LESSON 6
Site Selection

Goal

To familiarize you with the criteria used for proper site selection.

Objectives

After completion of this lesson you should be able to:

1. Identify pollution sources and obstacles that might bias particulate measurements.
2. Specify site characteristics that can be used to document the appropriateness of a measurement location and which can serve as indices of stable monitoring conditions.

Reading Assignment Topics

- Internal Siting Criteria
- External Siting Criteria

Procedure

1. Read sections 5.0 through 5.2 (pg. 5-1 through 5-3) of *Guidance for the Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}.*
2. Complete the review exercise.
3. Check your answers against the answer key in Appendix A.
4. Review the pages from any material you missed.
5. Take Quiz 2 in the back of this manual. Check your answers using the Quiz 2 answer sheet in Appendix B. Review the pages in the reading material for any questions you may have missed.
6. Continue to Lesson 7.

Review Exercise

1. Monitors should be placed more than 20 m from nearby ___, and twice the difference in elevation from nearby ___.

   a. buildings, trees
   b. roads, buildings
   c. roads, trees
   d. trees, buildings

2. True or false? Close proximity to paved roads are a source of potential bias for particulate measurements.

   a. True
   b. False

3. True or false? A building which houses a coal furnace would be a good site for a NAMS monitor.

   a. True
   b. False

4. _____ zone(s) of representation are needed for core monitors.

   a. Neighborhood
   b. Urban
   c. Both a and b
   d. Neither a nor b

Required Readings

5.0 MONITOR SITING

$PM_{2.5}$ monitors are situated to meet requirements as core sites, community averaging sites, or daily compliance sites. Internal requirements are those for operating the needed instruments, while external criteria address site surroundings to achieve specific monitoring purposes.

5.1 Internal Siting Criteria

Internal criteria refer to the logistics of locating and service instruments for multi-year monitoring. These include:

- **Long-term Site Commitment:** NAMS sites are meant to measure trends as well as compliance, and a long-term commitment from the property owner for continued monitoring is required. Public buildings such as schools, fire stations, police stations, recreation halls, and hospitals often have more stability and a motive for public service than do private or commercial buildings.

- **Sufficient Operating Space:** A large, flat space, elevated at least 1 m but no more than 14 m above ground level, is needed to place monitors and monitoring probes. The space available for samplers should be at least 5 m distant and upwind (most common wind direction) from building exhausts and intakes and at least 2 m from walls, parapets, or penthouses that might influence air flow. Buildings housing large emitters, such as coal-, waste-, or oil-burning boilers, furnaces or incinerators, should be avoided.

- **Access and Security**: Access to the sampling platform should be controlled by fencing or elevation above ground level. Sampler inlets should be sufficiently distant (>10 m) from public access to preclude purposeful contamination from reaching them in sufficient quantities to bias samples. Access should be controlled by a locked door, gate, or ladder with documentation of site visitations and the purposes of those visits.

- **Safety**: Wiring, access steps, sampler spacing, and platform railings should comply with all relevant codes and workplace regulations, as well as common sense, to minimize potential for injury to personnel or equipment.

- **Power**: Power should be sufficient for the samplers to be operated on a long-term basis, as well as for special study and audit samplers to be located at a site. Where possible, a separate circuit breaker should be provided for each instrument to prevent an electrical malfunction in one monitor from shutting off power to the other monitors at the site.

- **Environmental Control:** Environments surrounding monitoring instruments should be maintained within the manufacturers specifications for proper instrument function. Most FRM filter-based samplers are designed to operate

under a wide range of environmental conditions and can be located outdoors in most types of weather. Several continuous monitoring methods may require environmental shelters with temperature and humidity controls to protect their electronic sensing and data acquisition mechanisms.

These criteria may be tightened or relaxed for special purpose, transport, and background monitors. For example, battery-powered saturation monitors may be located on utility poles at various elevations to assess the zone of influence and zones of representation for sources and receptors.

5.2 External Siting Criteria

External siting criteria refer to the environs surrounding a measurement location, and these differ depending on the zone of representation intended for a specific monitoring site.

