

A New Tool to Evaluate and Improve the School Environment



CONTROLLING
ASTHMA
TRIGGERS IN THE
CLASSROOM



INDOOR AIR UNIT
POST OFFICE BOX 64975
ST. PAUL, MN 55164-0975

Funding

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative Commission on Minnesota Resources (LCMR).

MODEL SCHOOL ENVIRONMENTAL
ASTHMA MANAGEMENT PLAN:

A New Tool
to Evaluate
and Improve the
School
Environment



INDOOR AIR UNIT
Post Office Box 64975
St. Paul, MN 55164-0975

Executive Summary

IAQ . . . Indoor Air Quality

MDE . . . Minnesota Department
of Education

MDH . . . Minnesota Department
of Health

MSEAMP . . . Model School Environmental
Asthma Management Plan

EPA . . . United States Environmental
Protection Agency

The **MINNESOTA DEPARTMENT OF HEALTH (MDH)** completed a project to determine whether a school **INDOOR AIR QUALITY (IAQ)** management plan could be implemented in schools that resulted in measurable improvements.

A **MODEL SCHOOL ENVIRONMENTAL ASTHMA MANAGEMENT PLAN (MSEAMP)** was developed as a new tool to evaluate and improve school IAQ. The MSEAMP was utilized in six school consultations, to evaluate and improve the school environment and its impact on asthma. In addition, sampling was performed to determine whether implementation of the MSEAMP was associated with improvements in levels of known asthma triggers and ventilation parameters. All six schools showed modest improvements one year after the baseline evaluation. Many new practices and policies were reportedly implemented as part of each school's IAQ management plan. Fewer problem issues were observed during walk-through inspections, and the problems that remained were less prevalent. Pet allergen levels and staff perception of air quality improved significantly. The findings indicate that school officials in Minnesota can implement IAQ asthma management plans that include a variety of practices, policies, and corrective actions, which result in measurable improvements. The MSEAMP is now available to all Minnesota school officials. It is a voluntary tool to monitor and improve air quality in schools, and focuses on existing and potential contaminants that may impact asthma.

Introduction

INDOOR AIR QUALITY IN MINNESOTA SCHOOLS

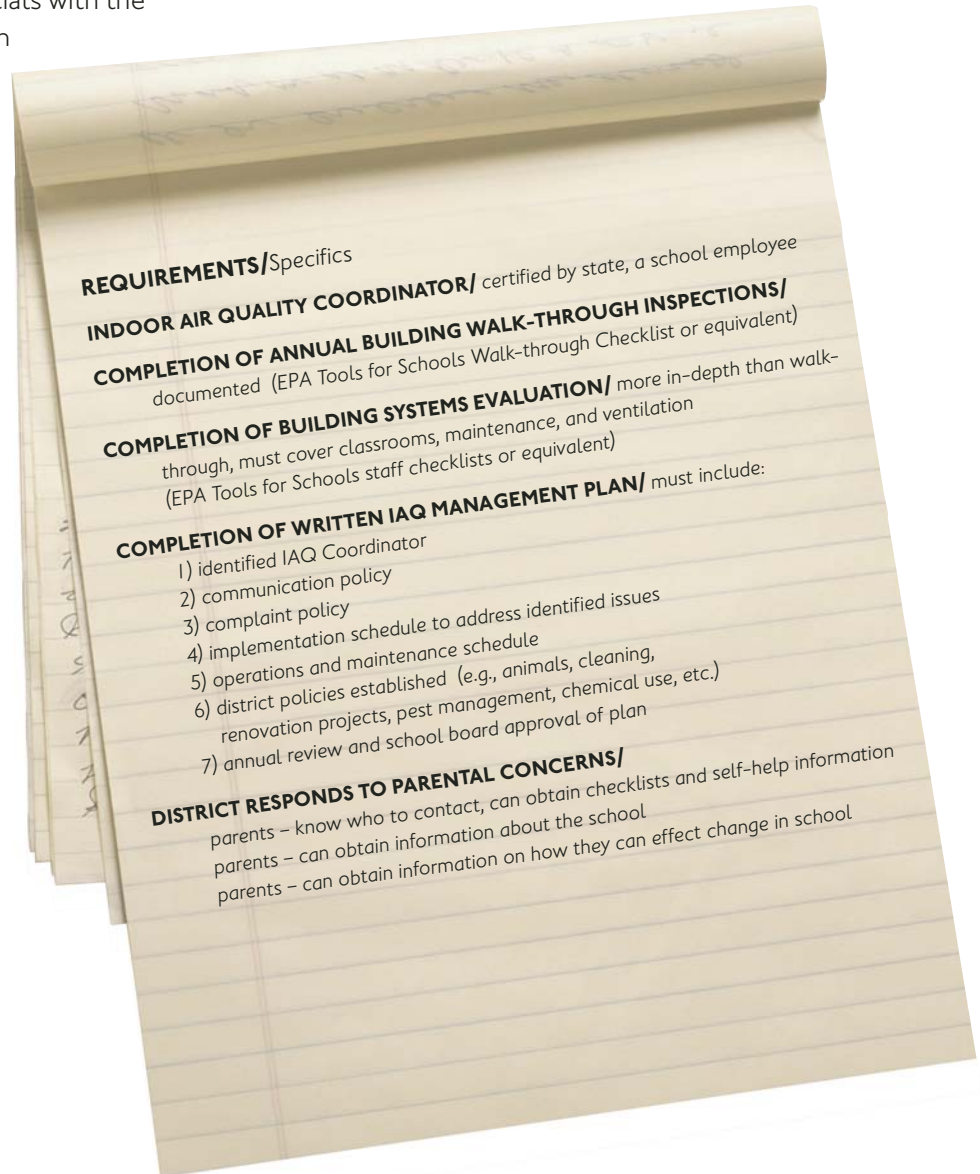
IAQ in schools has emerged as an area of great interest to parents, school staff, and government officials. This led the Minnesota state legislature in 1997 to require all public school districts to include a plan to monitor and improve IAQ as part of each district's health and safety program [1]. In 2000, the MDE and the MDH developed specific requirements for an IAQ management plan [2] (see Figure 1). To help school officials with the development and implementation

of their IAQ management plans, MDH and MDE trained school staff, distributed letters describing the guidelines, created an IAQ management plan development package, and completed on-site consultations with school staff. By January 2005, MDH surveys found that 79% of Minnesota school districts had developed a written IAQ management plan that met the state requirements [3].

