INDOOR AIR QUALITY ASSESSMENT REPORT
JUNE 8, 2016, EVENT
LAUREL WOODS ELEMENTARY SCHOOL
9250 NORTH LAUREL ROAD
LAUREL, MARYLAND 21723

PREPARED FOR

HOWARD COUNTY
MARYLAND

DEPARTMENT OF PUBLIC WORKS
9250 BENDIX ROAD
COLUMBIA, MARYLAND 21046

PREPARED BY

SKELLY AND LOY
ENGINEERING - ENVIRONMENTAL CONSULTANTS

449 EISENHOWER BOULEVARD, SUITE 300
HARRISBURG, PENNSYLVANIA 17111

AUGUST 1, 2016

R10-0163.019.07

TABLE OF CONTENTS

PAGE

LIST OF TABLES

1.0 EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

The Howard County Department of Public Works retained Skelly and Loy, Inc. to conduct an Indoor Air Quality (IAQ) assessment of Laurel Woods Elementary School within Howard County, Maryland. The assessment occurred on June 8, 2016.

The Scope of Work for these assessments included the collection of air samples for subsequent spore trap analysis and measuring various IAQ parameters as follows:

1. Comfort parameters (carbon dioxide [CO_2], temperature, and relative humidity);
2. Carbon monoxide (CO); and
3. Particulates – Total Particulate Matter 10 microns in diameter and smaller (PM_{10}).
4. Total airborne fungi;

Additionally, select accessible portions of the school were to be visually inspected, looking for signs of past or ongoing water damage and mold growth.

Regarding the sampling and analysis for airborne fungal spores in Laurel Woods Elementary School, airborne Genera of fungi were identified at 17 interior locations at higher concentrations than their corresponding outside control location. These locations included 2 portable and 12 traditional classrooms as well as 3 other areas.

Regarding the assessment for CO_2, relative humidity, temperature, CO, and respirable particulates, the upper limit of CO_2 of background plus 700 parts per million (ppm) was exceeded only in Traditional Classroom 108, and the lower limit of relative humidity acceptable range was not met in five locations (two traditional classrooms and three other areas). All temperature measurements fell within acceptable limits except for one traditional classroom. Respirable dust measurements exceeded their corresponding upper limit in seven traditional classrooms. CO concentrations fell within acceptable limits in all assessed locations.

Regarding the visual inspection performed, the industrial hygiene technician noted that stained ceiling tile and light water spots and stains were identified in Traditional Classroom 82. Also, in the hall outside of Traditional Classroom 103, a wet pipe jacket and stained ceiling tile were observed.

2.0 BACKGROUND

2.0 BACKGROUND

Skelly and Loy, Inc. was retained by the Howard County Department of Public Works to perform IAQ assessments at various elementary, middle, and high schools within the Howard County Public School System. Assessment efforts included the following:

- a visual inspection of accessible portions of the school;
- the measurement and recordation of comfort parameters, including CO_2, temperature, and relative humidity;
- the measurement and recordation of airborne CO and particulates; and
- the collection and analysis of fungal spore trap samples.

Including outdoor/exterior control (or baseline) locations, a total of 20 locations were assessed. This report is for the assessment performed at Laurel Woods Elementary School on June 8, 2016.

Laurel Woods Elementary School is one of 41 Elementary Schools located in Howard County, Maryland and serves students in grades Pre-Kindergarten through 5. It is located at 9250 North Laurel Road in Laurel, Maryland, 21723. Enrollment in school year 2015-2016 is reported to be 610. The school capacity is reported to be 640. This school first opened in 1973 and had additions in 1987, 2008, and 2015. Reported renovations occurred in 2005 and 2006.

A copy of the school's floor plans is included in Appendix A.

3.0 OBSERVATIONS AND MEASUREMENTS

3.0 OBSERVATIONS AND MEASUREMENTS

Assessment locations within the school were selected with a number of factors being considered:

- At least one assessment location should occur within each of the buildings' heating, ventilation, and air conditioning (HVAC) zones.
- Assessment locations should be evenly dispersed geographically throughout the school.
- If the school has portable classrooms, all such portable classrooms are to be assessed.

The locations where all 20 assessments occurred are depicted on the floor plans in Appendix A. The locations, dimensions, and orientation of all portable classrooms presented on the floor plans are approximate only. The floor plans depicting the assessment locations (Appendix A) were generated from base floor plans/heating, ventilation, and air conditioning zone plans obtained from Howard County Public Schools. On the floor plans in Appendix A and in Tables 2A, 2B, 3A, and 3B, the various interior sampling and assessment locations that were compared against specific outside/exterior "control" locations are identified by color (on the floor plans in Appendix A) and by grouping (in Tables 2A, 2B, 3A, and 3B).

3.1 VISUAL INSPECTION

During the on-site assessment activities, the industrial hygienist technician looked for signs of past and/or ongoing water infiltration, leaks, and damage to interior building materials, including signs of past or ongoing mold growth. Additionally, where applicable, if any building occupants (teachers and/or custodial staff) offered any information regarding IAQ concerns, water damage, or mold growth, the technician also recorded this information.

Regarding the visual inspection performed, the industrial hygiene technician noted that stained ceiling tile and light water spots and stains were identified in Traditional Classroom 82. Also, in the hall outside of Traditional Classroom 103, a wet pipe jacket and stained ceiling tile were observed.

3.2 COMFORT PARAMETERS, CARBON MONOXIDE, AND PARTICULATES

3.2.1 Assessment Methodology

Measurements of CO_2, air temperature, relative humidity, and CO concentrations were made using a calibrated direct reading hand-held TSI brand Q- Trak Model 7575 (or equivalent) instrument. Measurements of particulate concentrations were made using a TSI Brand Dust Trak II (or equivalent) particulate monitor. These instruments provide quick, accurate information to assess key IAQ parameters. The meters were allowed to equilibrate at each sample location prior to recording the measurements. Copies of the calibration records/certificates for the Q- and Dust Track meters are included in Appendix C.

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 55-2010, "Thermal Environmental Conditions for Human Occupancy" provides guidance for the desirable ranges of temperature and relative humidity to achieve occupant comfort. That document recommends that indoor air temperatures generally be maintained between 68 degrees Fahrenheit (°F) and 74 °F in the winter and 73 °F and 79 °F in the summer for 80 percent (%) occupant acceptability.[1] These ranges are presented in Table 1.

TABLE 1
ACCEPTABLE RANGES OF TEMPERATURE AND RELATIVE HUMIDITY IN SUMMER AND WINTER*

RELATIVE HUMIDIFY	WINTER TEMPERATURE	SUMMER TEMPERATURE
30%	68.5 °F - 76.0 °F	74.0 °F - 80.0 °F
40%	68.5 °F - 75.5 °F	73.5 °F - 79.5 °F
50%	68.5 °F - 74.5 °F	73.0 °F - 79.0 °F
60%	68.0 °F - 74.0 °F	72.5 °F - 78.0 °F
* Adapted from ASHRAE Standard 55-2013		

There are currently no specific Health and Safety regulations for relative humidity in indoor air. However, ASHRAE Standard 62.1-2010, "Ventilation for Acceptable Indoor Air Quality," recommends that relative humidity levels be maintained below 65% with a relative

humidity of 50% being ideal.[2] U.S. Environmental Protection Agency (U.S. EPA) Tools for Schools recommends that relative humidity levels be maintained between 30% and 60%.[3]

ASHRAE Standard 62.1-2010, "Ventilation for Acceptable Indoor Air Quality," specifies fresh air requirements for various types of occupancies. IAQ studies performed by the National Institute for Occupational Safety and Health (NIOSH) have indicated that, by far, the most common contributor to IAQ complaints is inadequate ventilation. CO_2 is often utilized as an indicator of fresh air infusion into buildings. CO_2 is a normal component of the atmosphere and is typically present at concentrations between 300 and 500 ppm in outside air. Because humans produce CO_2, its build-up in an occupied space may be an indicator of inadequate fresh air supply. For occupant comfort, ASHRAE recommends that CO_2 concentration in a space be maintained no greater than 700 ppm above outdoor air levels.[2]

The U.S. EPA National Ambient Air Quality Primary Standard for CO is 9 ppm for an eight-hour period that is not to be exceeded more than once per year. There is also a 35 ppm level for a one-hour period that is not to be exceeded more than once per year.[4] CO is formed from incomplete oxidation during combustion of natural gas and other fuels.

Total particulate levels were measured using a direct reading, factory calibrated TSI brand DustTrak II IAQ (or equivalent) instrument. This instrument measures particulates 10 microns and smaller also referred to as PM_{10}.

The U.S. Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for inert airborne particulates (not otherwise regulated) is 15 mg/M^3 of air as a total particulate sample or 5 mg/M^3 of air as a respirable particulate sample.[7] In 1987, the U.S. EPA replaced the earlier Total Suspended Particulate (TSP) air quality standard with a PM_{10} standard. The newer standard focuses on smaller particles that are likely responsible for adverse health effects because of their ability to reach the lower regions of the respiratory tract. The PM_{10} standard includes particles with a diameter of 10 micrometers or less (i.e., 0.0004 inch or one-seventh the width of a human hair). The U.S. EPA's health-based national air quality standard for PM_{10} is 0.15 mg/M^3 (measured as a daily concentration over a 24-hour period).[7]

3.2.2 Assessment Findings

Regarding the measurement of CO_2, temperature, relative humidity, CO, and particulates, the bolded measurements in Table 2A and Table 2B fell outside of their corresponding acceptable range. The upper limit of CO_2 of background plus 700 ppm was exceeded only in

Traditional Classroom 108, and the lower limit of relative humidity acceptable range was not met in five locations. However all temperature, CO, and respirable particulates measurements fell within acceptable limits.

