

4.11 INDOOR ENVIRONMENTAL QUALITY

National Park Service Indoor Environmental Quality Policy

Parks shall maintain indoor employee workplaces free from recognized environmental health hazards that are likely to cause illness by establishing management systems to prevent or mitigate them.

Scope: This section provides summary guidance for the anticipation, identification and evaluation of indoor environmental quality (IEQ) problems and for the development of management systems to prevent or mitigate them. The guidance will find application in all buildings owned or managed by the park, including places of work and residence. In addition, it provides a framework for coordinating IEQ issues in buildings not owned or managed by the park, but occupied by park employees.

References

1. ASHRAE 55-1992. *Thermal Environmental Condition for Human Occupancy*.
2. ASHRAE 62-2001 and Addenda. *Ventilation for Acceptable Indoor Air Quality*.
3. EPA/ NIOSH. 1991. *Building Air Quality: A Guide for Building Owners and Facility Managers*. EPA Doc. Ref. No. 402-F-91-102/DHHS NIOSH Pub No. 91-114.
4. EPA. 1995. *The Inside Story: A Guide to Indoor Air Quality*. EPA Doc. No. 402-K-93-007.
5. EPA. 2001. *Mold Remediation of Schools and Commercial Buildings*. EPA 402-K-D-0-01.
6. Lstiburek, J. and J. Carmody. 1994. *Moisture Control Handbook, Principles and Practices of Residential and Small Commercial Buildings*. John Wiley, New York. 214 pp.
7. Macher, J. Ed. 1999. *Bioaerosols, Assessment and Control*. ACGIH. Cincinnati.
8. New York City Department of Health, 2000. *Guidelines on Assessment and Remediation of Fungi*.

Principles

The development of indoor environmental quality problems and their prevention and mitigation is dependent on four factors. They are: 1. the sources of pollution, 2. the building's heating ventilation and air conditioning (HVAC) systems, 3. pollutant pathways and 4. exposed occupant population.

Pollutant Sources

There must be a source of contamination or discomfort. The source may be external or internal and may be within the mechanical systems of the building. Table 1 lists common IEQ pollution sources.

Table 1. Common Sources of Indoor Air Pollution

Outside	<ul style="list-style-type: none"> Contaminated outdoor air (pollen, dust, fungal spores, industrial pollutants) Emissions (vehicle exhaust, loading docks, garbage odors, re-entrained boiler exhaust) Soil gas (radon, leaking underground fuel tanks, previous uses of the property such as landfills, pesticides) Moisture or standing water promoting excess microbial growth
HVAC System	<ul style="list-style-type: none"> Dust or dirt in ductwork Microbial growth in drip pans, humidifiers, ductwork, coils Improper venting of combustion products Refrigerant leakage
Other Equipment	<ul style="list-style-type: none"> Emissions from office equipment (volatile organic compounds, ozone) Supplies (solvents, toners, ammonia) Emissions from shops, labs, cleaning processes Elevator motors and other mechanical systems
Human Activities	<ul style="list-style-type: none"> Personal activities (smoking, cooking, body odor, cosmetic odors) Housekeeping activities (cleaning materials and procedures, emissions from stored supplies or trash, use of deodorizers and fragrances, airborne dust circulated by sweeping or vacuuming) Maintenance activities (volatile organic compounds from paint, caulk, adhesives, pesticides, stored supplies)
Building Components & Furnishings	<ul style="list-style-type: none"> Locations that produce or collect dust or fibers (carpeting, curtains and textiles, open shelving, old or deteriorated furnishings, materials containing damaged asbestos) Unsanitary conditions and water damage (microbial growth in or on soiled or water-damaged furnishings, microbial growth in areas of surface condensation, standing water from clogged or poorly designed drains, dry traps that allow the passage of sewer gas) Chemicals released from building components or furnishings (volatile organic compounds, inorganic compounds)
Other Sources	<ul style="list-style-type: none"> Accidental events (spills, microbial growth due to flooding or leaks, fire damage) Special use and mixed-use areas (laboratories, smoking areas, art rooms, print shops, exercise rooms, food preparation areas) Redecorating, remodeling or repair activities (emissions from new furnishings, dust and fibers from demolition, odors and volatile organic and inorganic compounds from paint, caulk, adhesives, microbes released from demolition or remodeling activities)

Heating Ventilation and Air Conditioning Systems

HVAC systems are designed to provide thermal comfort, distribute adequate amounts of outdoor air to meet ventilation needs of all building occupants, and isolate and remove odors and contaminants through pressure control, filtration and exhaust fans. Therefore, HVAC systems play an important role in controlling IEQ problems and must be properly maintained and operated as designed.