FIGURE 1
MINNESOTA REQUIREMENTS FOR PUBLIC SCHOOL DISTRICT INDOOR AIR QUALITY (IAQ) MANAGEMENT PLANS

State law requires every public school district to develop a plan to monitor and improve air quality (§ 123B.57). Specific requirements are described in the MN Department of Education's annual health and safety revenue application letter addressed to superintendents (see [2], p.54-55). Determining mechanical ventilation rates is currently not required to receive health and safety funding (G, p.55). The **MODEL SCHOOL ENVIRONMENTAL ASTHMA MANAGEMENT PLAN (MSEAMP)** is far more detailed and prescriptive than current MDE requirements

- it is an optional, voluntary tool.



Introduction

THE 'HEALTHY SCHOOLS: INDOOR AIR QUALITY AND ASTHMA' PROJECT

While the progress made by Minnesota schools is impressive, it was uncertain whether the written IAQ management plans were truly implemented in schools. Moreover, there was no data to confirm that the school officials' written IAQ management plans resulted in significant improvements to the school environments and to occupants' comfort and health. A focused study was needed to fully evaluate whether practical school IAQ management plans could be implemented that resulted in demonstrable improvements.

To address these issues, MDH undertook a 'Healthy Schools: Indoor Air Quality and Asthma' project. MDH received a 2-year grant from the Legislative Commission on Minnesota Resources to fund the project.

The **overall goal of the project was to determine whether a comprehensive IAQ asthma management plan could be implemented in Minnesota schools that resulted in measurable improvements in the school environment.** This report summarizes findings and conclusions of the project. The objectives of the 'Healthy Schools: Indoor Air Quality and Asthma' Project were:

- 1 – To develop a Model School Environmental Asthma Management Plan.
- 2 – To complete environmental asthma consultative services in Minnesota schools.



MODEL SCHOOL ENVIRONMENTAL ASTHMA MANAGEMENT PLAN

The *Model School Environmental Asthma Management Plan* (MSEAMP) is a new tool used to monitor and improve school IAQ. It serves as a supplement to the IAQ management plan development package developed previously by MDH, which covers the basic requirements for an effective IAQ management plan. The MSEAMP was created for school officials who want to evaluate and address existing and potential IAQ-related asthma triggers in their schools. The MSEAMP includes environmental evaluation tools to identify asthma triggers and underlying building, behavioral, administrative, and maintenance factors in the school environment (*see Figure 2*). Each potential problem is linked to a model intervention and background information that justifies its relevance to asthma.

The evaluation tools consist of the following:

- 1 – An IAQ management plan questionnaire, completed by school administration and maintenance staff, used to identify problem issues in policies and practices in the school's IAQ management plan.
- 2 – Walk-through checklists used to inspect the school building for visible and apparent problems in classrooms and non-classroom areas (the ventilation system, bathrooms, hallways, exterior, rooftop, storage closets, kitchen and cafeteria).
- 3 – A brief staff perception survey used to rate air quality in classrooms and the overall school environment.
- 4 – A nurse office visit-tracking log for asthma-specific symptoms.



Why should school staff be concerned about asthma?

The number of children with asthma has almost doubled since 1980. In Minnesota, about one in eleven students currently has asthma [13, 14]. Asthma is the leading chronic disease cause of school absenteeism, and it limits life-activities in about one in five asthmatics [15]. A number of asthma triggers may be found in schools that cause asthma symptoms. They include dust mites, cockroaches, mold, cat and dog allergens, contaminants from combustion appliances, strong odors, outdoor pollution, animals, dust, respiratory viruses and certain chemicals [16-19]. These asthma triggers are present due to a variety of factors, including problems related to ventilation, moisture, cleaning, maintenance, occupant behavior, and administrative policies [17-19]. School staff can control many of these factors and create a healthful school environment.

MDH staff developed the MSEAMP using a variety of resources. First, the MDH’s previous experience with school IAQ and its management was used to outline the MSEAMP. Second, the relevant literature was reviewed, including journal articles, books, and government guidance documents. Third, staff consulted experts in the field, including government officials, university researchers, non-governmental organizations, private sector environmental scientists, and product vendors. A library was compiled consisting of over 200 journal articles, conference proceeding articles, government reports, best practice documents, and various books. Of these references, nine were relied on heavily to develop the assessment tools and model interventions [4-12].

FIGURE 2 THE MSEAMP EVALUATES A VARIETY OF ISSUES

The “Model School Environmental Asthma Management Plan” is designed for use by school officials to evaluate their buildings, using a questionnaire, checklists, a survey, and a log. Issues identified in the MSEAMP are listed in the table below:

- staff inspection practices
- building condition
- ventilation maintenance
- flooring and furnishing cleaning
- moisture management
- bathroom maintenance
- maintenance chemicals
- art supplies
- pesticides
- pest problems
- food use
- renovation practices
- furnishings
- personal products
- communications
- nearby outdoor pollutants
- plants
- animals
- staff perception of air quality
- asthma related office visits

Introduction

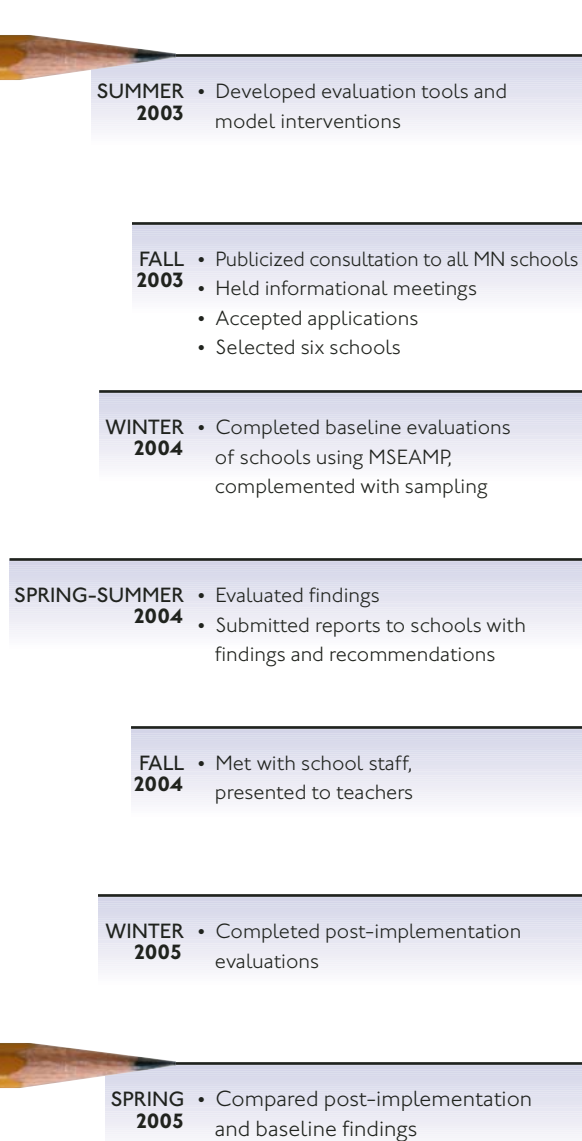


FIGURE 3
SCHOOL ENVIRONMENTAL ASTHMA CONSULTATION TIMELINE

The school environmental asthma consultations were completed to evaluate the practicality and effectiveness of implementing an indoor air quality and asthma management plan. The project covered a two year period.

