November 26, 2014

Mr. Matt Helgerson
Jordan Public Schools
500 Sunset Drive
Jordan, MN 55352

RE: Jordan Elementary School - Rooms 31, 69 and 81
Indoor Air Quality (IAQ) Assessment
IEA Project #201410785

Dear Mr. Helgerson:

IEA is pleased to provide this report for the IAQ assessment conducted at Jordan Elementary School in Jordan, Minnesota, on November 14, 2014. The purpose of the IAQ assessment was to address occupant concerns regarding air quality in some classrooms.

SITE INFORMATION/OBSERVATIONS

IEA's observations are summarized below.

Rooms 31, 69 and 81

- No odor was detected in the assessed rooms.
- IEA observed no evidence of moisture intrusion in the assessed rooms.
- A slight discoloration of approximately two square inches was observed at the base of the bookshelf storage cabinet by the sink in Room 69.
- IEA removed a portion of the bookshelf storage cabinet in Room 69 to inspect for fungal growth behind the cabinet. No fungal growth was observed.
- A moisture meter was used to test building materials. No wet building materials were identified at the time of the assessment.

SAMPLE RESULTS AND DISCUSSION

IEA conducted fungal air, tease tape and Microvac dust sampling. A copy of the laboratory analysis reports can be found in Appendix A. Sampling methodologies and existing guidelines can be found in Appendix B.

CULTURABLE AIRBORNE FUNGAL RESULTS

Air samples were collected to assess the level of culturable airborne fungi and to determine if the results are indicative of normal conditions or if they point to an interior source of fungal growth. Samples were collected following the end of the school day.

Room 31

No fungal colonies were detected on the sample indicating normal conditions at the time of sampling.

Room 69

The result identified a high level of culturable airborne fungi compared to the outdoor sample. The highest ranked organisms were *Penicillium* species. *Penicillium* species are often associated with moisture-impacted building materials. The result points to the presence of an interior source for the detected spores.

Room 81

The result identified a low level of culturable airborne fungi compared to the outdoor sample. The result indicates normal conditions at the time of sampling.

TEASE TAPE SAMPLES

A tease tape sample was collected on the base of the cabinet by the sink in Room 69.

Room 69

The results confirmed the presence a low level of fungal growth on the base of the cabinet by the sink. *Cladosporium* and *Trichoderma* were the fungal organisms identified. *Cladosporium* is a common outdoor organism; however, when a food source (*e.g.* dust) and damp environment are present, fungal growth can occur. *Trichoderma* is typically associated with growth on moisture-impacted building materials.

MICROVAC DUST SAMPLE RESULTS

Composite carpet dust samples were collected from three square feet of carpet in rooms 31, 69 and 81. The samples were analyzed for culturable fungal spores to determine if the results were indicative of normal conditions or suggestive of an interior source of fungal growth. Under normal conditions, a majority of the fungal spores detected in the carpet dust would have originated outdoors.

Room 31

- The result identified a moderate level of culturable fungal counts (spores) in the carpet dust sample. *Epicoccum nigrum* was the highest ranking organism on the DG18 agar and MEA analysis mediums. *Epicoccum nigrum* is associated with migration from outdoors. The majority of fungal spores detected are associated with migration from outdoors. Overall, the results indicate normal conditions.

Room 69

- The result identified a moderate level of culturable fungal counts (spores) in the carpet dust sample. *Epicoccum nigrum* was the highest ranking organism on the DG18 agar and MEA analysis mediums. The majority of fungal spores detected are associated with migration from outdoors. Overall, the results indicate normal conditions.

Room 81

- The result identified a moderate level of culturable fungal counts (spores) in the carpet dust sample. *Epicoccum nigrum* was the highest ranking organism on the DG18 agar and MEA analysis medium. The majority of fungal spores detected are associated with migration from outdoors. Overall, the results indicate normal conditions.

GENERAL INDOOR AIR QUALITY PARAMETERS

Carbon dioxide, carbon monoxide, temperature, and relative humidity levels were measured in Jordan Elementary School Rooms 31, 69 and 81, and outdoors for comparison. The HVAC system was operating in normal occupied mode during the testing.