- **Exposure:** Large nearby buildings and trees extending above the height of the monitor may present barriers or deposition surfaces for PM. Certain trees may also be sources of PM in the form of detritus, pollen, or insect parts. These can be avoided by locating samplers by placing them >20 m from nearby trees, and twice the difference in elevation difference from nearby buildings or other obstacles.

- **Distance from Nearby Emitters:** The monitor should be outside the zone of influence of sources located within the designated zone of representation for the monitoring site. Neighborhood and urban zones of representation are needed for community-oriented compliance monitors. These should generally be at least 1 km from very large, visibly identifiable source areas occupied by major industries such as cement and steel production or ore processing. Regarding exhaust and road dust emissions from paved roads, Figure 5.2.1 provides guidance on the recommended monitoring distances from paved roads with different levels of average daily traffic for neighborhood- and urban-scale sites. A minimum distance of ~50 m from busy paved highways is usually outside the road's immediate zone of influence for a rooftop monitor. These siting criteria were established for PM_{10} monitoring siting (U.S. EPA, 1987), and they have proven their validity in PM_{10} network design. For larger than middle-scale monitoring, no unpaved roads with significant traffic or residential wood-burning appliances should be located within 100 m of the monitoring location. Background monitoring sites should be located >100 km from large population centers, and >100 m from roads and wood burning (burning is common, though often intermittent, in camping, forested, and agricultural areas).

- **Proximity to Other Measurements:** Other air quality and meteorological measurements can aid in the interpretation of high PM levels, and with all other considerations being equal, $PM_{2.5}$ sites should give preference to existing sites that make other measurements. For example, high local wind gusts may