SCHOOL ENVIRONMENTAL ASTHMA CONSULTATIONS

The school environmental asthma consultations assisted school staff with fully developing and implementing an IAQ asthma management plan. The consultations were an opportunity to ‘field-test’ the MSEAMP, to determine its efficacy and practicality. **Figure 3** summarizes the consultation timeline.

Schools were selected for the consultation through a rigorous process. First, letters were sent in early fall 2003 to superintendents and IAQ coordinators at all Minnesota public school districts. The letters announced the project and included a letter of interest to be returned. Thirty-six school districts returned letters of interest. These school districts were invited to send representatives to a statewide videoconference. In November 2003, the MDH hosted two videoconferences for school officials, to explain the project and expectations from school officials. The school officials were asked to review an outline of the project and complete and return application materials by early December 2003. Fourteen school districts submitted the application materials.



The primary selection criteria were:

- 1 – availability of an elementary school;
- 2 – genuine motivation and desire to participate in the project;
- 3 – written support from superintendent, principal, buildings and grounds director, and business manager;
- 4 – financial and staffing flexibility to accommodate school evaluations and implement recommended interventions;
- 5 – geographic distribution; and
- 6 – the presence of specific surfaces needed for sampling.

MDH staff selected six school districts from this pool of applicants to participate in the consultations. The consultations were limited to six schools due to the significant expense of the project.

Baseline evaluations of the schools were completed in Winter 2004. The evaluation team consisted of three staff from the MDH Indoor Air Unit. The MSEAMP was used to collect data about the school. In addition, air and floor dust samples were collected to assess current conditions and evaluate changes. Dust samples were analyzed for the amount of total dust, cat allergen, dog allergen, dust mite allergens, cockroach allergen, and viable fungi (i.e., molds and yeast that grow on media). Air samples measured particulates, carbon dioxide, carbon monoxide, relative humidity, temperature, and air supply rates in every classroom.

School staff was provided a report of the baseline findings and a list of recommendations to address identified problems. They attempted to implement the recommendations over the following eight months. No special funds were available to pay the expenses of implementing the recommendations, but additional guidance was provided.

A post-implementation evaluation was completed after the implementation period and one year after the baseline evaluation. The post-implementation evaluation was identical to the baseline evaluation, but it also assessed the extent that the recommendations were implemented and the costs and barriers to implementation, as reported by the school administration.

Baseline findings are referred to as “2004” while post-implementation findings are referred to as “2005.” Post-implementation findings were compared to baseline findings, and in some cases statistical tests were used to identify significant changes. “Significant” is used in the findings to describe differences that have less than a 5% probability to have occurred by chance ($P < 0.05$).

Findings

THE SCHOOLS REPRESENTED THE RANGE OF MINNESOTA PUBLIC SCHOOLS The six elementary schools that participated in the project were from across the state, with four in rural areas and two in the Twin Cities Metropolitan area. The schools varied in size, ranging in enrollment from 250 students to 940 students. Three schools have constant air volume ventilation system, one school has a variable air volume system, and two schools have a mix of unit ventilators and constant air volume system. All six schools had written IAQ management plans that met the basic Minnesota requirements for an effective plan. The schools' plans differed regarding the extent to which the plans were actually implemented and designed specifically to address the schools' specific IAQ issues. Three of the six schools had a history of staff complaints regarding IAQ, prior environmental consultant inspections, and seemed more motivated to implement improvements in their schools. These three schools are referred to as the "Group A Schools."



GROUP A SCHOOLS

Three of the six participating schools had a history of staff complaints regarding IAQ and seemed more motivated to implement improvements in their schools.



SCHOOLS HAD A VARIETY OF MINOR PROBLEMS IN 2004

The six schools that participated in the consultations were generally in good condition. There were no major contaminant sources or building problems identified that could be linked to substantial environmental asthma risks. There were, however, a variety of minor problems observed related to maintenance, building structure, staff behavior, and administrative policies. At baseline, 71% (222/311) of all the issues evaluated were classified as preferable (see Figure 4 for details). The number of problem issues identified in each school ranged from 76 to 112. Most of the problems were identified in classrooms and in the school's existing IAQ management plan.

SCHOOL STAFF IMPLEMENTED MOST RECOMMENDATIONS.

To address the identified issues, MDH presented each school's staff with 89 to 123 recommendations (average 102), to be incorporated into their IAQ management plans. The school staff reported an average of 76 were fully or partially implemented by 2005 (see Figure 5, pg 10). The implementation rate ranged from 67% to 86%.

FEWER PROBLEM ISSUES WERE OBSERVED

IN 2005 In 2005, 80% (249/311) of all the issues evaluated were classified as preferable (see Figure 4). The number of problem issues identified in each school ranged from 49 to 77. On average, there were 27 fewer problem issues identified in the schools in 2005.

FIGURE 4
PROBLEM ISSUES BY ASSESSMENT AREA

- POSSIBLE** refers to the total possible problem issues for each evaluation method.
- AVERAGE NUMBER OF PROBLEMS** shows how many different kinds of problem issues were identified at baseline – **2004**
- AVERAGE NUMBER OF PROBLEMS** shows how many different kinds of problem issues were identified at at post-implementation – **2005**

- The numbers of problem issues are summarized.
- These problems were identified using the IAQ Plan Questionnaire, the sampling, and the observational checklists.
- The data are averages of totals for six schools.
- Each type of problem is not equally important.
- This table shows the types of problems and does not reflect the prevalence or significance of the problems.
- When several rooms or areas had the same problems, it was only counted once.