The comfort parameters associated with Outside/Exterior Sample 1 location are provided in Table 2A, and the comfort parameters associated with Outside/Exterior Sample 2 location are provided in Table 2B.

TABLE 2A
LAUREL WOODS ELEMENTARY SCHOOL
CARBON DIOXIDE, TEMPERATURE, RELATIVE HUMIDITY,
CARBON MONOXIDE, AND PARTICULATES MEASUREMENTS
ASSOCIATED WITH OUTSIDE/EXTERIOR SAMPLE 1 LOCATION
JUNE 8, 2016, SAMPLING EVENT

SAMPLE/ ASSESSMENT LOCATION	TIME SAMPLED/ ASSESSED	NUMBER OF OCCUPANTS	CO_2 (ppm)	TEMP (°F)	% RELATIVE HUMIDITY	CO (ppm)	PARTICULATES (mg/M^3)
Ext-1	10:42	-	453	76.8	19.0%	0.7	0.008
Portable 132	10:06	15-20	841	73.7	41.0%	0.5	0.006
Portable 133	10:30	15-20	515	77.6	31.6%	0.6	0.006

Bolded values indicate the assessed parameter value fell outside of the range deemed acceptable.
Acceptable CO_2 range is the background CO_2 level plus 700 ppm.
Acceptable temperature range is 73 °F to 79 °F.
Acceptable relative humidity range is 30% to 60%.
Acceptable CO range is 0 to 9 ppm.
Acceptable particulates range is 0 to 0.15 mg/M^3.

TABLE 2B
LAUREL WOODS ELEMENTARY SCHOOL
CARBON DIOXIDE, TEMPERATURE, RELATIVE HUMIDITY,
CARBON MONOXIDE, AND PARTICULATES MEASUREMENTS
ASSOCIATED WITH OUTSIDE/EXTERIOR SAMPLE 2 LOCATION
JUNE 8, 2016, SAMPLING EVENT

SAMPLE/ ASSESSMENT LOCATION	TIME SAMPLED/ ASSESSED	NUMBER OF OCCUPANTS	CO_2 (ppm)	TEMP (°F)	% RELATIVE HUMIDITY	CO (ppm)	PARTICULATES (mg/M^3)
Ext-2	13:55	-	438	71.4	20.3%	0.5	0.003
Classroom 32	12:22	20-30	880	77.4	32.5%	0.5	0.027
Classroom 34	12:24	20-30	1011	76.3	34.1%	0.5	0.072
Classroom 45	12:37	20-30	808	75.8	30.5%	0.6	0.011
Classroom 51	12:40	20-30	1006	74.3	33.8%	0.6	0.013
Classroom 64	12:57	20-30	803	76.3	**29.4%**	0.2	0.022
Classroom 74	12:02	20-30	810	77.3	33.6%	0.5	0.020
Classroom 79	12:04	20-30	875	77.5	34.5%	0.6	0.021
Classroom 85	11:48	20-30	915	77.1	36.6%	0.5	0.016
Classroom 92	11:34	20-30	586	75.9	34.7%	0.4	0.003
Classroom 95	11:13	20-30	811	76.7	33.4%	0.6	0.011
Classroom 105	11:30	-	495	76.7	31.9%	0.4	0.003
Classroom 108	10:58	20-30	**1174**	**79.5**	**28.3%**	0.7	0.026
Classroom 114	11:15	20-30	504	76.9	31.5%	0.5	0.002
Café (126)	13:12	-	546	74.8	**26.4%**	0.6	0.002
Media Room (22)	13:40	-	650	75.1	**24.5%**	0.1	0.007
Room 13	13:25	-	519	74.1	**23.2%**	0.2	0.004

Bolded values indicate the assessed parameter value fell outside of the range deemed acceptable.
Acceptable CO_2 range is the background CO_2 level plus 700 ppm.
Acceptable temperature range is 73 °F to 79 °F.
Acceptable relative humidity range is 30% to 60%.
Acceptable CO range is 0 to 9 ppm.
Acceptable particulates range is 0 to 0.15 mg/M^3.

3.3 FUNGI

3.3.1 Assessment Methodology

Fungi are common in and found throughout both the natural and man-made environment. Airborne mold is commonly found in homes, hotels, businesses, and offices, and in insti-

tutional and commercial buildings. It is quite possible that there are higher levels of fungi in one's home than in one's school or work. Many airborne fungi identified in the man-made environment (i.e., inside of buildings) originate outdoors and are brought inside with fresh air and attached to items brought into the buildings, including its occupants.

However, for certain sensitive individuals, increased levels of certain airborne fungi can cause adverse reactions. All individuals react differently to exposure to fungi, and the degree of reaction can change with time. Additionally, the degree of reaction can be affected by other factors, including an individual's overall health, the length and frequency of exposure, and other contaminants to which an individual is exposed. Also, individuals' susceptibility to different mold Genera, or combinations of mold Genera, vary. Because of this, there are no established regulatory or health-based levels of fungi above which could lead to moderate or severe illnesses. For fungi to grow, three criteria must be met: the presence of fungal spores, a food source, and moisture. Any organic matter can serve as the food source, and moisture can be from liquid water or elevated humidity. If any of these three criteria are eliminated, fungal growth will not occur.

Total airborne fungi samples were collected on specialized spore trap cassettes using a calibrated specialty sampling pump flowing at 15 liters of air per minute (lpm) for a total of 10 minutes and a total sample volume of 150 liters. Sampling works on the principle of initial impaction. Presumably particulate-laden air is drawn through the cassette's tapered inlet and accelerates the stream against a small slide coated with a collection media (adhesive). This sampling method is one that is industry-accepted.[5] The pump pulls air through the spore trap cassette before the air is subsequently pulled through the pump, so there is no need to decontaminate the pump between samples. Following the assessment, the spore trap samples were shipped under proper chain of custody (COC) to Southeast Environmental Microbiology Laboratories in Greenville, South Carolina, for microscopic count and identification (i.e., Genus) of fungi. Copies of the COC and corresponding results are included as Appendix B along with the laboratory's accreditation. All spore trap sample results were reported in fungal spores per cubic meter of air (spores/m^3) for the purposes of this assessment. The sampling pump used to collect the spore trap samples was calibrated using a manufacturer-supplied rotometer both before and after the sampling event. A copy of the calibration log is included as Appendix C. Specific areas of the school that were assessed and sampled are identified on the COC (Appendix B) and in Tables 3A and 3B (pages 10 and 11); these can be ascertained by cross-referencing the referenced room numbers to the room numbers on the floor plans (Appendix A).

There are currently no state or federal Health and Safety regulations or universally accepted guidelines for exposure to fungal spores in indoor air. The American Conference of Governmental Industrial Hygienists (ACGIH) has taken the position that the development of exposure guidelines based on the enumeration of viable or total (i.e., both viable and nonviable) fungi in air is not feasible.[6] It is commonly accepted that a "one size fits all" approach to developing exposure guidelines will not work due to wide variations in how different individuals respond to exposure to airborne fungi. To further complicate the development of exposure guidelines, multiple agencies and organizations have (sometimes widely) varying opinions on how exposure guidelines should be set and what the guidelines should be.

Because there are no "absolute" exposure limits for airborne fungal spores, the assessment protocol called for the comparison of indoor results from the interior areas with results from the outdoor air. In an ideal situation, indoor results should show lower fungi counts than outdoor samples and contain similar biodiversity. The results of the visual inspection and the building's history related to moisture and ventilation must also be considered when interpreting fungal air sample results. For the June 8 event, Outside/Exterior Sample 1 is being compared to Portable Classrooms 132 and 133. Outside/Exterior Sample 2 is being compared to results from all other (traditional) classrooms and internal areas.

The locations for the baseline (i.e., Outside/Exterior) assessments were selected based on one outside/exterior sample located in close proximity to the portable classrooms being compared to the results of the portable classroom samples and a second outside/exterior sample being compared against all remaining sample results.

3.3.2 Assessment Findings

Regarding the sampling and analysis for airborne mold spores in the Laurel Woods Elementary School, elevated Aspergillus/Penicillium spore counts in Portable Classroom 132 and Traditional Classroom 64 suggest that an interior source(s) of these mold Genera may exist in these two rooms. When viewing Tables 3A and 3B, bolded values represent such occurrences. Values in Tables 3A and 3B that are **bolded black** indicate that an interior mold source is likely, although airborne concentrations appear to be marginal. Values that are **bolded red** also indicate that an interior mold source is likely and that airborne concentrations appear to be higher than expected for a healthy indoor environment.[5]

When determining airborne fungi values that are marginal versus values that are higher than expected based on industry accepted practice, it must be noted that some limitations exist. The 1.5 multiplier was selected based on its reasonableness in helping identify those molds identified inside at a concentration higher than outside, while leaving some leeway for an occasional outlying value that was not considerably higher. Relatively low concentrations could still be bolded red if the corresponding exterior baseline concentrations were 1.5 times less or zero. It should be kept in mind that when calculating the airborne mold spore concentration, the laboratory uses a factor of 7 when multiplying the actual raw spore count (i.e., the actual number of a particular mold spore seen with a microscope by the analyst) to derive the concentration in spores per cubic meter of air. Therefore many bolded red values of low concentration may still be higher than ideal but are not necessarily uncommon or of concern.