Table #1: Carbon Dioxide, Carbon Monoxide, Temperature, and Relative Humidity Readings – November 14, 2014

Sample Location	# of Occ.	Carbon Dioxide (CO_2) (ppm)	Carbon Monoxide (CO) (ppm)	Temperature (°F.)	Relative Humidity (%)
Room 31	3	554	0.0	71.8	19.5
Room 69	3	901	0.0	69.7	19.5
Room 81	2	780	0.0	72.0	20.0
Outdoors	-	411	1.7	37.8	9.1

ppm - parts per million
TVOC – Total Volatile Organic Compounds

Discussion of Results for Rooms 31, 69 and 81

- Carbon dioxide, carbon monoxide, temperature and relative humidity levels were within IAQ guidelines during the sampling period.

CONCLUSIONS/RECOMMENDATIONS

IEA did not observe evidence of moisture or fungal growth in rooms 31 and 81. A small area of suspect fungal growth was observed at the base of the bookshelf storage cabinet by the sink in Room 69. The tease tape sample confirmed the presence of light fungal growth in this location.

Airborne fungal levels in Room 69 were elevated and an organism associated with moisture-impacted materials was dominant suggesting an interior source of fungal growth in the room. The dominant organism was not detected in the sample collected from the cabinet suggesting that a different fungal source is responsible for the elevated airborne fungal levels.

Airborne fungal levels in the other two rooms (Room 31 & 81) indicated normal conditions. The Microvac dust sample results for all three rooms indicated normal conditions in the carpet dust.

General IAQ measurements in Rooms 31, 69 and 81 were within IAQ guidelines at the time of the assessment.

Recommendations

- Thoroughly clean horizontal surfaces in Room 69 to collect settled fungal spores. Remove the light fungal growth on the base of the bookshelf by wet wiping with a bleach solution. Cleaning of the room should include wet wiping of hard surfaces and HEPA vacuuming of porous surfaces. Avoid disturbing settled dust prior to cleaning so that fungal spores do not become airborne and then settle out after cleaning. To reduce fungal load on carpet, clean carpet by hot water (steam) extraction per IEA guidelines. (See Appendix C for details.)
- Inspect accessible portions of the HVAC system, ductwork, and VAV box for Room 69 for evidence of moisture and/or fungal growth.
- Investigate other potential sources for the elevated airborne fungal levels in Room 69 (e.g. wall cavities).
- Conduct follow-up fungal sampling in Room 69 and comparison area served by same HVAC unit.

GENERAL COMMENTS

The analysis and opinions expressed in this report are based upon data obtained from Jordan Public Schools at the indicated locations. This report does not reflect variations in conditions that may occur across the site, property, or facility. Actual conditions may vary and may not become evident without further assessment.

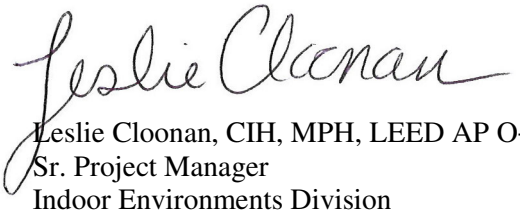
The report is prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted indoor air quality practices. Other than as provided in the preceding sentence and in our EH&S Proposal #3929 dated July 14, 2014, including the General Conditions attached thereto, no warranties are extended or made.

If you have any questions, please contact our office at 507-345-8818.

Sincerely,

IEA, INC.

George Rosburg
Project Manager
IEA-Mankato



Leslie Cloonan, CIH, MPH, LEED AP O+M
Sr. Project Manager
Indoor Environments Division

Enclosures

Appendix A

Laboratory Results

Prestige EnviroMicrobiology, Inc
www.prestige-em.com

Analytical Test Report

Client: Institute for Environmental Assessment, 9201 W. Broadway North, Suite 600, Brooklyn Park, MN

Client Project: 201410785

Sample date: 11-14-2014

Submittal date: NA

Samples submitted by: George Rosburg

Date analysis completed: November 20, 2014

Prestige Report number: 141118-03

Microscopic Method (P003): Analysis of Tape-Lift Samples for Fungi by Optical Microscopy

Prestige # Client sample ID Location	Sample dimension	Fungal ID	Fungal structures observed	Fungal density	Notes
141118-03-017 111414-8 Room 69-under cabinet by sink	1 1/2" x 1/2"	Asp/Pen-like *Chaetomium* *Cladosporium* *Trichoderma* unknown	spores in clusters loose spores spores, conidiophores, hyphae spores, conidiophores, hyphae spore mass	NA NA <1 <1 NA	Fungal growth.