ASSESSMENT AREA	POSSIBLE	AVG # OF PROBLEMS	
		2004	2005
IAQ-related Policies	83	37	22
Classroom Air Measurements	7	4	3
Classroom Floor Contaminants	5	3	3
Classroom Observations	70	24	19
Bathroom	7	3	2
Ventilation System	57	6	3
Exterior	37	3	2
Kitchen and Cafeteria	16	2	2
Chemical/Supply Room	14	4	3
Entrance/Hallways	9	3	3
Mechanical/Boiler Room	5	1	1
ALL ASSESSMENTS	311	89	62

Findings

FIGURE 5
IMPLEMENTATION & COSTS OF RECOMMENDATIONS

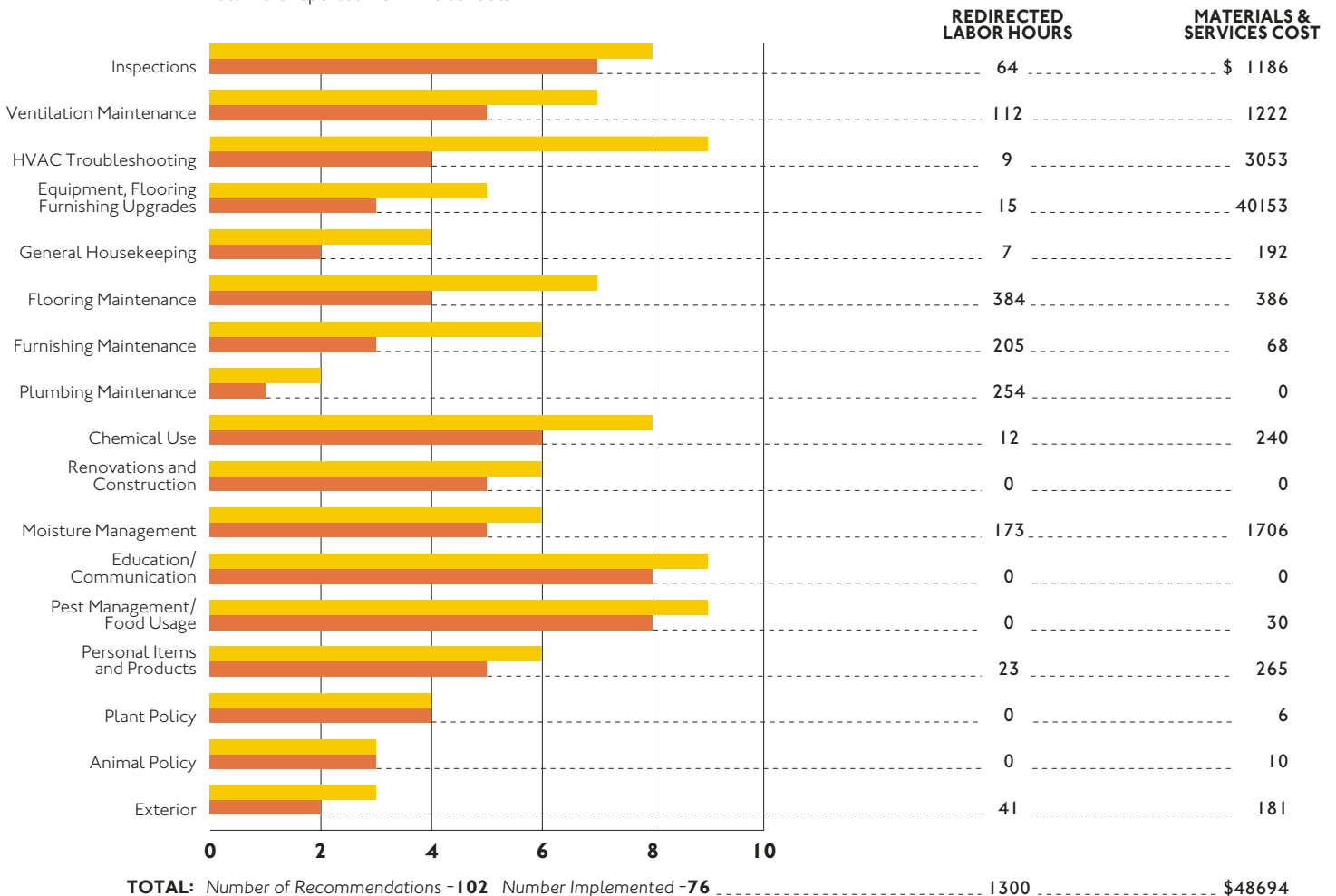
■ NUMBER OF RECOMMENDATIONS
■ NUMBER IMPLEMENTED

The figure describes the number of recommendations presented to the school in 2004, the number staff reported implementing by winter 2005, and the labor and material costs.

- All values are averages.
- Redirected labor hours refers to annual labor hours shifted towards these activities (from 06/04 - 06/05).
- Materials and service costs refers to annual cost of supplies, materials, and contracted services spent towards activity, beyond what would have been spent had the recommendation been ignored. Costs and labor hours varied greatly from school to school.
- Data were reported from five schools.

SCHOOL STAFF REPORTED SUPERIOR IAQ RELATED PRACTICES AND POLICIES

The IAQ management plan questionnaire was used to evaluate each district's IAQ management plan, including all policies and practices that are directly or indirectly related to IAQ. In 2004, on average each school reported 37 problem policies not favorable to IAQ, ranging from 28 to 48. In 2005, on average each school reported 22 problem policies, ranging from 12 to 34.



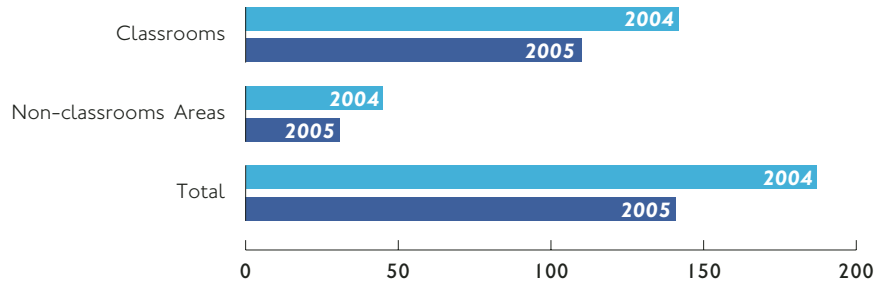


FIGURE 6
THE PREVALENCE OF PROBLEM OBSERVATIONS IN SCHOOL

The number of problem observations declined after the one year implementation period. Prevalences are total counts of problem observations noted during walk-through inspections. Some rooms or areas are counted more than once if there were several problems.