A recurring problem in NPS facilities is the lack of consideration of HVAC system functions during remodeling or renovation. Frequently, the result is that the HVAC system is no longer able to adequately control the indoor environment.

Pollutant Pathways

Pollutant pathways connect the source to the occupant of the building. Pathways generally involve the HVAC systems. Air movement within the HVAC system and the building is driven by pressure differentials and accounts for contaminant distribution patterns.

Occupants

Building occupants may have different tolerances as well as expectations for air quality. Some occupants may be particularly susceptible to effects of indoor air contaminants and include those with allergies or asthma, respiratory disease and compromised immune systems as a result of chemotherapy, radiation therapy or disease. This may also include contact lens wearers.

Indoor Air Pollution and Health

Health effects from indoor air pollutants may be experienced soon after exposure or, possibly, years later.

Immediate Effects

Immediate effects may show up after a single exposure or repeated exposures. These include irritation of the eyes, nose and throat, headaches, dizziness and fatigue. Such immediate effects are usually short-term and treatable. Sometimes the treatment is simply eliminating the person's exposure to the source of the pollution if it can be identified. Symptoms of some diseases, including asthma, hypersensitivity pneumonitis and humidifier fever, may also show up soon after exposure to some indoor air pollutants.

The likelihood of immediate reactions to indoor air pollutants depends on several factors. Age and preexisting medical conditions are two important influences. In other cases, whether a person reacts to a pollutant depends on individual sensitivity, which varies tremendously from person to person. Some people can become sensitized to biological pollutants after repeated exposures, and it appears that some people can become sensitized to chemical pollutants as well.

Certain immediate effects are similar to those from colds or other viral diseases, so it is often difficult to determine if the symptoms are a result of exposure to indoor air pollution. For this reason, it is important to pay attention to the time and place symptoms occur. If the symptoms fade or go away when a person is away from the workplace, for example, an effort should be made to identify indoor air sources that may be possible causes. Some effects may be made worse by an inadequate supply of outdoor air or from the heating, cooling or humidity conditions prevalent in the building.

Other health effects may show up either years after exposure has occurred or only after long or repeated periods of exposure. These effects, which include some respiratory diseases, heart disease and cancer, can be severely debilitating or fatal. It is prudent to try to improve the indoor environmental quality in buildings and homes even if symptoms are not noticeable.

Program Elements

1. *Designate an IEQ Manager.* Designate an IEQ manager responsible for overall indoor environmental quality. Specific responsibilities of the IEQ Manager might include:
 - Developing an IEQ profile.
 - Ensuring communication with occupants about IEQ issues.
 - Coordinating staff activities.
 - Ensuring adequate operating manuals, standard procedures and staff training.
 - Reviewing major projects in the building for their IEQ implications.
 - Reviewing contacts, such as those for cleaning services and pest control, which could create IEQ problems.
 - Periodically inspecting the building for indicators of IEQ problems.
 - Managing IEQ records.
 - Responding to complaints or observations regarding IEQ problems, including an initial walk-through investigation.

2. *Identify Pollutant Sources and Pathways.* One useful approach is to develop an IEQ profile for the building. An IEQ profile will answer basic questions about the building's current condition, including its function, use patterns, furnishings, mechanical equipment and changes since its original design and construction. It will identify conditions that are, or could be, contributing to IEQ problems and will provide the basis for developing building management strategies and procedures for good indoor environmental quality. Steps for conducting an IEQ profile are summarized in Table 2.