TABLE 3A
LAUREL WOODS ELEMENTARY SCHOOL
SUMMARY OF SPORE TRAP SAMPLE ANALYTICAL RESULTS
ASSOCIATED WITH OUTSIDE/EXTERIOR SAMPLE 1 LOCATION
JUNE 8, 2016, SAMPLING EVENT

LOCATION	ALTERNARIA	ASCOSPORES	BASIDIOSPORES	BIPOLARIS/ DRECHSLERA	CHAETOMIUM	CLADOSPORIUM	CURVULARIA	EPICOCCUM	NIGROSPORA	PENICILLIUM/ ASPERGILLUS	POLYTHRINCIUM	RUSTS	SMUTS/PERICONIA/ MYXOMY	SPEGAZZINIA	TORULA	OIDIUM	PITHOMYCES
	(spores/m^3)																
Ext-1	133	567	2270	28	7	2060		63		189	7	14	154			7	
Portable 132	7	70	294			273		7		**945**	21		14				
Portable 133	14	161	273			546		7		**252**		7	14				

Bold Black values are indicative of a mold source within the building and levels appear to be marginal. There are no established state or federal guidelines for determining levels that pose a health risk to the general population.

Bold Red values are indicative of a mold source within the building and levels appear to be higher than expected based on industry-accepted practices. Nonetheless, there are no established state or federal guidelines for determining levels that pose a health risk to the general population.

TABLE 3B
LAUREL WOODS ELEMENTARY SCHOOL
SUMMARY OF SPORE TRAP SAMPLE ANALYTICAL RESULTS
ASSOCIATED WITH OUTSIDE/EXTERIOR SAMPLE 2 LOCATION
JUNE 8, 2016, SAMPLING EVENT

LOCATION	ALTERNARIA	ASCOSPORES	BASIDIOSPORES	BIPOLARIS/ DRECHSLERA	CHAETOMIUM	CLADOSPORIUM	CURVULARIA	EPICOCCUM	NIGROSPORA	PENICILLIUM/ ASPERGILLUS	POLYTHRINCIUM	RUSTS	SMUTS/PERICONIA/ MYXOMY	SPEGAZZINIA	TORULA	OIDIUM	PITHOMYCES
	(spores/m^3)																
Ext-2	35	1450	609			1930		7		21	7	7	14				
Classroom 32	21	42	42			105	**7**	7		**168**			**56**				
Classroom 34	7	49	63			147		**14**		**168**			**105**				
Classroom 45		14	84			21				**126**		**21**	7				
Classroom 51	7	14	63		**7**	105		7		**42**			7				
Classroom 64	7	35	63			105		7		**315**		**14**	**35**				**7**
Classroom 74		7	84			21				**126**			7				
Classroom 79		70				84	**7**		7	**105**		7	**21**				
Classroom 85		21	84			84		**14**		**168**			14	**7**			
Classroom 92		42	21			105				**84**			**21**				
Classroom 95	21	70	42			210		**14**		**168**			**21**				**7**
Classroom 105		14	84			42				21							
Classroom 108		70	126			126		7		**294**			**56**				
Classroom 114	7					21				**63**			7				
Café (126)	21	49	42			294				**126**			14		**14**		
Media Room (22)		7				63				**84**			**21**				
Room 13		42	21			63				**105**							

Bold Red values are indicative of a mold source within the building and levels appear to be higher than expected based on industry-accepted practices. Nonetheless, there are no established state or federal guidelines for determining levels that pose a health risk to the general population.

4.0 REFERENCES

4.0 REFERENCES

1. American Society for Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), Standard 55-2010, “Thermal Environmental Conditions for Human Occupancy,” ASHRAE, Atlanta, Georgia, 2010.

2. American Society for Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), Standard 62.1-2010, “Ventilation for Acceptable Indoor Air Quality,” ASHRAE, Atlanta, Georgia, 2010.

3. United States Environmental Protection Agency (U.S. EPA), Tools for Schools, U.S. EPA 402/K-07/008, January 2009.

4. United States Environmental Protection Agency (U.S. EPA), Clean Air Act – National Ambient Air Quality Standard, 40 CFR Part 50, 1990.

5. Jensen, Paul A., Ph.D., P.E., CIH; and Schafer, Millie P., Ph.D.; NIOSH/DPSE “Sampling and Characterization of Bioaerosols,” NIOSH Manual of Analytical Methods, Chapter J, January 15, 1998

6. ACGIH, 2015 Threshold Limit Values and Biological Exposure Indices

7. National Institute for Occupational Safety and Health/Centers for Disease Control, Pocket Guide to Chemical Hazards 2015, Cincinnati, Ohio, 2015.

5.0 LIMITATIONS AND USER RELIANCE

5.0 LIMITATIONS AND USER RELIANCE

The scope of this report is limited to the matters expressly covered. In preparing this report, Skelly and Loy has relied, in part, on information derived from secondary sources and interviews. Except as set forth in this report, Skelly and Loy has made no independent investigation as to the accuracy or completeness of the information derived from the secondary sources and interviews and has assumed that such information was accurate and correct. The floor plans depicting the assessment locations (Appendix A) were generated from base floor plans/heating, ventilation, and air conditioning zone plans obtained from Howard County Public Schools. Dimensions, orientation, and locations of any portable classrooms depicted are approximate only.

Skelly and Loy's findings are based on and have been developed in accordance with generally accepted standards of indoor air quality assessments, scientific principles, and professional judgment with resultant subjective interpretations. Professional judgments expressed herein are based on the facts currently available within the limits of existing data, Scope of Work, budget, and schedule. The findings are relevant for the dates of our site visit and should not be relied on to represent conditions at a later date.

This report was completed in accordance with the Scope of Work and contractual agreement between Skelly and Loy and the Howard County Department of Public Works. This report has been prepared for and is intended for the exclusive use of Howard County Department of Public Works, the client, and those parties authorized by the client. The information may not be relied on by any other person or entity without the written authorization of Skelly and Loy or the client.

APPENDICES

APPENDIX A -
BUILDING FLOOR PLANS

IAQ Assessment Legend
Laurel Woods Elementary School -
June 8, 2016, Event

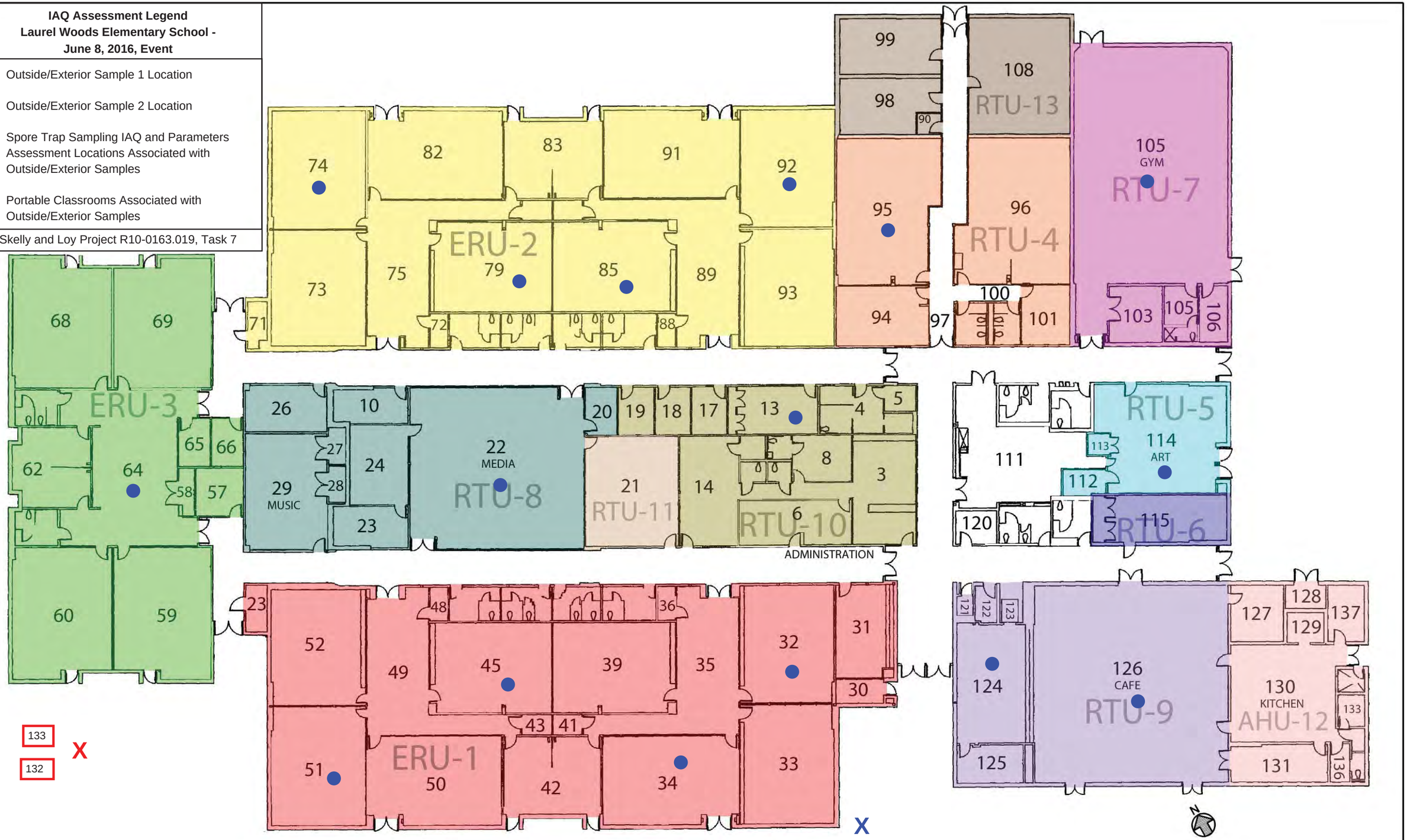
X Outside/Exterior Sample 1 Location

X Outside/Exterior Sample 2 Location

● Spore Trap Sampling IAQ and Parameters Assessment Locations Associated with Outside/Exterior Samples

□ Portable Classrooms Associated with Outside/Exterior Samples

Skelly and Loy Project R10-0163.019, Task 7



ERU-1 ERU-2 ERU-3 RTU-4 RTU-5 RTU-6
RTU-7 RTU-8 RTU-9 RTU-10 RTU-11 AHU-12 RTU-13

The Howard County Public School System
10910 Route 108 Ellicott City, Maryland 21042-6198 (410)313-6600

LEARNING FOR A LIFETIME

Floor Plan prepared by
Howard County Public School System

LAUREL WOODS ELEMENTARY FLOOR PLAN

MODIFIED - 8/8/11

APPENDIX B -
SPORE TRAP SAMPLE ANALYTICAL REPORT, CHAIN OF CUSTODY, AND LABORATORY ACCREDITATION

SEEML Reference Number:
160610002

Southeast Environmental Microbiology Laboratories
506 Laurens Rd
Greenville, SC 29607
Phone: (864) 233-3770
FAX: (864) 233-6589

The information and data for **Skelly and Loy, Inc.** has been checked for thoroughness and accuracy. The following reports are contained within this document:

- ☐ Direct Exam Report
- ☒ Spore Trap Report
- ☐ Andersen Fungal Report
- ☐ Quantitative Direct Exam Report
- ☐ Quantitative Fungal Report

Lab Manager Review: Rafael Berrios Date: 06/10/16

Thank you for using SEEML laboratories. We strive to provide superior quality and service.
SEEML laboratories are AIHA (American Industrial Hygiene Association) Environmental Microbiology Accredited laboratory for only fungal analysis Air-Direct Examination (EMLAP # 173667).