PROBLEM IAQ OBSERVATIONS THAT PERSISTED WERE LESS PREVALENT OR LESS SEVERE

While most problem issues persisted in classrooms, they were less prevalent or severe in 2005. In 2004, an average of 24 problem issues were identified in 142 classrooms in each building. In 2005, an average of 19 problem issues were identified in 110 classrooms in each building (see Figure 6). The greatest improvements identified in classrooms were fewer problem art supplies, maintenance chemicals, stained surfaces from water leaks, and odors (see Figure 7).

The non-classroom area evaluation included the ventilation system, exterior, bathroom, hallways, entrances, supply rooms, boiler room, kitchen, and cafeteria. In 2004, an average of 22 problem issues were identified in a total of 45 areas in each building. In 2005, an average of 16 problem issues were identified in a total of 31 areas. The greatest improvements identified in non-classroom areas were regarding greater negative pressure in bathrooms and storage closets, fewer particulate sources, cleaner building entrance mats, cleaner ventilation filters, and cleaner ventilation system components (see Figure 7).



FIGURE 7
MOST IMPROVED OBSERVATIONS

The table summarizes the problems that showed substantial improvement in 2005 based on findings using the building walk-through observational checklists.

CLASSROOM AREAS Number of schools (📎) with noted improvements

- Art supplies 📎 📎 📎 📎 📎
- Maintenance chemicals 📎 📎 📎 📎 📎
- Stained ceiling tiles, carpet or plumbing leaks 📎 📎 📎 📎
- Odors 📎 📎 📎
- Fleecy items 📎 📎
- Personal products 📎 📎
- Too many plants 📎 📎
- Open food 📎 📎
- Worn flooring 📎 📎
- Dirty floors 📎 📎
- Stuffed toys 📎
- Clutter 📎
- Pets 📎
- Dusty diffusers 📎
- Blocked air return 📎
- Absence of airflow 📎
- Ventilation disrepair 📎
- Sources of particulates 📎

NON-CLASSROOM AREAS

- Better negative pressure in restrooms 📎 📎 📎 📎
- Fewer particulate sources 📎 📎
- Cleaner entrance mats 📎 📎
- Cleaner ventilation filters 📎 📎
- Cleaner ventilation system components 📎 📎
- Fewer water leaks and stained building materials 📎
- Fewer odors 📎
- Fewer signs of pests 📎
- Larger entrance mats 📎
- Cleaner restrooms 📎
- Superior ventilation filter efficiency 📎
- Green maintenance chemicals 📎

Findings

PET ALLERGEN LEVELS DECLINED IN MOST FLOOR AREAS SAMPLED

Floor coverings were sampled for several known asthma triggers. A total of 72 samples were collected in each year from carpeting and vinyl tile floor coverings. The same areas were sampled in both years.

Cat and dog allergen levels were significantly lower in 2005. Approximately 70% of the areas sampled had lower levels of these pet allergens in 2005 (see Figure 8). In addition, there were fewer pet allergen levels in the moderate and high ranges (see Figure 9). A survey of students and staff, in classrooms where dust samples were collected, showed no significant overall change in the number of pet owners.

Fungi and total dust levels in floor coverings did not change to a significant extent when all schools were analyzed together. There was, however, a significant decline in fungi and a decline in dust levels in the Group A schools. Dust mites were detected in 8 samples in 2004 and 6 samples in 2005, with 3 samples above 2 mcg/g in 2004, and 2 samples in 2005. Cockroach allergen was never detected.

VENTILATION IMPROVED IN THE GROUP A SCHOOLS

The carbon dioxide levels in every classroom were measured, to identify possible areas with inadequate outdoor ventilation. In 2004, five of the six schools had at least one room in which carbon dioxide exceeded the outdoor level by 700 parts per million. Two of the schools (both Group A schools) had many rooms with elevated carbon dioxide levels. The five schools were given recommendations to consult a professional engineer and attempt to increase outdoor ventilation rates. The Group A schools completed upgrades and repairs in the ventilation systems that improved outdoor ventilation rates. In 2005, the Group A school classrooms had a significant decline in carbon dioxide levels, by an average of 159 parts per million. The three other schools showed no significant change.

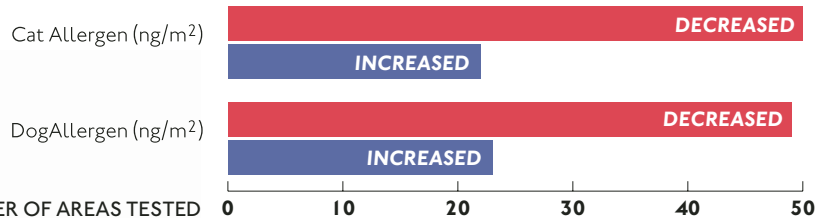


FIGURE 8
CHANGE IN PET ALLERGEN LEVELS
IN CLASSROOM FLOOR

The table shows the number of specific areas where cat and dog allergens either increased or decreased in 2005 compared to 2004.

- A large majority of areas sampled had lower cat and dog allergen levels in 2005, compared to 2004.
- Dust samples were collected from carpeting and vinyl tile floors.
- The same areas were sampled in both years.
- 72 samples were taken for each contaminant in each year.



YEAR	1.6 ≤ Cat < 8	cat ≥ 8	1.6 ≤ Dog < 8	dog ≥ 8
2004	20	4	29	8
2005	18	1	22	6

FIGURE 9
NUMBER OF AREAS WITH ELEVATED
CAT AND DOG ALLERGENS

- The number of areas sampled that exceeded certain thresholds are shown.
- A level over 1.6 mcg/g is considered a moderate level, above the level found in most homes with no pets [23].
- Levels greater than 8 mcg/g are considered high, because homes with these levels present a greater risk of symptoms in asthmatics [20, 21].

CONTAMINANT	2004		2005	
	CARPET	TILE	CARPET	TILE
Cat (ng/m ²)	327	16	256	13
Dog (ng/m ²)	551	51	374	26
Fungi (cfu/m ²)	14647	937	20202	1163
Dust (mg/m ²)	301	40	287	52
Number of samples	41	31	38	34

FIGURE 10
COMPARISON OF ALLERGENS IN CARPETING
VS VINYL TILE FLOORING

- The table shows the average levels of contaminants present in school carpet and school vinyl tile.
- The baseline and post-implementation findings are shown separately because of the flooring, maintenance and other difference between the two years.
- The results are in contaminant units per square meter of flooring area.
- All differences between carpeting and tile are significant.
- Carpet also had significantly higher levels when contaminants were expressed in units per gram floor dust.