1. The samples in this report were received in good, acceptable conditions. Prestige EnviroMicrobiology has not performed sample collection for the sample items listed in this report. Results relate only to the items tested.
2. Fungal density rating 1-5 (1 being the lowest and 5 the highest) indicates density of fungal growth structures observed. No fungal density is provided for loose spores, hyphal fragments and other structures. (<1) is used to indicate a light fungal density. NA = not applicable, ND = not detected.
3. Growth coverage, if provided, is based on estimation of the entire bulk sample surface on all sides.
4. Fungal contamination is noted when an analyst, at times during sample analysis, can differentiate the unusual compositions (types or numbers) of fungal spores or structures from background fungal compositions.
5. For more information on the results and their interpretation, please visit our website www.prestige-em.com.

Report approved: Theresa Lehman
Theresa Lehman, MPH, Lab Director

Technical Manager:
Chin S Yang, Ph.D.

Analyst: Chin S. Yang, Ph.D.

Prestige EnviroMicrobiology, Inc
AIHA Environmental Microbiology PAT Program participant
EMLAP Laboratory ID Number 192810
Website: www.prestige-em.com

Analytical Test Report

Client: Institute for Environmental Assessment, IEA, 9201 West Broadway North, Suite 600, Brooklyn Park, MN

Client Project: 201410785

Sample date: 11-14-2014

Submittal date: NA

Date samples received: 11-18-2014

Inoculation date: 11-14-2014 (Andersen); 11-18-2014 (Dust)

Samples submitted by: George Rosburg

Date analysis completed: November 25, 2014

Prestige report number: 141118-03

Culture Method (P006): Culture Analysis of Andersen Samples for Airborne Fungi

Prestige # Client sample ID Location	Air vol. (m^3)	Medium used	Fungal Identification	Colony counts	CFU/ m^3	Percentage
141118-03-010 111414-1 Room 69	0.085	DG18	Fungi, overloaded *Alternaria alternata* *Aspergillus calidoustus* *Aspergillus versicolor* *Paecilomyces variotii* *Penicillium* spp.	>400 Dom.	>4,700 Dominant Total >4,700	 Dominant
141118-03-011 111414-2 Room 81	0.085	DG18	*Cladosporium* spp. *Penicillium* spp.	9 4	110 47 Total 160	70% 30%
141118-03-012 111414-3 Room 31	0.085	DG18	No fungal colony detected	ND	<12 Total <12	NA
141118-03-013 111414-4 Outdoors-exit by Room 74	0.085	DG18	*Cladosporium* spp. *Eurotium amstelodami*	4 1	47 12 Total 59	80% 20%

Culture Method (P014): Culture Analysis of Dust Samples for Fungi

Prestige # Client sample ID Location Total dust wt. (g)	Wt. (g)	Medium used	Dilution factor	Fungal Identification	Colony counts	Conc. (CFU/g)	Percentage
141118-03-014 111414-5 Room 69 (0.0044g)	0.0044	DG18	40x	*Alternaria alternata*	10	91,000	23%
				Aspergillus versicolor	2	18,000	4%
				Aureobasidium pullulans	2	18,000	4%
				Cladosporium spp.	8	73,000	18%
				Epicoccum nigrum	12	110,000	27%
				Nigrospora sphaerica	1	9,100	2%
				Penicillium spp.	5	45,000	11%
				Pithomyces chartarum	3	27,000	7%
				sterile fungi	1	9,100	2%
						Total 400,000	
		MEA	40x	*Alternaria alternata*	2	18,000	8%
				Cladosporium spp.	3	27,000	11%
				Epicoccum nigrum	10	91,000	39%
				Pithomyces chartarum	9	82,000	35%
				Trichoderma harzianum	2	18,000	8%
						Total 240,000	
141118-03-015 111414-6 Room 81 (0.0110g)	0.0110	DG18	40x	*Alternaria alternata*	20	73,000	21%
				Cladosporium spp.	23	84,000	24%
				Epicoccum nigrum	45	160,000	44%
				Eurotium chevalieri	1	3,600	1%
				Nigrospora sphaerica	2	7,300	2%
				Phoma glomerata	2	7,300	2%
				Pithomyces chartarum	5	18,000	5%
						Total 350,000	
		MEA	40x	*Alternaria alternata*	14	51,000	17%
				Cladosporium spp.	27	98,000	32%
				Epicoccum nigrum	31	110,000	36%
				Penicillium sp.	1	3,600	1%
				Phoma glomerata	5	18,000	6%
				Pithomyces chartarum	7	25,000	8%
						Total 310,000	