Table 2. Steps for Conducting an IEQ Profile

STEP	PROCEDURES	PRODUCTS
Collect and review existing records	<ul style="list-style-type: none"> • Review design, construction and operating documents • Check HVAC maintenance records against equipment lists • Review complaint record 	<ul style="list-style-type: none"> • Description of HVAC system design and operation; set of operating instructions, manuals • Set of maintenance and calibration records • Inventory of locations where occupancy, equipment or building has changed
Conduct walk-through inspection of the building	<ul style="list-style-type: none"> • Talk with staff and other occupants • Look for IEQ problem indicators • HVAC system condition and operation 	<ul style="list-style-type: none"> • List of responsible staff or contractors; evidence of training; job descriptions • Identification of areas where positive or negative pressures should be maintained (sketched plan) • Record of locations that need monitoring or correction
Collect detailed information	<ul style="list-style-type: none"> • Pollutant pathways • Pollutant sources • Occupants 	<ul style="list-style-type: none"> • Inventory of HVAC system components needing repair, adjustment or replacement • Record of control settings and operating schedules • Completed plan showing airflow direction or pressure differentials in significant areas • Inventory of significant pollutant sources and their locations • Set of Material Safety Data Sheets for supplies and hazardous substances that are stored or used in the building

If IEQ problems are identified as a result of conducting the IEQ profile, they should be investigated and mediated.

3. *Managing Buildings for Good Indoor Environmental Quality.* Most IEQ problems can be prevented by implementing a good building management system. Successful management systems will attend to the operation and maintenance of equipment, including the HVAC system. Some examples include adequate ventilation; isolation of contaminants through building air pressure management; inspections; controlling the purchase, inventory and storage of materials; preventive maintenance of the structure, its equipment and furnishings; managing housekeeping schedules, cleaning materials and trash disposal; managing pest control activities; managing a system for review of renovation, redecorating and remodeling plans; and occupant communications and relations.

4. Investigating IEQ Complaints and Problems.

The source of many IEQ complaints can be identified by an initial walk-through inspection and discussion with occupants and staff. The cause of a problem is frequently associated with a change in the building or its mechanical systems or uses. It is usually related to management system failures.

Obvious causes of IEQ problems should be corrected and may not require further investigation. Less apparent causes and contributors will require further examination. Investigations of IEQ problems or complaints generally follow the sequence summarized in Table 3.

Table 3. Steps for Conducting an IEQ Investigation

Step 1	Initial walk-through	<ul style="list-style-type: none"> • Visual inspection • Talk with occupants and staff Note: If initial walk-through provides an explanation, go directly to Step 4: Attempt Control
Step 2	Collect additional Information	<ul style="list-style-type: none"> • Interview building occupants • Evaluate HVAC system • Identify pollutant pathways and sources • Conduct environmental sampling if needed
Step 3	Develop hypotheses to explain the problem	<ul style="list-style-type: none"> • Test these hypotheses by manipulating building conditions or exposure, or by performing appropriate tests Note: If tests support the hypotheses, go to Step 4: Attempt Control. If not, return to Step 2
Step 4	Attempt a control strategy	Note: If controls fail to solve the problem, return to Step 2
Step 5	Make changes in management system to ensure the problem does not recur	

Additional guidance for the investigation of fungi (molds) problems in buildings is provided in Appendix A.

Appendix A: Guidance for the Investigation of Mold Complaints

Because of a history of misinterpreting data, drawing conclusions and making recommendations on limited air sampling data, the IEQ profession does not generally recommend air sampling as a screening tool to determine whether a mold exposure problem exists in a building. The ubiquitous nature of molds in the environment, the lack of an established exposure limit, and the unclear link between exposure level and health effects makes interpreting the data difficult if not impossible. Precisely because of these problems with interpreting sampling data, IEQ professionals are now relying on visible inspection of workplaces and not on sampling data.