Carpeting or vinyl tile: which is better?

There has been a lot of debate over carpeting and whether it harms or benefits IAQ. Flooring is important to IAQ because elevated levels of allergens in settled dust are strongly associated with asthma development and symptoms [16, 20, 21]. The Carpet and Rug Institute, a carpet industry trade group, claims that carpeting is not a problem, if maintained properly. They believe that carpet traps and holds dust and allergens away from occupants, and that cleaning effectively removes the contaminants [22]. Yet, at least nine previous studies reported significantly higher levels of specific allergens in school carpeting compared to smooth floors [17].

In the six schools that participated in the consultations, significantly higher levels of cat allergen, dog allergen, viable fungi, and total dust were present in classroom carpeting compared to vinyl tile (see Figure 10). Vinyl tile and carpeting in these schools were cleaned and maintained at the same frequencies, and yet the school carpeting was not as clean as the vinyl tile. Some of the maintenance practices necessary to keep carpeting clean were not fully implemented in the schools, due to financial, logistic, and supervisory challenges. The practices that were lacking included deep cleaning carpeting twice a year, replacing carpeting according to manufacturer schedules, thorough daily vacuuming with high quality HEPA-filter vacuum cleaners, and maintaining cleaning equipment. In conclusion, carpeting should be considered in classrooms only if a school administration is willing and committed to implementing and sustaining all the maintenance requirements; if not, smooth flooring should be considered as the practical option for superior IAQ.

Findings

STAFF PERCEPTION IMPROVED IN FIVE SCHOOLS, ESPECIALLY IN THE GROUP A SCHOOLS

The anonymous staff perception surveys were distributed to all staff. A total of 333 surveys were collected in 2004 and 377 surveys in 2005. More than 70% of teaching staff were surveyed in each school. Five of the six schools showed some improvement in staff perception. Group A schools had a significant improvement where 54% of staff rated air “average” or “good” in 2004, which increased to 83% in 2005 (see Figure II).

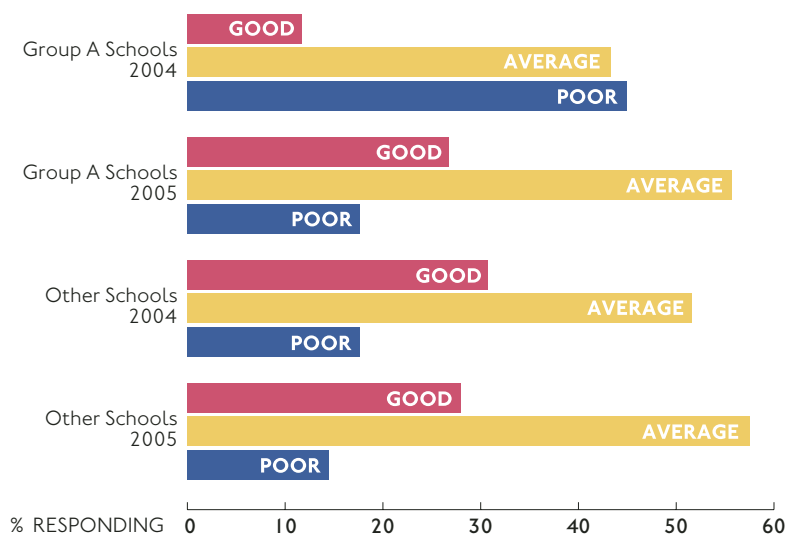


FIGURE II
STAFF PERCEPTION OF CLASSROOM AIR QUALITY

- Teaching staff’s perception of air quality improved in the schools.
- A larger and significant improvement was found for the three Group A schools.
- Paper surveys were distributed to teaching staff in the six schools in 2004 and a year later in 2005. About 70% of all eligible staff responded to the surveys.

COSTS AND LABOR HOURS SPENT BY SCHOOL STAFF WAS UNIQUE TO EACH SCHOOL

Each school’s staff reported redirected labor hours and the total cost of materials and contracted services associated with implementing the recommendations for the period of June 2004 to June 2005 (see Figure 5, pg 10). Estimates differed considerably between schools. The reported redirected annual labor hours ranged from only 22 hours to 3,230 hours. Most of the labor hours were associated with the time-consuming recommendations, such as those related to cleaning, maintenance, and inspections. Yet one school reported that they were able to make many improvements in these areas without redirecting labor hours from other existing maintenance work. Instead, they motivated staff, improved work efficiency, and solicited simple assistance from teachers.

Annual material and contracted service costs ranged from as little as \$1,700 to as much as \$173,400. These material costs reflected only a few costly actions taken in each school, such as replacing floor coverings, purchasing new building entrance mats, purchasing ventilation filters, purchasing whiteboards, contracting ventilation system repairs and upgrades, and purchasing cleaning supplies. The vast majority of actions had no or very low costs, and two of the schools did not spend more than \$1,000 on any individual action item.



COST AND INSUFFICIENT TIME WERE THE MOST IMPORTANT BARRIERS TO IMPLEMENTATION

About a quarter of the recommendations presented to the school staff were not implemented. School staff provided reasons (“barriers”) for why these recommendations were not implemented (see Figure 12). The top two barriers were the costs associated with the recommendations and not having enough time to address the issue. Considering the school staff were given about 8 months to address about 100 issues, it is not surprising that some issues would not be given attention by the post-implementation evaluation. Maintenance, cleaning, and ventilation improvements were the least implemented due to the costs and labor hours associated with these recommendations. The Group A schools made significant improvements in these areas, while the other three schools made some minor improvements. Another important barrier was administrative prerogative, which refers to the judgment of the school administration to not pursue an action because it conflicts with other priorities. Examples of this barrier included choosing not to prohibit all food from classrooms and not prohibiting personal items such as hair sprays.