141118-03-016 111414-7 Room 31 (0.0078g)	0.0078	DG18	40x	*Alternaria alternata*	20	100,000	23%
				Aspergillus fumigatus	1	5,100	1%
				Aspergillus versicolor	1	5,100	1%
				Aureobasidium pullulans	4	21,000	5%
				Cladosporium spp.	21	110,000	25%
				Epicoccum nigrum	26	130,000	30%
				Eurotium chevalieri	1	5,100	1%
				Fusarium sp.	1	5,100	1%
				Penicillium spp.	4	21,000	5%
				Phoma glomerata	2	10,000	2%
				Pithomyces chartarum	4	21,000	5%
						Total 430,000	
		MEA	40x	*Alternaria alternata*	13	67,000	16%
				Aureobasidium pullulans	6	31,000	7%
				Cladosporium spp.	15	77,000	18%
				Epicoccum nigrum	34	170,000	41%
				Nigrospora sphaerica	1	5,100	1%
				Penicillium sp.	1	5,100	1%
				Phoma glomerata	4	21,000	5%
				Pithomyces chartarum	5	26,000	6%
				Rhodotorula glutinis	1	5,100	1%
				yeasts	2	10,000	2%
						Total 420,000	

Report approved: Theresa Lehman
Theresa Lehman, MPH, Lab Director

Technical Manager:
Chin S Yang, Ph.D.

Analyst: Chin S. Yang, Ph.D.

1. The samples in this report were received in good, acceptable conditions. Prestige EnviroMicrobiology has not performed sample collection for the sample items listed in this report. Results relate only to the items tested.
2. Concentrations and percentages are rounded to the nearest two significant digits. Total percentage may not add up to 100% due to rounding. Percentage is for each group of fungal structures/fungi in total population.
3. Abbreviations where applicable: CMA = cornmeal agar, DG18 = Dichloran 18% glycerol agar, MEA = 2% malt extract agar, PCA = plate count agar, TSA = tryptic soy agar, ND = not detected, NA = not applicable.
4. All culture samples are incubated at 25±0.5ºC unless otherwise indicated.
5. The detection limit of this analysis is one fungal colony, one bacterial colony or one fungal structure. The analytical sensitivities vary from analysis to analysis or by air volume. For calculation of your analytical sensitivities, please visit our webpage http://prestige-em.com/index-tech.htm or contact us by calling 856-767-8300 or by email info@Prestigeem.com.

IAQ Chain of Custody

9201 West Broadway North, Suite 600
Brooklyn Park, MN 55445
763-315-7900 ☎ 1-800-233-9513

CLIENT NAME: Jordan Public Schools	PROJECT #: 20141078S	ANALYTICAL LAB: Prestige	# OF SAMPLES @ $ /sample
IEA CONTACT NAME:	BUILDING NAME: Elementary School	VERBAL RESULTS: ☐ NO ☐ YES	# OF SAMPLES @ $ /sample
PHONE # FAX #	PROJECT NAME: IAQ Sampling	WRITTEN SAMPLE RESULTS TO:	# OF SAMPLES @ $ /sample
			TOTAL $

141118-03

Sample #	Sample Location	Sample Type: Air	Bulk	Microvac	Swab	TT	Contact	Other	Media Type (Specific agar, filter tube, etc.)	Area (in²) or VOL (L)	Instructions (Type of analysis, analytical method requested, etc.)	Comments & Observations (Environmental factors--temp., RH, outdoor conditions, interior conditions, water stains, reported leaks, sample composition, etc.)
111414-1	Room 69	X							DG-18	85L	P006	
111414-2	Room 81	X							DG-18	85L	P006	
111414-3	Room 31	X							DG-18	85L	P006	
111414-4	Outdoors-Exit By Room 74	X							DG-18	85L	P006	
111414-5	Room 69			X					MEA & DG-18	5 SQ FT	P014	
111414-6	Room 81			X					MEA & DG-18	5 SQ FT	P014	
111414-7	Room 31			X					MEA & DG-18	5 SQ FT	P014	
111414-8	Room 69-Under Cabinet By Sink					X					P003	

OTHER INFORMATION:

SAMPLED BY: George Russell	DATE: 11-14-14	TIME: 3:30 PM	ANALYZED BY (COMPANY):	ANALYST:	DATE:	TIME:
SHIPPED BY: Fed Ex	DATE:	TIME:	TURNAROUND TIME: ☐ NORMAL ☐ RUSH ☐ OTHER			
RECEIVED BY:	DATE: 11/15/14	TIME: 9:52 AM	Fedex			

Appendix B

Sampling Methodologies & Existing Guidelines

Existing Guidelines/Health Concerns for Fungi

High levels of fungi in the indoor environment are known to cause a variety of human health concerns and may constitute one aspect of environmental sensitivity known as "sick building syndrome." Several fungal species are known to be allergenic, toxigenic, and/or pathogenic if present at elevated levels. However, the most common type of response is allergic in nature and is manifested by irritation to the respiratory system and eyes, sneezing, sinus congestion, and rhinitis.

The presence of fungi on building materials as identified by a visual assessment or by bulk/surface sampling results does not necessitate that people will be exposed or exhibit health effects. In order for humans to be exposed indoors, fungal spores, fragments, or metabolites must be released into the air and inhaled, physically contacted (dermal exposure), or ingested. Whether or not symptoms develop in people exposed to fungi depends on the nature of the fungal matter (e.g., allergenic, toxic, or infectious), the amount of exposure, and the susceptibility of the exposed persons. Susceptibility varies with the genetic predisposition (e.g., allergic reactions do not always occur in all individuals), age, state of health, and concurrent exposures. For these reasons, and because measurements of exposure are not standardized and biological markers of exposure to fungi are largely unknown, it is not possible to determine "safe" or "unsafe" levels of exposure in general.[1]

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1. New York City Department of Health, 2000. *Guidelines on Assessment and Remediation of Fungi in Indoor Environments.*

Fungal Air Samples – Culturable

Culturable airborne fungal samples were collected with a single-stage Andersen impact sampler, and DG-18 agar sample plates. The sampler was calibrated at 28.3 liters per minute, and was run for three minutes per sample for a total volume of 85 liters. The edge of each sample plate was sealed with masking tape to protect against cross-contamination. An outdoor reference sample was also collected.

Guideline to Aid in the Result Interpretation:

In mechanically-ventilated buildings with adequate filtration, the American Conference of Governmental Industrial Hygienists (ACGIH) has indicated that indoor bioaerosol levels should be less than the outdoor levels and the predominant species should be similar.[(1)] The publication also recommends the interpretation of bioaerosol data based on a combination of the following:

- indoor/outdoor concentration ratios,
- a comparison of species composition indoors and outdoors, and
- The presence of "indicator species" (those that indicate excessive moisture or a specific health hazard) isolated from the indoor environment.

1. ACGIH, 1999. *Bioaerosols: Assessment and Control*, §7.4.2 Fungi

Sample analysis was performed by Prestige EnviroMicrobiology, Inc. of Voorhees, New Jersey.

Microvac Carpet Dust Samples – Culturable Fungi

Bulk samples of dust from carpet tops were collected by the Microvac sampling method. The samples were collected with three-piece, 37 mm 0.8 μm MCE filter cassettes. The filters were connected to a high-flow sampling pump with tygon tubing. The sampling pump was operated at a flow rate of 10-20 liters per minute. A one-square-foot template was placed onto the carpet top. The samples were collected open-faced, and were pressed against the top surface of the carpet. The cassette was moved back and forth over the square foot twice in one orientation. The orientation was then switched ninety degrees, and then the process was repeated. Additional square feet were sampled until an adequate visible dust loading was present on the sample cassette.

The bulk dust (Microvac) samples were then prepared by serial dilution, which entails diluting a known mass of the sample (dust) in a measured amount of sterile water. The water solution in a range of dilution concentrations was then spread onto an analysis medium, which in this case was DG-18 agar. A fungal concentration is then determined by the amount of growth, the dilution factor used and the mass of the sample.

Sample analysis was performed by Prestige EnviroMicrobiology, Inc. of Voorhees, New Jersey.

Tease Tape Samples

Tease tape samples are collected by pressing a piece of clear cellophane tape against discoloration suspected of being fungal growth. The tape is then mounted to a clear glass microscope slide. The tape is then analyzed by optical microscopy.

Sample analysis was performed by Prestige EnviroMicrobiology, Inc. of Voorhees, New Jersey.