The data within this report is reliable to three significant figures. The third significant figure is technically unjustified. In this instance, the third figure is reported as an estimate to facilitate the interpretation by the customer.

Guidelines for Interpretation:
No accepted quantitative regulatory standards currently exist by which to assess the health risks related to mold and bacterial exposure. Molds and bacteria have been associated with a variety of health effects and sensitivity varies from person to person.
Several organizations, including: the American Conference of Government Industrial Hygienists (ACGIH); the American Industrial Hygiene Association (AIHA); the Indoor Air Quality Association (IAQA); the United States Environmental Protection Agency (USEPA); the Centers for Disease Control (CDC), as well as the California Department of Health Services (CADHS), have all published guidelines for assessment and interpretation of mold resulting from water intrusion in buildings.

Interpretation of the data and information within this document is left to the company, consultant, and/or persons who conducted the fieldwork.

Spore Trap Report

	Date Sampled: 06/08/16
Attn: Rob Rowley	Date Received: 06/10/16
Skelly and Loy, Inc	Date Analyzed: 06/10/16
449 Eisenhower Blvd.	Date Reported: 06/10/16
Harrisburg, PA 17111	Date Revised:
	Project Name: Laurel Woods Elementary
	Project Address: 9250 N. Laurel Rd.
	Project City, State, ZIP: Laurel, MD.20723
	SEEML Reference # : 160610002

TEST METHOD: DIRECT MICROSCOPY EXAMINATION AT 400X (100% OF TRACE ANALYZED) SEEML SOP 7

Client Sample ID	Portable 132			Portable 133			Ext-1		
Location	Desk Top in Center of Room			Desk Top in Center of Room			Outside of Portables 132 & 133		
Lab Sample ID	160610002-021			160610002-022			160610002-023		
Detection Limit (spores/m^3)	7			7			7		
Hyphal Fragments	2	14		3	21		6	42	
Pollen				2	14		26	182	
Spore Trap Used	AOC			AOC			Allergenco		
	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%
Alternaria	1	7	<1	2	14	1	19	133	2
Ascospores	10	70	4	23	161	13	81	567	10
Basidiospores	42	294	18	39	273	21	324	2270	41
Bipolaris/Drechslera							4	28	<1
Chaetomium							1	7	<1
Cladosporium	39	273	17	78	546	43	294	2060	37
Curvularia									
Epicoccum	1	7	<1	1	7	<1	9	63	1
Cercospora									
Fusarium									
Memnoniella									
Nigrospora									
Penicillium/Aspergillus	135	945	58	36	252	20	27	189	3
Polythrincium	3	21	1				1	7	<1
Rusts				1	7	<1	2	14	<1
Smuts/Periconia/Myxomy	2	14	<1	2	14	1	22	154	3
Spegazzinia									
Stachybotrys									
Stemphylium									
Tetraploa									
Torula									
Ulocladium									
Colorless/Other Brown 2									
Oidium							1	7	<1
Zygomycetes									
Pithomyces									
Background debris (1-5)3	3			3			3		
Sample Volume(liters)	150			150			150		
TOTAL SPORES/M^3	233	**1630**		182	**1270**		785	**5500**	

Comments: Condition of the sample(s) upon receipt: Acceptable.

1=Total % may not equal 100 due to rounding.

2 = Colorless,other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.

3 = Background debris is the amount of particulate matter present on the slide and is graded from 1-5 with 1 = very light, 2= Light, 3 = Medium, 4 = Heavy, 5 = Very Heavy. The higher the rating the more likelihood spores may be underestimated. A rating of 5 should be interpreted as minimal counts and may actually be higher than reported.

The reporting limit is 1 Spore/sample.

Disclaimer: This report relates only to the samples tested

Respectfully submitted, SEEML

Rafael Berrios

Rafael Berrios, Approved Laboratory Signatory

506 Laurens Road
Greenville, SC 29607
Phone: (864) 233- 3770
Fax: (864) 233-6589
AIHA-LAP, LLC EMLAP # 173667

Spore Trap Report

	Date Sampled: 06/08/16
Attn: Rob Rowley	Date Received: 06/10/16
Skelly and Loy, Inc	Date Analyzed: 06/10/16
449 Eisenhower Blvd.	Date Reported: 06/10/16
Harrisburg, PA 17111	Date Revised:
	Project Name: Laurel Woods Elementary
	Project Address: 9250 N. Laurel Rd.
	Project City, State, ZIP: Laurel, MD.20723
	SEEML Reference # : 160610002

TEST METHOD: DIRECT MICROSCOPY EXAMINATION AT 400X (100% OF TRACE ANALYZED) SEEML SOP 7

Client Sample ID	Classroom 108			Classroom 95			Classroom 114		
Location	Desk Top in Center of Room			Desk Top in Center of Room			Desk Top in Center of Room		
Lab Sample ID	160610002-024			160610002-025			160610002-026		
Detection Limit (spores/m^3)	7			7			7		
Hyphal Fragments	2	14		2	14				
Pollen	3	21		1	7				
Spore Trap Used	AOC			AOC			AOC		
	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%
Alternaria				3	21	4	1	7	7
Ascospores	10	70	10	10	70	13			
Basidiospores	18	126	19	6	42	8			
Bipolaris/Drechslera									
Chaetomium									
Cladosporium	18	126	19	30	210	38	3	21	21
Curvularia									
Epicoccum	1	7	1	2	14	3			
Cercospora									
Fusarium									
Memnoniella									
Nigrospora									
Penicillium/Aspergillus	42	294	43	24	168	30	9	63	64
Polythrincium									
Rusts									
Smuts/Periconia/Myxomy	8	56	8	3	21	4	1	7	7
Spegazzinia									
Stachybotrys									
Stemphylium									
Tetraploa									
Torula									
Ulocladium									
Colorless/Other Brown 2									
Oidium									
Zygomycetes									
Pithomyces				1	7	1			
Background debris (1-5)3	3			3			2		
Sample Volume(liters)	150			150			150		
TOTAL SPORES/M^3	97	**679**		79	**553**		14	**98**	

Comments: Condition of the sample(s) upon receipt: Acceptable.

1=Total % may not equal 100 due to rounding.

2 = Colorless,other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.

3 = Background debris is the amount of particulate matter present on the slide and is graded from 1-5 with 1 = very light, 2= Light, 3 = Medium, 4 = Heavy, 5 = Very Heavy. The higher the rating the more likelihood spores may be underestimated. A rating of 5 should be interpreted as minimal counts and may actually be higher than reported.

The reporting limit is 1 Spore/sample.

Disclaimer: This report relates only to the samples tested

Respectfully submitted, SEEML

Rafael Berrios

Rafael Berrios, Approved Laboratory Signatory

506 Laurens Road
Greenville, SC 29607
Phone: (864) 233- 3770
Fax: (864) 233-6589
AIHA-LAP, LLC EMLAP # 173667

Spore Trap Report

	Date Sampled: 06/08/16
Attn: Rob Rowley	Date Received: 06/10/16
Skelly and Loy, Inc	Date Analyzed: 06/10/16
449 Eisenhower Blvd.	Date Reported: 06/10/16
Harrisburg, PA 17111	Date Revised:
	Project Name: Laurel Woods Elementary
	Project Address: 9250 N. Laurel Rd.
	Project City, State, ZIP: Laurel, MD.20723
	SEEML Reference # : 160610002

TEST METHOD: DIRECT MICROSCOPY EXAMINATION AT 400X (100% OF TRACE ANALYZED) SEEML SOP 7

Client Sample ID	Classroom 105			Classroom 92			Classroom 85		
Location	Desk Top in Center of Room			Desk Top in Center of Room			Desk Top in Center of Room		
Lab Sample ID	160610002-027			160610002-028			160610002-029		
Detection Limit (spores/m^3)	7			7			7		
Hyphal Fragments									
Pollen							3	21	
Spore Trap Used	AOC			AOC			AOC		
	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%
Alternaria									
Ascospores	2	14	9	6	42	15	3	21	5
Basidiospores	12	84	52	3	21	8	12	84	21
Bipolaris/Drechslera									
Chaetomium									
Cladosporium	6	42	26	15	105	38	12	84	21
Curvularia									
Epicoccum							2	14	4
Cercospora									
Fusarium									
Memnoniella									
Nigrospora									
Penicillium/Aspergillus	3	21	13	12	84	31	24	168	43
Polythrincium									
Rusts									
Smuts/Periconia/Myxomy				3	21	8	2	14	4
Spegazzinia							1	7	2
Stachybotrys									
Stemphylium									
Tetraploa									
Torula									
Ulocladium									
Colorless/Other Brown 2									
Oidium									
Zygomycetes									
Pithomyces									
Background debris (1-5)3	3			3			3		
Sample Volume(liters)	150			150			150		
TOTAL SPORES/M^3	23	**161**		39	**273**		56	**392**	

Comments: Condition of the sample(s) upon receipt: Acceptable.