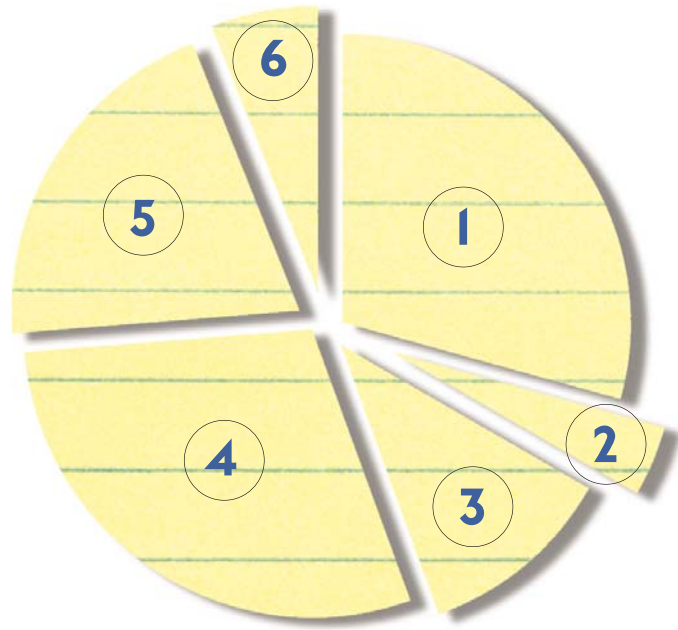


FIGURE 12 BARRIERS TO IMPLEMENTING RECOMMENDATIONS

On average, 76 recommendations were implemented, 26 recommendations were not. Choosing from five options, reasons cited for failure to implement were as follows:

	AVG NO. RESPONSES
1 - Not enough time— but committed to implementing it later.	7.7
2 - Did not understand or it did not make sense.	1.0
3 - Technically not feasible or not compatible with existing mechanical systems or equipment.	2.8
4 - Too expensive or too time consuming	7.7
5 - Not a high enough priority relative to other administrative policies, priorities, or prerogatives . . .	5.3
6 - Not reported by school staff	1.7
TOTAL	26.2



Conclusion

IMPLEMENTING A COMPREHENSIVE IAQ MANAGEMENT PLAN CAN IMPROVE THE SCHOOL ENVIRONMENT Each of the six schools that participated in the consultation had a wide variety of minor problems that could negatively impact the school environment. These schools were presented an IAQ asthma management plan with about 100 specific recommendations. All the schools that participated in the school environmental asthma consultation showed improvements. Overall, 89 problem issues were identified on average in 2004, compared to 62 in 2005. The problem issues were less prevalent in 2005, and the number of problems declined by 23% in classrooms, 31% in non-classrooms areas, and 41% in IAQ-related policies. Moreover, pet allergen levels declined significantly. Preliminary statistical analysis detected associations between contaminants and cleaning practices, indicating that more frequent and thorough cleaning is associated with fewer contaminants. Outdoor ventilation rates improved in the three Group A schools, including the two schools where this was a widespread problem. Also, staff perception improved in five of the six schools, and to a statistically significant extent in the Group A schools.

The improvements, while modest, should be considered a success since school staff had only eight months to implement the recommendations, and they had no special funds to cover labor and material costs. With more flexible budgets, greater funding, and more time to implement changes, even greater improvements are expected.



THE MSEAMP IS AN EFFECTIVE TOOL The school environmental asthma consultations demonstrated that the MSEAMP is an effective tool to monitor and improve IAQ problems and associated environmental asthma risks in schools. The MSEAMP was used to evaluate the schools and provide recommendations to address identified problems. School staff implemented three-quarters of the MSEAMP recommendations, which were effective in directing maintenance, administrative, and teaching staff to take specific actions to improve IAQ. On average, fewer than 4 of the 102 recommendations made to each school were not implemented due to school staff not understanding the recommendation or due to the technical incompatibility of the recommendation with existing equipment.

Most recommendations involved minimal time, material cost and inconvenience to staff, and the school succeeded with their implementation. Teachers' behaviors improved, especially related to art supplies, cleaning chemicals, controlling moisture problems, and limiting odor-generating activities. The administration adopted policies that will protect IAQ during future renovations, aggressively address moisture problems, and utilize integrated pest management to control pests. Maintenance, cleaning, and ventilation improvements were the most difficult to implement, and some schools implemented just a few of these recommendations while others made sweeping changes.

Implementing the recommendations were associated with a wide variety of improvements, including superior practices and policies incorporated into the school IAQ plan, fewer observed problems, lower contaminant levels, higher ventilation rates, and improved staff perception of air quality. While each individual action may have a small impact on the school environment, the findings suggest that their cumulative effect is associated with positive measurable outcomes.

Continued, next page



Conclusion

SCHOOLS ARE ENCOURAGED TO UTILIZE THE MSEAMP Implementing an IAQ asthma management plan can help to improve the school environment and minimize its impact on asthmatics. School officials who want a detailed and prescriptive tool are encouraged to use the MSEAMP. This tool is an advanced and voluntary tool. It is more detailed and prescriptive than other guidance documents (e.g., [9]) and it exceeds MDE's requirements for an IAQ management plan.

The implementation of the MSEAMP will take time, some money, and dedication. It is best suited for use by school staff that have already used more basic assessment tools and intervention strategies (e.g. EPA Tools for Schools). Schools that are motivated by a history of asthma or other related IAQ problems are most willing to fully implement this type of plan.

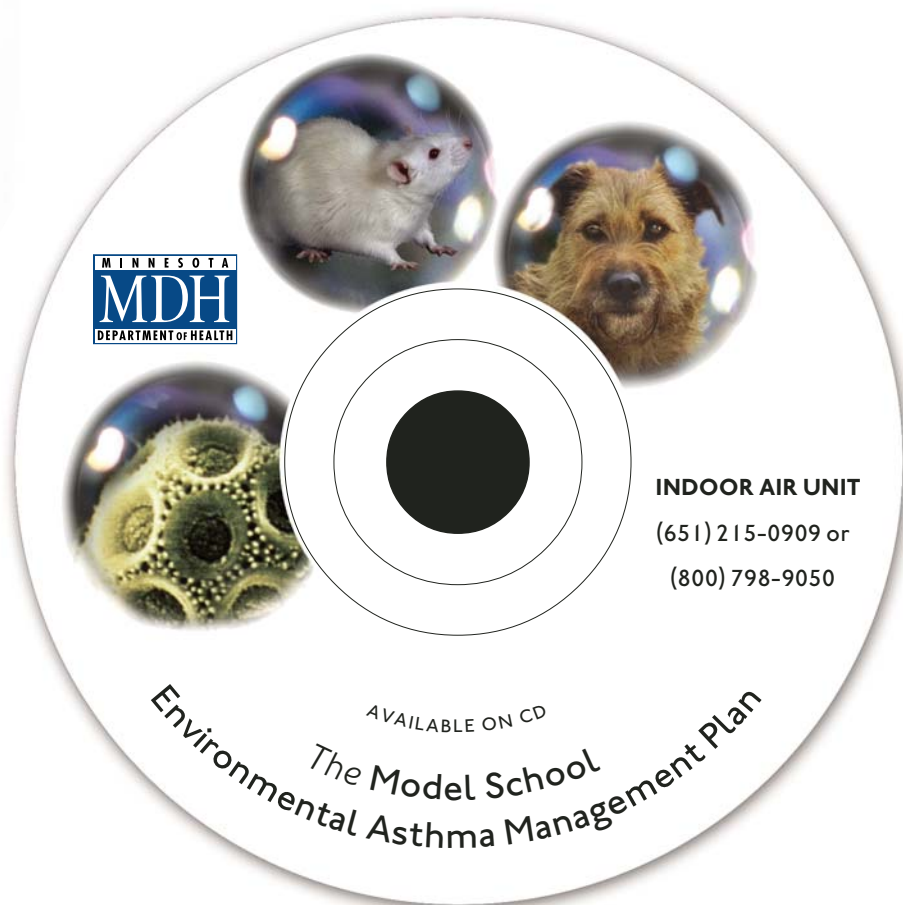
You can take action today to control asthma triggers in classrooms. Use the Model School Environmental Asthma Management Plan, available on a compact disc inside the back cover of this publication and also at www.health.state.mn.us/divs/eh/air/index.htm. You may also call the Minnesota Department of Health Indoor Air Unit at 651 215-0909 or 800 798-9050, with your questions.