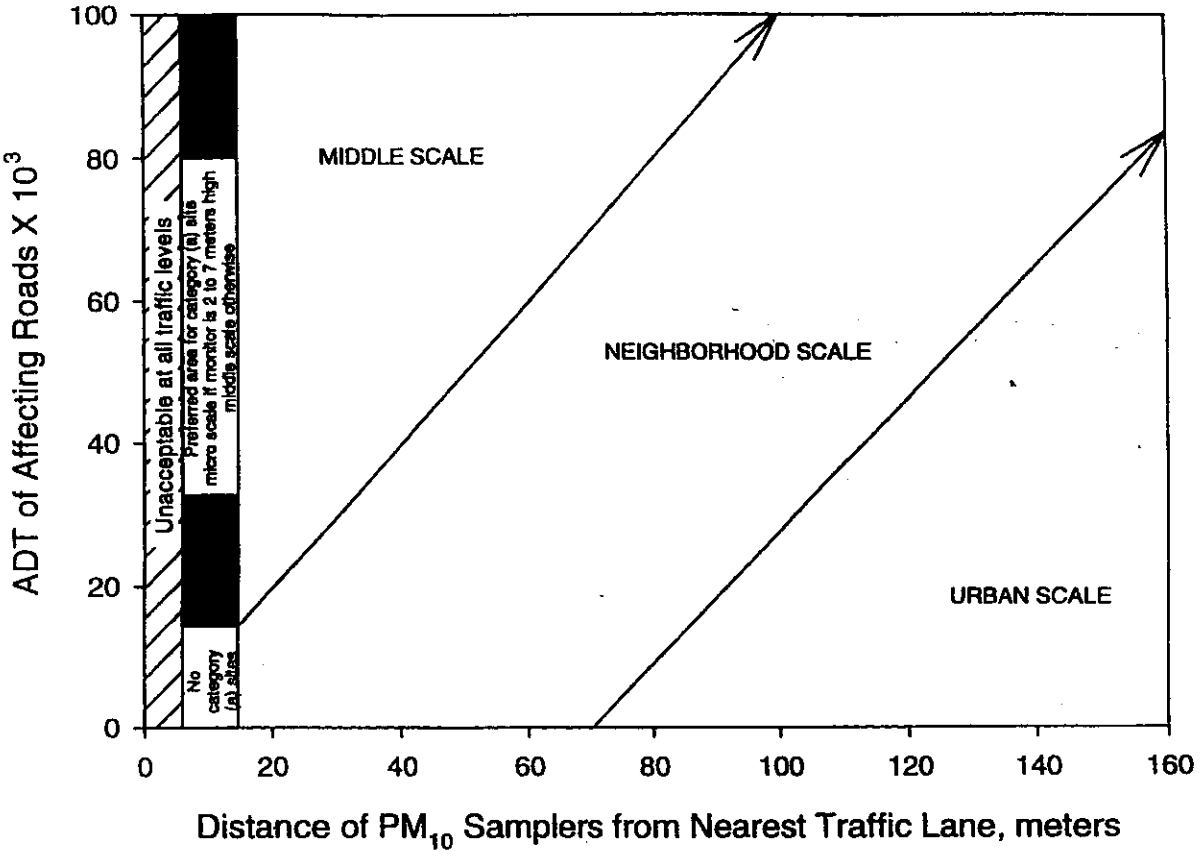

Figure 5.2.1. Recommended distances and elevations of PM sampler inlets from heavily traveled roadways.

explain high PM readings as caused by wind blown dust. These gusts are often localized, and would not be detected on a more distant monitor. Similarly, a strong correspondence between hourly CO and PM readings would indicate that locally emitted vehicle exhaust is a large contributor at that site. This conclusion would be more tenuous if the CO measurements were not collocated. In particular, collocating PM_{10} and $PM_{2.5}$ monitors will provide information on the size distribution of suspended particles.

5.3 Evaluating Zones of Representation

A site originally selected to represent community exposure (generally on a neighborhood or urban scale) may have its zone of representation change owing to long-term changes in land use or short term events that affect that particular site.

- **Annual Site Surveys:** The land use and sources around a monitoring site may change from year to year, especially in high growth areas. Maps should be updated as part of the annual measurement network summary, and the setbacks

APPENDIX A

Answers to Review Exercises

Lesson 2

1. a
2. b
3. d
4. c
5. c
6. d
7. a
8. b
9.
    - define concepts and terms of network design.
    - summarize the availability and usage of existing resources for network design.
    - demonstrate the methodology in practical applications.
    - present a methodology for defining planning areas and selecting and evaluating monitoring sites in a network.
10.
    - Twenty-four hour average $PM_{2.5}$ not to exceed 65 $\mu g/m^3$ for a three-year average of annual 98^{th} percentiles at any population-oriented monitoring site in a monitoring area.
    - Three-year annual average $PM_{2.5}$ not to exceed 15 $\mu g/m^3$ concentrations from a single community-oriented monitoring site or the spatial average of eligible community-oriented monitoring sites in a monitoring area.
    - Twenty-four hour average PM_{10} not to exceed 150 $\mu g/m^3$ for a three-year average of annual with percentiles at any monitoring site in a monitoring area.
    - Three-year average PM_{10} not to exceed 50 $\mu g/m^3$ for three annual average concentrations at any monitoring site in a monitoring area.

Lesson 3

1. less than 0.08 μm
2. from 0.08 μm to 2.5 μm
3. greater than 2.5 μm

4. d
5. c
6. d
7. b
8. a
9.

- To determine representative concentrations in areas of high population density.
- To determine the impact on ambient pollution levels of significant sources or source categories.
- To determine general background concentration levels.
- To determine the extent of regional pollutant transport among populated areas; and in support of secondary standards.
- To determine the highest concentrations expected to occur in the area covered by the network.
- To determine the welfare-related impacts in more rural and remote areas such as visibility impairment and effects on vegetation.

10. c
11. b
12. a
13. f
14. e
15. b
16. a
17. d
18. a

Lesson 4

1. b
2. c
3. a
4. c
5. c
6. c
7. a
8. a
9. c
10. b
11. a

Lesson 5

1.
   - Identify political boundaries of populated areas.
   - Identify natural air basins.
   - Locate existing air quality monitoring sites.
   - Reconcile boundaries with existing planning areas.
2. a
3. a
4.
   - Locate emissions sources and population
   - Identify meteorological patterns
   - Compare pm concentrations.
   - Adjust cmzs to jurisdictional boundaries
   - Locate sites
5. b
6. d
7. b
8. a
9. b

Lesson 6

1. d
2. a
3. b
4. c

Lesson 7

1. d
2. a
3. a
4. b
5. a
6. b
7. a
8. d
9. a
10. d

Network Design and Site Selection for Monitoring $PM_{2.5}$ and PM_{10} in Ambient Air

Quiz 2

Directions: Take this quiz to determine whether you have mastered the objectives of Lessons 4, 5, and 6 before you take the final exam.