1=Total % may not equal 100 due to rounding.

2 = Colorless,other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.

3 = Background debris is the amount of particulate matter present on the slide and is graded from 1-5 with 1 = very light, 2= Light, 3 = Medium, 4 = Heavy, 5 = Very Heavy. The higher the rating the more likelihood spores may be underestimated. A rating of 5 should be interpreted as minimal counts and may actually be higher than reported.

The reporting limit is 1 Spore/sample.

Disclaimer: This report relates only to the samples tested

Respectfully submitted, SEEML

Rafael Berrios

Rafael Berrios, Approved Laboratory Signatory

506 Laurens Road
Greenville, SC 29607
Phone: (864) 233- 3770
Fax: (864) 233-6589
AIHA-LAP, LLC EMLAP # 173667

Spore Trap Report

	Date Sampled: 06/08/16
Attn: Rob Rowley	Date Received: 06/10/16
Skelly and Loy, Inc	Date Analyzed: 06/10/16
449 Eisenhower Blvd.	Date Reported: 06/10/16
Harrisburg, PA 17111	Date Revised:
	Project Name: Laurel Woods Elementary
	Project Address: 9250 N. Laurel Rd.
	Project City, State, ZIP: Laurel, MD.20723
	SEEML Reference # : 160610002

TEST METHOD: DIRECT MICROSCOPY EXAMINATION AT 400X (100% OF TRACE ANALYZED) SEEML SOP 7

Client Sample ID	Classroom 74			Classroom 79			Classroom 32		
Location	Desktop in Center of Room			Desktop in Center of Room			Desktop in Center of Room		
Lab Sample ID	160610002-030			160610002-031			160610002-032		
Detection Limit (spores/m^3)	7			7			7		
Hyphal Fragments				3	21		6	42	
Pollen	1	7		3	21				
Spore Trap Used	AOC			AOC			AOC		
	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%
Alternaria							3	21	5
Ascospores	1	7	3	10	70	23	6	42	9
Basidiospores	12	84	34				6	42	9
Bipolaris/Drechslera									
Chaetomium									
Cladosporium	3	21	9	12	84	28	15	105	23
Curvularia				1	7	2	1	7	2
Epicoccum							1	7	2
Cercospora									
Fusarium									
Memnoniella									
Nigrospora				1	7	2			
Penicillium/Aspergillus	18	126	51	15	105	35	24	168	38
Polythrincium									
Rusts				1	7	2			
Smuts/Periconia/Myxomy	1	7	3	3	21	7	8	56	13
Spegazzinia									
Stachybotrys									
Stemphylium									
Tetraploa									
Torula									
Ulocladium									
Colorless/Other Brown 2									
Oidium									
Zygomycetes									
Pithomyces									
Background debris (1-5)3	3			3			3		
Sample Volume(liters)	150			150			150		
TOTAL SPORES/M^3	35	**245**		43	**301**		64	**448**	

Comments: Condition of the sample(s) upon receipt: Acceptable.

1=Total % may not equal 100 due to rounding.

2 = Colorless,other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.

3 = Background debris is the amount of particulate matter present on the slide and is graded from 1-5 with 1 = very light, 2= Light, 3 = Medium, 4 = Heavy, 5 = Very Heavy. The higher the rating the more likelihood spores may be underestimated. A rating of 5 should be interpreted as minimal counts and may actually be higher than reported.

The reporting limit is 1 Spore/sample.

Disclaimer: This report relates only to the samples tested

Respectfully submitted, SEEML

Rafael Berrios

Rafael Berrios, Approved Laboratory Signatory

506 Laurens Road
Greenville, SC 29607
Phone: (864) 233- 3770
Fax: (864) 233-6589
AIHA-LAP, LLC EMLAP # 173667

Spore Trap Report

	Date Sampled: 06/08/16
Attn: Rob Rowley	Date Received: 06/10/16
Skelly and Loy, Inc	Date Analyzed: 06/10/16
449 Eisenhower Blvd.	Date Reported: 06/10/16
Harrisburg, PA 17111	Date Revised:
	Project Name: Laurel Woods Elementary
	Project Address: 9250 N. Laurel Rd.
	Project City, State, ZIP: Laurel, MD.20723
	SEEML Reference # : 160610002

TEST METHOD: DIRECT MICROSCOPY EXAMINATION AT 400X (100% OF TRACE ANALYZED) SEEML SOP 7

Client Sample ID	Classroom 34			Classroom 45			Classroom 51		
Location	Desktop in Center of Room			Desktop in Center of Room			Desktop in Center of Room		
Lab Sample ID	160610002-033			160610002-034			160610002-035		
Detection Limit (spores/m^3)	7			7			7		
Hyphal Fragments	3	21							
Pollen	6	42							
Spore Trap Used	AOC			AOC			AOC		
	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%
Alternaria	1	7	1				1	7	3
Ascospores	7	49	9	2	14	5	2	14	6
Basidiospores	9	63	11	12	84	31	9	63	25
Bipolaris/Drechslera									
Chaetomium							1	7	3
Cladosporium	21	147	27	3	21	8	15	105	42
Curvularia									
Epicoccum	2	14	3				1	7	3
Cercaspora									
Fusarium									
Memnoniella									
Nigrospora									
Penicillium/Aspergillus	24	168	30	18	126	46	6	42	17
Polythrincium									
Rusts				3	21	8			
Smuts/Periconia/Myxomy	15	105	19	1	7	3	1	7	3
Spegazzinia									
Stachybotrys									
Stemphylium									
Tetraploa									
Torula									
Ulocladium									
Colorless/Other Brown 2									
Oidium									
Zygomycetes									
Pithomyces									
Background debris (1-5)3	3			3			3		
Sample Volume(liters)	150			150			150		
TOTAL SPORES/M^3	79	**553**		39	**273**		36	**252**	

Comments: Condition of the sample(s) upon receipt: Acceptable.

1=Total % may not equal 100 due to rounding.

2 = Colorless,other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.

3 = Background debris is the amount of particulate matter present on the slide and is graded from 1-5 with 1 = very light, 2= Light, 3 = Medium, 4 = Heavy, 5 = Very Heavy. The higher the rating the more likelihood spores may be underestimated. A rating of 5 should be interpreted as minimal counts and may actually be higher than reported.

The reporting limit is 1 Spore/sample.

Disclaimer: This report relates only to the samples tested

Respectfully submitted, SEEML

Rafael Berrios

Rafael Berrios, Approved Laboratory Signatory

506 Laurens Road
Greenville, SC 29607
Phone: (864) 233- 3770
Fax: (864) 233-6589
AIHA-LAP, LLC EMLAP # 173667

Spore Trap Report

	Date Sampled: 06/08/16
Attn: Rob Rowley	Date Received: 06/10/16
Skelly and Loy, Inc	Date Analyzed: 06/10/16
449 Eisenhower Blvd.	Date Reported: 06/10/16
Harrisburg, PA 17111	Date Revised:
	Project Name: Laurel Woods Elementary
	Project Address: 9250 N. Laurel Rd.
	Project City, State, ZIP: Laurel, MD.20723
	SEEML Reference # : 160610002

TEST METHOD: DIRECT MICROSCOPY EXAMINATION AT 400X (100% OF TRACE ANALYZED) SEEML SOP 7

Client Sample ID	Classroom 64			Room 126			Room 13		
Location	Desktop in Center of Room			Center of Room			Center of Room		
Lab Sample ID	160610002-036			160610002-037			160610002-038		
Detection Limit (spores/m^3)	7			7			7		
Hyphal Fragments	2	14		3	21		1	7	
Pollen				2	14				
Spore Trap Used	AOC			AOC			AOC		
	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%
Alternaria	1	7	1	3	21	4			
Ascospores	5	35	6	7	49	9	6	42	18
Basidiospores	9	63	11	6	42	8	3	21	9
Bipolaris/Drechslera									
Chaetomium									
Cladosporium	15	105	18	42	294	53	9	63	27
Curvularia									
Epicoccum	1	7	1						
Cercospora									
Fusarium									
Memnoniella									
Nigrospora									
Penicillium/Aspergillus	45	315	54	18	126	23	15	105	45
Polythrincium									
Rusts	2	14	2						
Smuts/Periconia/Myxomy	5	35	6	2	14	3			
Spegazzinia									
Stachybotrys									
Stemphylium									
Tetraploa									
Torula				2	14	3			
Ulocladium									
Colorless/Other Brown 2									
Oidium									
Zygomycetes									
Pithomyces	1	7	1						
Background debris (1-5)3	3			2			3		
Sample Volume(liters)	150			150			150		
TOTAL SPORES/M^3	84	**588**		80	**560**		33	**231**	

Comments: Condition of the sample(s) upon receipt: Acceptable.

1=Total % may not equal 100 due to rounding.

2 = Colorless,other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.

3 = Background debris is the amount of particulate matter present on the slide and is graded from 1-5 with 1 = very light, 2= Light, 3 = Medium, 4 = Heavy, 5 = Very Heavy. The higher the rating the more likelihood spores may be underestimated. A rating of 5 should be interpreted as minimal counts and may actually be higher than reported.

The reporting limit is 1 Spore/sample.