References

1. Omnibus Education Act. In: I23B.57; 2004.
<http://www.revisor.leg.state.mn.us/stats/I23B/>
2. Minnesota Department of Education. Capital Expenditure: Health and Safety Revenue Application per MN Statute I23B.57. St. Paul; 2004. <http://education.state.mn.us/content/011021.pdf>
3. Minnesota Department of Health. 2004 Status of Minnesota Public School Districts' Indoor Air Quality Management Plans. St. Paul; 2005. <http://www.health.state.mn.us/divs/eh/indoorair/schools/progress.htm>
4. Dautel PJ, Whitehead LW, Tortolero SR, Abramson SL, Sockrider MM. Asthma Triggers in the Elementary School Environment: A Pilot Study. *J Asthma*; 1999;36(8):691-701.
5. Connecticut Department of Public Health. Managing Asthma in Connecticut Schools: A Resource Manual; 2002.
http://www.dph.state.ct.us/BCH/eeoh/new_Asthma/Asthma_schl_manual_web.pdf
6. Minneapolis Public Schools. Acceptable Indoor Air Quality for School Construction Projects. Minneapolis; 1997.
<http://www.health.state.mn.us/divs/eh/indoorair/schools/plan/appdxg.pdf>
7. Minnesota Department of Health. Indoor Air Quality Management Plan Development Package. St. Paul; 2001.
<http://www.health.state.mn.us/divs/eh/indoorair/schools/plan/index.html>
8. Minnesota Department of Education. Indoor Air Quality Operations and Maintenance Manual. St. Paul; 1997.
<http://www.health.state.mn.us/divs/eh/indoorair/schools/plan/appdxf.pdf>
9. U.S. Environmental Protection Agency. Indoor Air Quality Tools for Schools Action Kit. 2nd ed. Washington, D.C.; 2000.
<http://www.epa.gov/iaq/schools/tools4s2.html>
10. U.S. Environmental Protection Agency. Building Air Quality: A Guide for Building Owners and Facility Managers. Washington, D.C.; 1991. p. 45-108. <http://www.epa.gov/iaq/largebldgs/baqtoc.html>
11. American Conference of Governmental Industrial Hygienists. Bioaerosols: Assessment and Control. Cincinnati; 1999.
12. Washington State Department of Health. School Indoor Air Quality Best Management Practices Manual. Olympia; 1995.
13. Minnesota Department of Health. Minnesota Middle School Asthma Survey; 2004.
<http://www.health.state.mn.us/divs/hpcd/cdee/asthma/documents/asthmasurvey.pdf>
14. Minnesota Department of Health. Asthma in Rural Minnesota Adolescents; 2004. <http://www.health.state.mn.us/divs/hpcd/cdee/asthma/documents/RuralAdolescents.pdf>
15. American Lung Association. Making Schools Lung Healthy. New York; 1996.
16. Institute of Medicine. Clearing the Air: Asthma and Indoor Air Exposures. 1st ed. Washington, D.C.: National Academy Press; 2000. p. 1-18.
17. Tranter DC. Indoor Allergens in Settled School Dust: A Review of Findings and Significant Factors. *Clin Exp Allergy*; 2005;35:126-136.
18. Daisey JM, Angell WJ, Apte MG. Indoor Air Quality, Ventilation, and Health Symptoms in Schools: An Analysis of Existing Information. *Indoor Air*; 2003;13:53-64.
19. Henckel CL, Angell WJ. Survey of Indoor Air Quality and Related Complaints and Building Factors in Minnesota Schools. In: Proceedings of the 8th International Conference in Indoor Air Quality and Climate-Indoor Air '99; 1999; 987-992.
20. Platts-Mills TA. Allergens Derived from Arthropods and Domestic Animals. In: Spengler JD, Samet JM, McCarthy JF, editors. *Indoor Air Quality Handbook*. New York: McGraw-Hill; 2001; 43.1-43.12.
21. Platts-Mills TAE, Vervloet D, Thomas WR, Aalberse RC, Chapman MD. Indoor Allergens and Asthma: Report of the Third International Workshop. *J Allergy Clin Immunol*; 1997;100(6):S2-S24.
22. Lang S. CU Expert: Carpets in Schools Benefit Indoor Air Quality. *Cornell Chronicle*; 2001; March 29, 2001. http://www.news.cornell.edu/Chronicle/01/3.29.01/carpet_school.html
23. Arbes SJ, Cohn RD, Yin M, Muilenberg ML, Friedman W, Zeldin DC. Dog Allergen (Can f 1) and Cat Allergen (Fel d 1) in US homes: Results from the National Survey of Lead and Allergens in Housing. *J Allergy Clin Immunol*; 2004;114(1):111-117.



MSEAMP on CD




This report and the MSEAMP are also available at www.health.state.mn.us/divs/eh/air/index.htm.

If you have questions contact the Minnesota Department of Health Indoor Air Unit at (651) 215-0909 or (800) 798-9050 .



For more information, or to request this document in another format such as large print, Braille, or cassette tape, contact the Minnesota Department of Health Indoor Air Unit at (651) 215-0909; TDD (651) 215-0707; or toll-free through the Minnesota Relay Service at (800) 627-3529.

06/05

 Printed on 20% post-consumer content, recycled paper.