Do not use your notes or books. Take no more than 30 minutes to complete the quiz. Check your answers against the answer key in Appendix B. Review the materials for any questions you may have missed.

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1. MPAs are required to correspond to all metropolitan statistical areas with populations ____.

   a. less than 100,000.

   b. greater than 100,000.

   c. less than 200,000.

   d. greater than 200,000.

Match the Step description in Column A with the correct sequence of steps for MPA designation in Column B.

	Column A	Column B
2. ___	Compare outer boundaries of the initial MPA on a topographic map showing terrain that might engender trapping, channeling, or separation of source emissions from populated areas.	a. First Step
3. ___	Make initial MPA boundaries correspond to existing planning boundaries.	b. Second Step
4. ___	Plot the locations of existing PM monitoring sites from NAMS, SLAMS, PAMS, and IMPROVE.	c. Third Step
5. ___	Identify a grouping of populated entities that define a contiguous area and designate this as an initial MPA.	d. Fourth Step

6. True or false? MSAs are generally useful for defining the boundaries of MPAs.

   a. True

   b. False

7. True or false? Initial CMZ boundaries should be modified to better represent exposure to nearby source emissions from commercial, residential, industrial, and other emissions.

   a. True

   b. False

Match the correct action for determining CMZ designation in Column A with the correct sequence in Column B.

	Column A	Column B
8. ___	Plot wind directions and speeds, vertical temperature structure, and frequencies of fogs by season.	a. First Step
9. ___	Plot emissions for major point sources for primary PM, sulfur dioxide, and oxides of nitrogen.	b. Second Step
10. ___	Where CMZs do not contain existing sites, apply siting criteria to select new ones.	c. Third Step
11. ___	Where air quality management jurisdictional boundaries are within a natural CMZ, divide the CMZ along these lines so that a separate CMZ resides within each jurisdiction.	d. Fourth Step
12. ___	Determine the spatial homgeneity of average and maximum concentrations from previous measurements or model calculations within the potential CMZ for annual, seasonal, and maximum PM concentrations.	e. Fifth Step

13. True or false? The first step in the MPA designation process is "Identify Existing Air Quality Monitoring Sites."

   a. True

   b. False

14. It is critical to determine spatial homogeneity in

    a. designating MPAs.
    b. designating CMZs.
    c. Both
    d. Neither

15. True or false? If PM_{10} measurements in an area are spatially uniform, $PM_{2.5}$ measurements may or may not be equally uniform.

    a. True
    b. False

16. Core $PM_{2.5}$ sites should include which of the following:

    a. a population-oriented site with the highest expected community-oriented concentrations
    b. a population-oriented site with the lowest anticipated community-oriented concentrations
    c. a site with high population density with good air quality (low population exposure)
    d. all of the above

17. Which of the following is NOT a potential source of bias for particulate measurements?

    a. Unpaved roads
    b. Residential wood-burning appliances
    c. Freshly mowed lawns
    d. Large buildings

18. True or false? Public buildings are good choices for NAMS sites.

    a. True
    b. False

19. _____ zone(s) of representation are needed for core monitors.

    a. Neighborhood
    b. Urban
    c. Both a and b
    d. Neither a nor b

20. The second site to be added to the CMZ is one of high population and poor air quality. In this case, _____ should be given prime consideration.

    a. existing SLAMS sites
    b. existing PM_{10} NAMS sites
    c. existing PM_{10} sites of any type
    d. a site with a continuous fine particle analyzer

APPENDIX B

Answers to Quizzes

Answers to Quiz 1

1. c
2. b
3. d
4. c
5. c
6. c
7. d
8. a
9. a
10. b
11. c
12. b
13. c
14. b
15. a

Answers to Quiz 2

1. d
2. b
3. d
4. c
5. a
6. a
7. a
8. b
9. a
10. e
11. d
12. c
13. b
14. b
15. a
16. a
17. c
18. a
19. c
20. b