Disclaimer: This report relates only to the samples tested

Respectfully submitted, SEEML

Rafael Berrios

Rafael Berrios, Approved Laboratory Signatory

506 Laurens Road
Greenville, SC 29607
Phone: (864) 233- 3770
Fax: (864) 233-6589
AIHA-LAP, LLC EMLAP # 173667

Spore Trap Report

	Date Sampled: 06/08/16
Attn: Rob Rowley	Date Received: 06/10/16
Skelly and Loy, Inc	Date Analyzed: 06/10/16
449 Eisenhower Blvd.	Date Reported: 06/10/16
Harrisburg, PA 17111	Date Revised:
	Project Name: Laurel Woods Elementary
	Project Address: 9250 N. Laurel Rd.
	Project City, State, ZIP: Laurel, MD.20723
	SEEML Reference # : 160610002

TEST METHOD: DIRECT MICROSCOPY EXAMINATION AT 400X (100% OF TRACE ANALYZED) SEEML SOP 7

Client Sample ID	Room 22			Ext-2					
Location	Center of Room			Frot of Main Building					
Lab Sample ID	160610002-039			160610002-040					
Detection Limit (spores/m^3)	7			7					
Hyphal Fragments				2	14				
Pollen	1	7		1	7				
Spore Trap Used	AOC			Allergenco					
	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%			
Alternaria				5	35	<1			
Ascospores	1	7	4	207	1450	36			
Basidiospores				87	609	15			
Bipolaris/Drechslera									
Chaetomium									
Cladosporium	9	63	36	276	1930	47			
Curvularia									
Epicoccum				1	7	<1			
Cercospora									
Fusarium									
Memnoniella									
Nigrospora									
Penicillium/Aspergillus	12	84	48	3	21	<1			
Polythrincium				1	7	<1			
Rusts				1	7	<1			
Smuts/Periconia/Myxomy	3	21	12	2	14	<1			
Spegazzinia									
Stachybotrys									
Stemphylium									
Tetraploa									
Torula									
Ulocladium									
Colorless/Other Brown 2									
Oidium									
Zygomycetes									
Pithomyces									
Background debris (1-5)3	3			3					
Sample Volume(liters)	150			150					
TOTAL SPORES/M^3	25	**175**		583	**4080**				

Comments: Condition of the sample(s) upon receipt: Acceptable.

1=Total % may not equal 100 due to rounding.

2 = Colorless,other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.

3 = Background debris is the amount of particulate matter present on the slide and is graded from 1-5 with 1 = very light, 2= Light, 3 = Medium, 4 = Heavy, 5 = Very Heavy. The higher the rating the more likelihood spores may be underestimated. A rating of 5 should be interpreted as minimal counts and may actually be higher than reported.

The reporting limit is 1 Spore/sample.

Disclaimer: This report relates only to the samples tested

Respectfully submitted, SEEML

Rafael Berrios

Rafael Berrios, Approved Laboratory Signatory

506 Laurens Road
Greenville, SC 29607
Phone: (864) 233- 3770
Fax: (864) 233-6589
AIHA-LAP, LLC EMLAP # 173667

Fungal Descriptions

Alternaria sp.

Aw - 0.89. Conidia dimensions: 18-83 x 7-18 microns. A very common allergen with an IgE mediated response. It is often found in carpets, textiles and on horizontal surfaces in building interiors. Often found on window frames. Outdoors it may be isolated from samples of soil, seeds and plants. It is commonly found in outdoor samples. The large spore size, 20 - 200 microns in length and 7 - 18 microns in sizes, suggests that the spores from these fungi will be deposited in the nose, mouth and upper respiratory tract. It may be related to bakers' asthma. It has been associated with hypersensitivity pneumonitis. The species *Alternaria alternata* is capable of producing tenuazonic acid and other toxic metabolites that may be associated with disease in humans or animals. Common cause of extrinsic asthma (immediate-type hypersensitivity: type I). Acute symptoms include edema and bronchiospasms; chronic cases may develop pulmonary emphysema.

Ascospore

A spore borne in a special cell called an ascus. Spores of this type are reported to be allergenic.
All ascomycetes, members of a group of fungi called Ascomycotina, have this type of spore. The minute black dots on rotting wood and leaves or the little cups on lichens are examples of ascomycetes; another is the "truffle" mushroom.

Aspergillus/Penicillium

These are two of the most commonly found allergenic fungi in problem buildings. *Aspergillus* comes in many varieties (species). Many of the varieties produce toxic substances. It may be associated with symptoms such as sinusitis, allergic bronchiopulmonary aspergillosis, and other allergic symptoms.
Penicillium is a variety of mold that is very common indoors and is found in increased numbers in problem buildings. It also has many varieties, some of which produce toxic substances. The symptoms are allergic reactions, mucous membrane irritation, headaches, vomiting, and diarrhea.
Because the spores of *Aspergillus* and *Penicillium* are very similar, they are not differentiated by microscopic analysis and are reported together.

Aspergillus sp.

Aw 0.75 - 0.82. Reported to be allergenic. Members of this genus are reported to cause ear infections. Many species produce mycotoxins that may be associated with disease in humans and other animals. Toxin production is dependent on the species or a strain within a species and on the food source for the fungus. Some of these toxins have been found to be carcinogenic in animal species. Several toxins are considered potential human carcinogens. Common cause of extrinsic asthma (immediate-type hypersensitivity: type I). Acute symptoms include edema and bronchiospasms; chronic cases may develop pulmonary emphysema; may also be associated with sinusitis, allergic bronchiopulmonary aspergillosis, and other allergic symptoms.

Basidiospore

Spore from basidiomycetes. Many varieties are reported to be allergenic.

Bipolaris sp.

A fungus with large spores that could be expected to be deposited in the upper respiratory tract. This fungus can produce the mycotoxin - sterigmatocystin, which has been shown to produce liver and kidney damage when ingested by laboratory animals.

Botrytis sp.

Aw 0.93. Conidia dimensions: 7-14 x 5-9 microns. It is parasitic on plants and soft fruits. Found in soil and on house plants and vegetables, it is also known as "gray mold". It causes leaf rot on grapes, strawberries, lettuce, etc. It is a well-known allergen, producing asthma type symptoms in greenhouse workers and "wine grower's lung".

Cercaspora

Common outdoors in agricultural areas, especially during harvest. Parasite of higher plants, causing leaf spot. Commonly found as parasites on higher plants.

Chaetomium sp.

large ascomycetous fungus producing perithecia. It is found on a variety of substrates containing cellulose, including paper and plant compost. It has been found on paper in sheetrock. It can produce an *Acremonium*-like state on fungal media. Varieties are considered allergenic and have been associated with peritonitis, cutaneous lesions, and system mycosis.

Cladosporium sp.

Aw 0.88; Aw 0.84. Most commonly identified outdoor fungus. The outdoor numbers are reduced in the winter. The numbers are often high in the summer. Often found indoors in numbers less than outdoor numbers. It is a common allergen. Indoor *Cladosporium* sp. may be different than the species identified outdoors. It is commonly found on the surface of fiberglass duct liners in the interior of supply ducts. A wide variety of plants are food sources for this fungus. It is found on dead plants, woody plants, food, straw, soil, paint, and textiles. Produces greater than 10 antigens. Antigens in commercial extracts are of variable quality and may degrade within weeks of preparation. Common cause of extrinsic asthma (immediate-type hypersensitivity: type I). Acute symptoms include skin lesions, eye ulceration, mycosis (including onychomycosis, an infection of the nails of the feet or hands) edema and bronchiospasms; chronic cases may develop pulmonary emphysema.

Curvularia sp.

Reported to be allergenic and has been associated with allergic fungal sinusitis. It may cause corneal infections, mycetoma, and infections in immune compromised hosts.

Dreschlera sp.

Conidia dimensions: 40-120 x 17-28 microns. Found on grasses, grains and decaying food. It can occasionally cause a corneal infection of the eye.

Epicoccum sp.

Conidia dimensions: 15-25 microns. A common allergen. It is found in plants, soil, grains, textiles and paper products.

Fusarium sp.

Aw 0.90. A common soil fungus. It is found on a wide range of plants. It is often found in humidifiers. Several species in this genus can produce potent trichothecene toxins. The trichothecene (scirpene) toxin targets the following systems: circulatory, alimentary, skin, and nervous. Produces vomitoxin on grains during unusually damp growing conditions. Symptoms may occur either through ingestion of contaminated grains or possibly inhalation of spores. The genera can produce hemorrhagic syndrome in humans (alimentary toxic aleukia). This is characterized by nausea, vomiting, diarrhea, dermatitis, and extensive internal bleeding. Reported to be allergenic. Frequently involved in eye, skin, and nail infections.

Myxomycetes

Members of a group of fungi that is included in the category of "slime molds". They're occasionally found indoors, but mainly reside in forested regions on decaying logs, stumps, and dead leaves. Myxomycetes display characteristics of fungi *and* protozoans. In favorable (wet) conditions they exhibit motile, amoeba-like cells, usually bounded only by a plasma membrane, that are variable in size and form. During dry spells, they form a resting body (sclerotium) with dry, airborne spores. These fungi are not known to produce toxins, but can cause hay fever and asthma.

Memnoniella

Contaminant, found most often with Stachybotrys on wet cellulose. Forms in chains, but it are very similar to Stachybotrys and sometimes is considered to be in the Stachybotrys family. Certain species do produce toxins very similar to the ones produced by Stachybotrys chartarum and many consider the IAQ importance of Memnoniella to be on par with Stachybotrys. Allergenic and infectious properties are not well studied.

Nigrospora sp.

Commonly found in warm climates, this mold may be responsible for allergic reactions such as hay fever and asthma. It is found on decaying plant material and in the soil. It is not often found indoors.

