporting structure.
- C.** To be considered a regionally representative site, the site must not be located in a small valley, or on barren ground that is not typical of the region.
- D.** The site must have 2.5A of current at 120V available for each module.
- E.** The site must be accessible for filter changes in all weather conditions.
- F.** The site should be located near existing particulate monitoring stations to provide continuity in the data set whenever possible.
- G.** The sampler inlets must be located between 2 and 15 meters above the ground, except where SO<sub>2</sub> sampling is being done in which case the inlet should be between 3 and 15 meters above the ground.



**FORM 1 Photographic Log for Potential Aerosol Monitoring Sites**

**POTENTIAL SITE #1 NAME:**

Photo #	Date	Time	Description/Comments
			Photo from N. including site
			Photo from E. including site
			Photo from S. including site
			Photo from W. including site
			Photo of power source relative to site
			Close-up of building or location from N.
			Close-up of building or location from E.
			Inside of building facing N.
			Inside of building facing E.
			Inside of building facing S.
			Inside of building facing W
			Photo of nearby air sampling/meteorological equip.
			Photo of nearby air sampling/meteorological equip.

**POTENTIAL SITE #2 NAME:**

Photo #	Date	Time	Description/Comments
			Photo from N. including site
			Photo from E. including site
			Photo from S. including site
			Photo from W. including site
			Photo of power source relative to site
			Close-up of building or location from N.
			Close-up of building or location from E.
			Inside of building facing N.
			Inside of building facing E.
			Inside of building facing S.
			Inside of building facing W
			Photo of nearby air sampling/meteorological equip.
			Photo of nearby air sampling/meteorological equip.

**FORM 2 Required Information for Evaluation of Potential Aerosol Monitoring Sites.**

**POTENTIAL SITE SKETCHES  
(copy as needed for each potential site)**

**SITE NAME:** \_\_\_\_\_

Site Access Constraints (4-wheel drive road, gates/locks, time of day/week/month/year): \_\_\_\_\_

\_\_\_\_\_

Elevation: \_\_\_\_\_

Nearest City or Town: \_\_\_\_\_ Distance: \_\_\_\_\_ Direction \_\_\_\_\_

Potential for Vandalism: \_\_\_\_\_

Site Area Uses Within 200 Yards: \_\_\_\_\_

Average and Maximum Snow Depth at Proposed Site: \_\_\_\_\_

Is there any nearby air monitoring instrumentation (aerosol, meteorological, nephelometer, gaseous)? \_\_\_

If yes, describe type, location, distance and direction from the proposed site. \_\_\_\_\_

\_\_\_\_\_

Is 120 volt AC power available (Distance?): \_\_\_\_\_

Is a telephone available nearby? (Distance?): \_\_\_\_\_

Nearest Telephone Pole #, Box #, or Telephone #: \_\_\_\_\_

Particulate Sources Type / Distance / Direction

Site (within 200 yards.)

Fugitive Dust: \_\_\_\_\_

Combustion: \_\_\_\_\_

Other: \_\_\_\_\_

**On the back of this page:**

- 1. Please draw a quick sketch of the proposed site. Indicate North, and include the dimensions of nearby buildings and the distances to prominent objects seen in the photos.**
- 2. Also, sketch the route taken to get from a main road to the site.**
- 3. If possible, please send a topographic map or photocopy of a map of the site area and return it with this form.**

## Form 2 (Continued)

**FIELD SURVEY  
AND SITE  
SELECTION  
DOCUMENT-  
TATION**      The local contact should review the technical and monitoring requirements and identify potential sites. Actual field surveys may be performed by the local contact, an Air Quality Group field specialist, or both.

The results of the field survey should include:

- A series of 35mm camera photos, recorded in the photographic log along with identifying features of each shot, and including the following shots:
  - One photo of the proposed site
  - Four photos, all taken from the proposed site, but one facing north, one south, one east and one west.
  - Photos of any potential local aerosol sources or sinks.
  - Photos of any other features the contact deems necessary.
- Topographic maps with the proposed sites, and major local sources, clearly identified.
- A record of pertinent information regarding accessibility, security, site preferences, special requirements for site usage, etc.

Return the siting package with the above listed contents to the Air Quality Group for review and site selection.

**CHECK  
RETURNED  
SITING  
PACKAGE**      Check the returned aerosol monitoring documentation and photographic log for completeness. Process undeveloped film. Obtain any missing information from the local contact. Evaluate the photos from each potential site for compliance with EPA siting guidelines. If additional photographs are required, send more film or another disposable camera to the local contact with instructions detailing the shots required.

## 4.2 Reviewing and Selecting Potential Sites

The siting package for potential sites must be reviewed to determine if any of the monitoring sites are acceptable. The following criteria should be used to evaluate the suitability of a potential site.

- |                              |  |
|------------------------------|--|
| EVALUATE SITE<br>SUITABILITY | <ul style="list-style-type: none"><li>• Overall monitoring criteria defined by the project manager.</li><li>• Relation to existing visibility monitoring equipment.</li><li>• Year-round site operator accessibility</li><li>• Availability of a reliable site operator.</li><li>• Security from potential vandalism.</li><li>• Location of obstructions or interfering factors</li><li>• Locations of potential sources or sinks for aerosols.</li><li>• Type and location of any co-located instrumentation.</li><li>• Local land manager or land owner cooperation.</li></ul> |
| SELECT BEST<br>SITE          | <p>In consultation with the local contact, select the best site based on the results of the evaluation and pertinent on-site comments. Compromises may be required.</p> <ul style="list-style-type: none"><li>• Provide selected site description, map, and photographs to the project manager for final approval</li><li>• As required, provide the above materials to the local contact and any other personnel involved in the final review process.</li></ul>  |

## 4.3 Finalizing Site Selection

After evaluating potential sites and selecting the most appropriate site, the following actions are required to finalize the site selection.

- Obtain approval of the selected site from the project manager.
- Obtain approval from the IMPROVE contact requesting the project.
- Provide a detailed description of the selected site, proposed instrumentation, and installation schedule to the property manager.
- Obtain permission to use the site and arrange for any special site preparation from the property manager, land manager (public lands), or land owner (private land).
- Initiate installation protocols as described in SOP 151, Installation and Site Documentation for IMPROVE Aerosol Monitoring Equipment.