Moisture Meter Measurements

The primary purpose of the moisture meter is to identify wet building materials and to determine the extent of water damage to those materials. In fungal IAQ investigations, the moisture meter can aid in locating the source of excess moisture leading to fungal growth. This information can be used to stop the progression of fungal growth and to pinpoint possible areas for remediation.

SAMPLING METHODOLOGY

Moisture content of water-damaged building materials was evaluated with the Protimeter Surveymaster SM ™. The moisture meter was used in the both pin and search modes.

Guideline to Aid in the Result Interpretation:

Moisture measurements are relative because materials (e.g. sheetrock) have varying levels of moisture content. Measurements are evaluated by comparing readings from suspected moisture-impacted materials with readings from non-impacted materials of the same type collected within the same building and time period. Moisture measurements are representative of the date(s) and time(s) that they were collected. Ongoing measurements taken in one location can document the drying progress of a moisture-impacted material.

Carbon Dioxide (CO_2), Carbon Monoxide (CO), Temperature, and Relative Humidity

SAMPLING METHODOLOGY

Carbon dioxide (CO_2), carbon monoxide (CO), temperature, and relative humidity (RH) levels were measured using a TSI, Inc. Q-Trak™ Plus IAQ Monitor. Measurements were made in occupied areas and outdoors for comparison.

Guideline to Aid in the Result Interpretation:

At present, no indoor air quality regulatory limits exist apart from OSHA's Permissible Exposure Limits (PELs) which were developed for traditional industrial settings. OSHA's PELs are generally not a suitable measure of good indoor air quality in non-industrial environments. Recommended guidelines and other information for acceptable levels of carbon dioxide, carbon monoxide, temperature, and relative humidity are provided as follows:

- **Carbon Dioxide (CO_2)**

  Carbon dioxide is a colorless, odorless gas and is a natural and necessary component of our atmosphere. In outdoor air, CO_2 levels typically range from 300 to 400 parts per million (ppm). In indoor environments, CO_2 levels are usually higher than the levels measured outdoors. This is due, for the most part, to human respiration. Our exhaled breath contains approximately 30,000 ppm of CO_2; therefore, CO_2 levels will tend to increase indoors when people are present.

  The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 62.1-2004, *Ventilation for Acceptable Indoor Air Quality*, Appendix C states that maintaining a
  CO_2 concentration no greater than about 700 ppm above outdoor air levels will indicate that a substantial majority of occupants will be satisfied with respect to human bioeffluents (body odor).

  Measuring CO_2 levels in an occupied area can aid in determining how well the ventilation system is functioning. However, low CO_2 levels do not necessarily indicate that the ventilation system is functioning properly. If CO_2 levels are high, this suggests that the ventilation system is not functioning properly.

  Recommended CO_2 Limit

  Based on our past IAQ studies, the number of reported air quality complaints tends to increase when CO_2 levels exceed approximately 1,200 ppm. If CO_2 levels exceed 1,200 ppm in occupied areas, additional evaluation should be considered which may include ventilation or specific contaminant testing.

- **Carbon Monoxide (CO)**

  Carbon monoxide is a colorless, odorless, and tasteless gas, which is present at trace amounts in the environment. The primary source of CO is the combustion of fossil fuels and other oxidation processes. Therefore, if CO is present at significant levels, the most likely sources will be heating units or internal combustion engines.

  Carbon monoxide is classified toxicologically as a chemical asphyxiant, which means that it interferes with the oxygen-carrying capacity of the blood. If CO levels are high, enough oxygen can be displaced from the blood stream to cause the victim to suffer CO poisoning. As a result of this potential health hazard, the following regulatory exposure limits have been promulgated:

  - MN OSHA
    - Permissible Exposure Limit (PEL) = 35 ppm for an 8-hour TWA exposure
    - Ceiling level - 200 ppm
  - ACGIH
    - Threshold Limit Value (TLV) = 25 ppm for an 8-hour TWA exposure

  However, indoor CO levels less than the above regulatory limits have caused health-related symptoms such as headaches and nausea. As a result, recommended indoor air quality guidelines have been proposed to maintain indoor CO levels below 10 ppm. One recommended guideline referenced in ASHRAE 62.1-2004 is the National Ambient Air Quality Standard of 9 ppm for an 8-hour exposure.