Oidium sp.

The asexual phase of *Erysiphe* sp. It is a plant pathogen causing powdery mildews. It is very common on the leaves stems, and flowers of plants. The health effects and allergenicity have not been studied. It does not grow on non-living surfaces such as wood or drywall.

Penicillium sp.

Aw 0.78 - 0.88. A wide number of organisms have been placed in this genus. Identification to species is difficult. Often found in aerosol samples. Commonly found in soil, food, cellulose and grains. It is also found in paint and compost piles. It may cause hypersensitivity pneumonitis, allergic alveolitis in susceptible individuals. It is reported to be allergenic (skin). It is commonly found in carpet, wallpaper, and in interior fiberglass duct insulation. Some species can produce mycotoxins. Common cause of extrinsic asthma (immediate-type hypersensitivity: type I). Acute symptoms include edema and bronchiospasms; chronic cases may develop pulmonary emphysema. It may also cause headaches, vomiting, and diarrhea.

Periconia sp.

found in soil, blackened and dead herbaceous stems leaf spots, grasses, rushes, and sedges. Almost always associated with other fungi. Rarely found growing indoors. Reportedly associated with a rare case of mycotic keratitis.

Pithomyces sp.

A common mold found on dead leaves, plants, soil and especially grasses. Causes facial eczema in ruminants. It exhibits distinctive multi-celled brown conidia. It is not know to be a human allergen or pathogen. It is rarely found indoors, although it can grow on paper.

Polythrincium sp.

Polythrincium species comprise a very small proportion of the fungal biota. This genus is somewhat related to Ramularia. No information is available regarding health effects, or toxicity. Allergenicity has not been studied. Our laboratory has never seen this organism growing on environmental surfaces. May be identified in air on spore trap samples (spores have distinctive morphology). Also, spores may be seen in dust as part of the normal influx of outdoor microbial particles. Natural habitat is on leaves.

Rusts/Smuts

These fungi are associated with plant diseases. In the classification scheme of the fungi, the smuts have much in common with the rusts, and they are frequently discussed together. Both groups produce wind-borne, resistant teliospores that serve as the basis for their classification and their means of spread. Rusts usually attack vegetative regions (i.e., leaves and stems) of plants; smuts usually are associated with the reproductive structures (seeds). They can cause hay fever and asthma.

Spegazzinia

Spegazzinia species comprise a very small proportion of the fungal biota. This genus is somewhat related to other lobed or ornamented genera such as Candelabrum. No information is available regarding health effects or toxicity. Allergenicity has not been studied. Usually identified on spore trap samples where it is seen every few weeks. (Spores have very distinctive morphology.) May also be found in air by culturable (Andersen) samples if a long enough incubation period is provided so that sporulation occurs. Our laboratory has never found this organism growing on indoor environmental surfaces. Natural habitat includes soil and many kinds of trees and plants.

Stachybotrys sp.

Aw - 0.94 , optimum Aw ->0.98. Several strains of this fungus (*S. atra, S. chartarum* and *S. alternans* are synonymous) may produce a trichothecene mycotoxin- Satratoxin H - which is poisonous by inhalation. The toxins are present on the fungal spores. This is a slow growing fungus on media. It does not compete well with other rapidly growing fungi. The dark colored fungus grows on building material with high cellulose content and low nitrogen content. Areas with a relative humidity above 55%, and are subject to temperature fluctuations, are ideal for toxin production.
Individuals with chronic exposure to the toxin produced by this fungus reported cold and flu symptoms, sore throats, diarrhea, headaches, fatigue, dermatitis, intermittent local hair loss and generalized malaise. Other symptoms include coughs, rhinitis, nosebleed, a burning sensation in the nasal passages, throat, and lungs, and fever. The toxins produced by this fungus will suppress the immune system affecting the lymphoid tissue and the bone marrow. Animals injected with the toxin from this fungus exhibited the following symptoms: necrosis and hemorrhage within the brain, thymus, spleen, intestine, lung, heart, lymph node, liver, and kidney. Affects by absorption of the toxin in the human lung are known as pneumomycosis.
This organism is rarely found in outdoor samples. It is usually difficult to find in indoor air samples unless it is physically disturbed (or possibly -this is speculation- a drop in the relative humidity). The spores are in a gelatinous mass. Appropriate media for the growth of this organism will have high cellulose content and low nitrogen content. The spores will die readily after release. The dead spores are still allergenic and toxigenic. Percutaneous absorption has caused mild symptoms.

Stemphylium sp.

Reported to be allergenic. Isolated from dead plants and cellulose materials.

Taeniolella sp.

contaminant primarily grows on wood. It was isolated from human cutaneous and subcutaneous lesions.

Torula sp.

Found outdoors in air, soil, on dead vegetation, wood, and grasses. Also found indoors on cellulose materials. Reported to be allergenic and may cause hay fever and asthma.

Tetraploa

Tetraploa species comprise a very small proportion of the fungal biota. This genus is somewhat related to Triposporium and Diplocladiella. The only reported human infections are two cases of keratitis (1970, 1980) and one case of subcutaneous infection of the knee (1990). No information is available regarding other health effects or toxicity. Allergenicity has not been studied. Usually identified on spore trap samples where it is seen every few weeks. (Spores have very distinctive morphology.) Our laboratory has never found this organism growing on indoor environmental surfaces. Natural habitat includes leaf bases and stems just above the soil on many kinds of plants and trees.

Ulocladium sp.

Aw 0.89. Isolated from dead plants and cellulose materials. Found on textiles.

Zygomycetes

Zygomycetes are one of the four major groups of fungi, the others being the Oomycetes, the Ascomycetes, and the Basidiomycetes. Zygomycetes are common, fast growing, and often overgrow and/or inhibit other fungi nearby. Rhizopus and Mucor are two of the most common Zygomycetes seen in the indoor environment. However, others are seen as well, including Syncephalastrum, Circinella, Mortierella, Mycotypha, Cunninghamella, and Choanephora. For further information, please see descriptions of these individual genera.

The following table lists mycotoxins that are produced by certain types of fungi:

Fungi	Mycotoxin
Acremonium crotocinigenum	Crotocin
Aspergillus favus	Alfatoxin B, cyclopiazonic acid
Aspergillus fumigatus	Fumagilin, gliotoxin
Aspergillus carneus	Critrinin
Aspergillus clavatus	Cytochalasin, patulin
Aspergillus Parasiticus	Alfatoxin B
Aspergillus nomius	Alfatoxin B
Aspergillus niger	Ochratoxin A, malformin, oxalicacid
Acremonium crotocinigenum	Crotocin
Aspergillus nidulans	Sterigmatocystin
Aspergillus ochraceus	Ochratoxin A, penicillic acid
Aspergillus versicolor	Sterigmatocystin, 5 ethoxysterigmatocystin
Aspergillus ustus	Ausdiol, austamide, austocystin,brevianamide
Aspergillus terreus	Citreoviridin
Alternaria	Alternariol, altertoxin, altenuene, altenusin, tenuazonic acid
Arthrinium	Nitropropionic acid
Bioploaris	Cytochalasin, sporidesmin, sterigmatocystin
Chaetomium	Chaetoglobosin A,B,C. Sterigmatocystin
Cladosporium	Cladosporic acid
Clavipes purpurea	Ergotism
Cylindrocorpon	Trichothecene
Diplodia	Diplodiatoxin
Fusarium	Trichothecene, zearalenone
Fusarium moniliforme	Fumonisins
Emericella nidulans	Sterigmatocystin
Gliocladium	Gliotoxin
Memnoniella	Griseofulvin , dechlorogriseofulvin, epi-decholorgriseofulvin, trichodermin, trichodermol
Myrothecium	Trichothecene
Paecilomyces	Patulin, viriditoxin
Penicillium aurantiocandidum	Penicillic acid
Penicillium aurantiogriseum	Penicillic acid
Penicillium brasilanum	Penicillic acid
Penicillium brevicompactum	Mycophenolic acid
Penicillium camemberti	Cyclopiazonic acid
Penicillium carneum	Mycophenolic acid, Roquefortine C
Penicillium crateriforme	Rubratoxin

Penicillium citrinum	Citrinin
Penicillium commune	Cyclopiazonic acid
Penicillium crustosum	Roquefortine C
Penicillium chrysogenum	Roquefortine C
Penicillium discolor	Chaetoglobosin C
Penicillium expansum	Citrinin, Roquefortine C
Penicillium griseofulvum	Roquefortine C, cyclopiazonic acid, griseofulvin
Penicillium hirsutum	Roquefortine C
Penicillium hordei	Roquefortine C
Penicillium nordicum	Ochratoxin A
Penicillium paneum	Roquefortine C
Penicillium palitans	Cyclopiazonic acid
Penicillium polonicum	Penicillic acid
Penicillum roqueforti	Roquefortine C, Mycophenolic acid
Penicillium veridicatum	Penicillic acid
Penicillium verrucosum	Citrinin, ochratoxin A
Penicillium/ Aspergillus	Patulin
Penicillium/ Aspergillus/Alternaria	Glitoxin
Phomopsis	Macrocyclic trichothecenes
Phoma	Brefeldin, cytochalasin, secalonic acid, tenuazonic acid
Pithomyces	Sporidesmin
Rhizoctonia	Slaframine
Rhizopus	Rhizonin
Sclerotinia	Furanocoumarins
Stachybotrys chartarum	Iso-satratoxin F, roridin E, L-2, satratoxin G & H, trichodermin, trichodermol, trichothecene
Torula	Cytotoxins
Trichoderma	Trichodermin, trichodermol, gliotoxin
Trichothecium	Trichothecene
Wallemia	Walleminol
Zygosporium	Cytochalasin

General terms

Allergen

An allergen is a substance that elicits an IgE antibody response and is responsible for producing allergic reactions. Chemicals are released when IgE on certain cells come into contact with an allergen. These chemicals can cause injury to surrounding tissue - the visible signs of an allergy. Only a few fungal allergens have been characterized but all fungi are thought to be potentially allergenic. Fungal allergens are proteins found in either the mycelium or spores

"Black mold"

The poorly defined term? Black mold? Or? Toxic black mold? Has usually been associated with the mold *Stachybotrys chartarum*. While there are only a few molds that are truly black, there are many that can appear black. Not all molds that appear to be black are *Stachybotrys*.