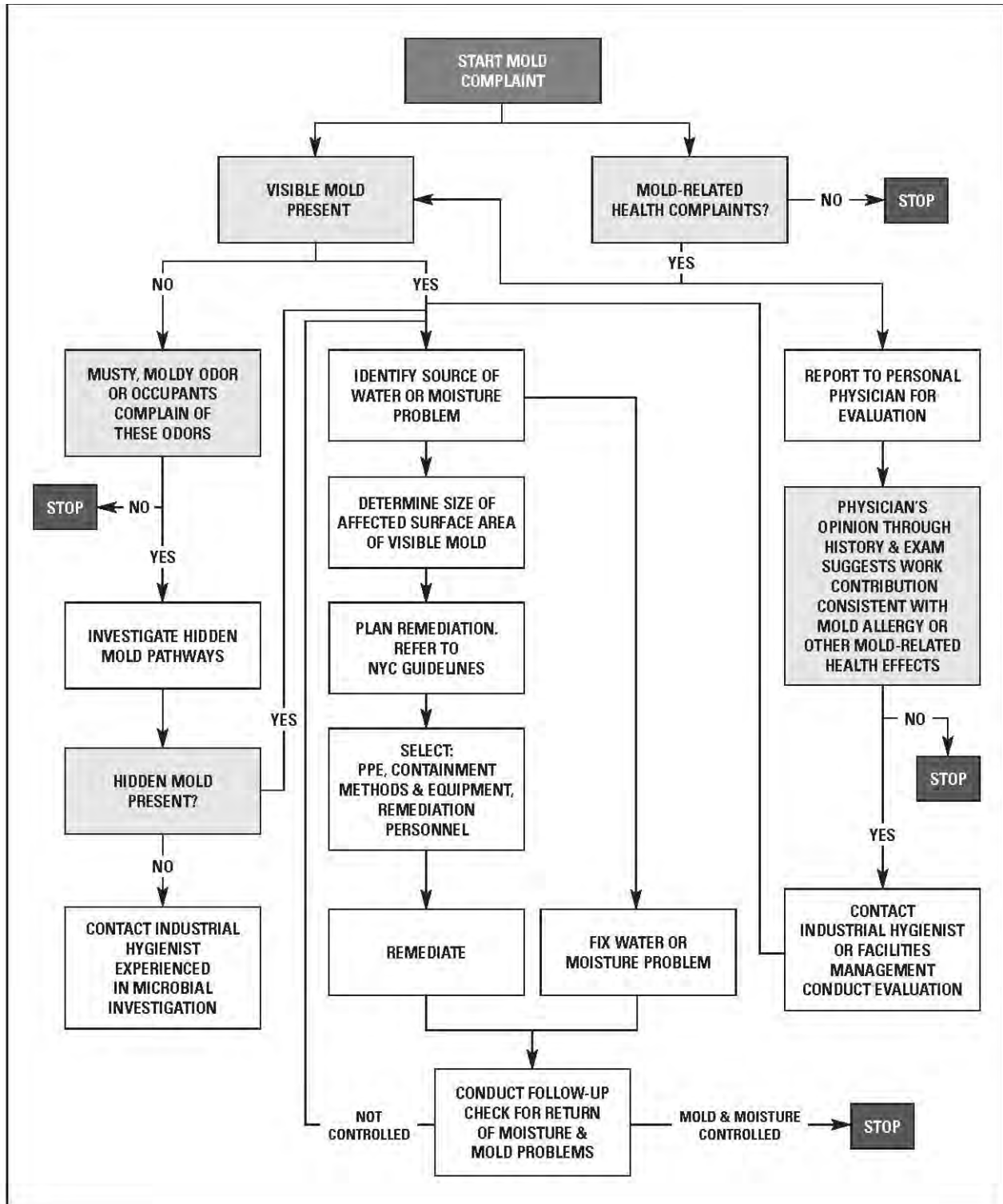
In the last few years, a new industry has emerged in assessments and remediation of buildings with mold contamination. This was fueled by the assumption that the presence of any mold in a building was a health hazard requiring extensive sampling and mitigation using asbestos abatement techniques. The public quickly became alarmed about these toxic molds, particularly the genus *Stachybotrys*. Scientists are now realizing that this reaction is not supported by scientific studies and in most cases air sampling does little to solve the problem.

While the “toxic mold” phenomenon gained momentum, two agencies primarily responsible for guidance on epidemiology (CDC) and remediation (NYC Dept of health) quietly re-evaluated the issue and recently released dramatically different recommendations. After intensive analysis of the data by review panels, the CDC stated the following:

- Mold potentially containing mycotoxins (e.g., *Stachybotrys*) present the same health risk as other common building molds.
- Mold growth in buildings can generally be controlled with simple procedures such as wiping with bleach solution and removing contaminated materials.

The amount of detail and precaution required for mitigation should be determined on a site-specific basis. This can be accomplished in the majority of cases by in-house personnel when equipped with appropriate guidance. Those planning such control or remediation work should follow protocols and requirements presented in New York City Department of Health, 2000, *Guidelines on Assessment and Remediation of Fungi*. Except for the most complex or controversial situations, microbial sampling and on-site “experts” need not be a necessary part of the equation. Figure X.A.1 provides a flow chart to assist IEQ managers in decisions regarding mold investigations.

Figure X.A.1: Mold Investigation Decision Guide



4.12 RADIATION PROTECTION

RESERVED