  IEA also supports implementing corrective actions where significant indoor CO levels are present in indoor environments. Based on our air quality investigations, headaches, nausea, and dizziness can be reported when CO levels approach and exceed 10 ppm. However, in most indoor environments without a known CO source, a CO level of 5 ppm should be considered significant. A low CO level, in this case, indicates that a problem may exist in the heating or ventilation system.

- **Temperature and Humidity**

  Temperature and humidity levels will affect the thermal comfort of an individual. However, other factors including air speed, activity levels, metabolic rates, and clothing also affect thermal comfort. ASHRAE
  55-2004 has recommended temperature ranges suitable for people performing light, primarily sedentary activities for summer and winter seasons.

  The ASHRAE recommended temperature range varies from a minimum of 68°F for people wearing warm clothing to a maximum of 82°F for people wearing summer clothing. IEA has found that a temperature range of 68°F to 75°F is generally acceptable for the majority of occupants during winter months and a temperature range of 73°F to 79°F is generally acceptable during the summer months.

  As previously stated, humidity levels also impact thermal comfort. ASHRAE recommends that humidity levels be maintained below 65%. However, humidity extremes can cause conditions which lead to other air quality concerns. Very low humidity levels (<20%), which are common in non-humidified buildings during the winter, dry out mucous membranes, causing increased susceptibility to irritation from airborne contaminants at low levels and airborne pathogens. On the other hand, very high humidity levels (>70%) can lead to moisture condensation and mold growth in and on building materials and furnishings.

Appendix C

Carpet Cleaning Guidelines

IEA RECOMMENDED HOT WATER EXTRACTION CARPET CLEANING PROCEDURES

The following carpet cleaning procedures are provided to remove accumulated soil and reduce or minimize mold contamination from carpeting.

Carpets shall be cleaned with a truck-mounted system using a 2-5% bleach and hot water extraction process. Water temperature should be maintained at 180 degrees Fahrenheit at the point of application. The use of pre-treatment or spot remover shall not be applied unless approved by the building owner or their representative. Alterations, changes, or other activities beyond the stated procedures shall be approved by the building owner or their representative prior to their implementation.

- **Dry vacuum**. HEPA vacuum the carpeting to remove large particulate matter and soil from the carpet surface. The building personnel may execute this step.

  Prior to the following extraction procedure, the 2-5% bleach solution should be tested on a remote carpeting surface to determine any fiber damage. The following four-step process shall be performed with the cleaning wand or buffer at normal suction and operating speed by the contractor.

  - First pass: **Dry Extraction -** Remove dry particulate matter from the carpet surface.
  - Second pass: **Cleaning Agent Application -** Apply the cleaning agent (2-5% bleach solution) according to equipment manufacturer's guidelines and at a rate consistent with the cleaning chemical instructions.
  - Third and fourth pass: **Moisture Extraction -** Extract as much moisture from the carpet as feasible.

- **Dry the carpet**. It is the contractor's responsibility to dry the carpet within 24 hours after the application of the cleaning agent. The contractor may need to provide a sufficient number of carpet fans, commercial dehumidifiers, or other equipment necessary to dry the carpet within the 24 hour time period.

Contractor Responsibilities

The contractor shall supply all equipment necessary to perform the contracted work.

The contractor shall take all necessary precautions to protect building components from damage while performing work or during equipment storage. Materials containing bleach, water, or other dry or wet compounds that may damage the flooring materials shall be placed on polyethylene sheeting. Damage to carpeting surfaces, furnishing, or other building components resulting from cleaning compounds, equipment, or employees will be repaired at the contractor's expense to new or pre-existing condition.

The contractor shall abide by all owner policies while on the property including, but not limited to, a no-smoking policy, if applicable. The contractor shall abide by all local ordinances, state and federal laws or regulations while on the premises or performing contracted work.

If the contractor disturbs interior furnishings, the contractor shall restore to "as is" condition at work completion.

The contractor shall also determine that the carpeting has completely dried within the allotted 24 hours with the use of a moisture meter. Moisture sampling should be conducted of the carpeting along the perimeter walls as well as the center of the carpet. The contractor shall record the carpet moisture information for the building owner.

Building Owner Responsibilities

A minimum 48-hour continuous operation of the AHUs, unit ventilators, and exhaust systems shall be maintained after carpet cleaning.

IEA also recommends follow-up microbial sampling to determine the effectiveness of the hot water extraction on the reduction of fungal levels in the carpeting.