Fungi

Fungi are neither animals nor plants and are classified in a kingdom of their own? The Kingdom of Fungi. Fungi include a very large group of organisms, including molds, yeasts, mushrooms and puffballs. There are >100,000 accepted fungal species but current estimates range to 1.5 million species. Mycologists (people who study fungi) have grouped fungi into four large groups according to their method of reproduction.

Hidden mold

This refers to visible mold growth on building structures that is not easily seen, including the areas above drop ceilings, within a wall cavity (the space between the inner and outer structure of a wall), inside air handlers, or within the ducting of a heating/ventilation system.

Microbial Volatile Organic Compounds (MVOCs)

Fungi produce chemicals as a result of their metabolism. Some of these chemicals, MVOCs, are responsible for the characteristic moldy, musty, or earthy smell of fungi, whether mushrooms or molds. Some MVOCs are considered offensive or annoying. Specific MVOCs are thought to be characteristic of wood rot and mold growth on building materials. The human nose is very sensitive to mold odors and sometimes more so than current analytical instruments.

Mold

Molds are a group of organisms that belong to the Kingdom of Fungi (see Fungi). Even though the terms mold and fungi had been commonly referred to interchangeably, all molds are fungi, but not all fungi are molds.

Mycotoxin

Mycotoxins are compounds produced by some fungi that are toxic to humans or animals. By convention, the term? Mycotoxin? Excludes mushroom toxins. Fungi that produce mycotoxins are called "toxigenic fungi.

Spore

General Term for a reproductive structure in fungi, bacteria and some plants. In fungi, the spore is the structure which may be used for dissemination and may be resistant to adverse environmental conditions.

Toxic mold

The term? Toxic mold" has no scientific meaning since the mold itself is not toxic. The metabolic byproducts of some molds may be toxic (see mycotoxin).

Hypha (plural, hyphae)

An individual fungal thread or filament of connected cells; the thread that represents the individual parts of the fungal body.

Southeast Environmental Microbiology Laboratories
Chain of Custody

506 Laurens Rd, Greenville, SC 29607
Phone : 864-233-3770, Fax: 864-233-3779, www.seeml.com, AIHA-LAP, LLC. (EMLAP) #173667

For Lab Use Only			
Condition of samples is acceptable	☑ YES ☐ NO	SEEML Ref #: 160610002	Lab ID: 021 – 040

Company Information		Client Information		Environmental Conditions	
(Project Manager)	Rob Rowley	Date Sampled:	6-8-16	Precipitation in last 16hrs:	Ø
(Company Name)	Skelly & Loy	Project Name:	Laurel Woods Elementary	Relative Humidity I/O:	/
(Address)	449 Eisenhower Blvd	Project Address:	9250 N Laurel Rd	Temperature I/O:	/
(City, State, Zip)	Harrisburg, PA 17111	City, State, Zip:	Laurel, MD, 20723	Wind Conditions	
(Phone)	717-232-0593				
(Email)	rrowley@skellyloy.com				

Sample Type Abbreviations:
A- Allergenco **S**-Swab **AP**-Andersen Plate
AOC- Air O Cell **T**-Tape **W**- Water
M5- Micro 5 **B**- Bulk **D**- Dust

Project# R10-0163.019 Task 7
please include Job# on Invoice.

Analysis Type:
1. SporeTrap, Air Sample Analysis-Same Day
2. Direct Exam Surface Sample Analysis -Same Day
3. Culturable Air / Surface Samples -7-10 days

Sample ID	Sample Location	Sample Type	Analysis Type	*Area	**Volume (L)	Notes
Portable 132	Desktop in center of room	AOC	1		150L	
Portable 133	"					
Ext-1	Outside of Portables 132 & 133	A				
Classroom 108	Desktop in center of room	AOC				
Classroom 95	"					
Classroom 114	"					
Classroom 105	"					
Classroom 92	"					
Classroom 85	"					
Classroom 74	"					

Reliquished By:	Date/Time	Recieved By:	Date/Time
Matt Neely	6-9-16 1700	Lauren Bass	6-10-16

* Area is only required for culturable surface samples.
** Volume = Pump setting (L/min) x minutes

Southeast Environmental Microbiology Laboratories
Chain of Custody

506 Laurens Rd, Greenville, SC 29607
Phone : 864-233-3770, Fax: 864-233-3779, www.seeml.com, AIHA-LAP, LLC. (EMLAP) #173667

For Lab Use Only			
Condition of samples is acceptable	☑ YES ☐ NO	SEEML Ref #: 160610002	Lab ID: 021-040

Company Information		Client Information		Environmental Conditions	
(Project Manager)	Rob Rowley	Date Sampled:	6-8-16	Precipitation in last 16hrs:	
(Company Name)	Skelly & Loy	Project Name:	Laurel Woods Elementary	Relative Humidity I/O:	/
(Address)	449 Eisenhower Blvd	Project Address:	9250 N Laurel Rd	Temperature I/O:	/
(City, State, Zip)	Harrisburg, PA 17111	City, State, Zip:	Laurel, MD, 20723	Wind Conditions	
(Phone)	717-232-0593				
(Email)	rrowley@skelly&loy.com				

Sample Type Abbreviations:
A- Allergenco **S**-Swab **AP**-Andersen Plate
AOC- Air O Cell **T**-Tape **W**- Water
M5- Micro 5 **B**- Bulk **D**- Dust

Analysis Type:
1. SporeTrap, Air Sample Analysis-Same Day
2. Direct Exam Surface Sample Analysis -Same Day
3. Culturable Air / Surface Samples -7-10 days

Sample ID	Sample Location	Sample Type	Analysis Type	*Area	**Volume (L)	Notes
Classroom 79.	Desktop in center of room	AOC	1		150L	
Classroom 32.	"					
Classroom 34.	"					
Classroom 45.	"					
Classroom 51.	"					
Classroom 64.	"					
Room 126.	Center of room					
Room 13.	"					
Room 22.	"					
Ext-2.	Front of Main Building.	A				

Reliquished By:	Date/Time	Recieved By:	Date/Time
Matt Nash	6-9-16 1700		6-10-16

* Area is only required for culturable surface samples.
** Volume = Pump setting (L/min) x minutes

AIHA
Laboratory Accreditation Programs, LLC

AIHA Laboratory Accreditation Programs, LLC

acknowledges that

Southeast Environmental Microbiology Laboratories

506-A Laurens Road, Greenville, SC 29607

Laboratory ID: 173667

along with all premises from which key activities are performed, as listed above, has fulfilled the requirements of the AIHA Laboratory Accreditation Programs (AIHA-LAP), LLC accreditation to the ISO/IEC 17025:2005 international standard, *General Requirements for the Competence of Testing and Calibration Laboratories* in the following:

LABORATORY ACCREDITATION PROGRAMS

☐	**INDUSTRIAL HYGIENE**	Accreditation Expires:
☐	**ENVIRONMENTAL LEAD**	Accreditation Expires:
✓	**ENVIRONMENTAL MICROBIOLOGY**	Accreditation Expires: 11/01/2017
☐	**FOOD**	Accreditation Expires:
☐	**UNIQUE SCOPES**	Accreditation Expires:

Specific Field(s) of Testing (FoT)/Method(s) within each Accreditation Program for which the above named laboratory maintains accreditation is outlined on the attached **Scope of Accreditation**. Continued accreditation is contingent upon successful on-going compliance with ISO/IEC 17025:2005 and AIHA-LAP, LLC requirements. This certificate is not valid without the attached **Scope of Accreditation**. Please review the AIHA-LAP, LLC website (www.aihaaccreditedlabs.org) for the most current Scope.

Gerald R Schultz

Gerald Schultz, CIH
Chairperson, Analytical Accreditation Board

Cheryl O. Morton

Cheryl O. Morton
Managing Director, AIHA Laboratory Accreditation Programs, LLC

Revision 14: 03/26/2014

Date Issued: 09/30/2015

APPENDIX C -
INSTRUMENT CALIBRATION LOGS

CALIBRATION LOG

Instrument Name: Zefon Biopump
Serial Number: 2766
Model Number: ZBD-200
Date Calibrated: 10/8/16

Calibrated by: Matt Nowlin
Signature: Matt Nowlin

S&L job number: R10-0163.019.07
S&L job name: Laurelwood

Pre calibration: 15LPM w/Flow meter Air-o-cell rotameter
Time: 930
Post Calibration: 15LPM w/Flow meter Air-o-cell rotameter
Time: 1540

Instrument Name: Zefon Biopump
Serial Number: 1888
Model Number: ZBD-200
Date Calibrated: 10/8/16

Calibrated by: Matt Nowlin
Signature: Matt Nowlin

S&L job number: R10-0163.019.07
S&L job name: Laurelwood

Pre calibration: 15LPM w/Flow meter Air-o-cell rotameter
Time: 932
Post Calibration: 15LPM w/Flow meter Air-o-cell rotameter
Time: 1543

INSTRUMENT CALIBRATION REPORT

Advanced Labs, Inc.

Pine Environmental Services, Inc

Instrument ID 31088
Description TSI DustTrak DRX Aerosol Monitor
Calibrated 4/26/2016

Manufacturer TSI
Model Number 8533
Serial Number 8533151102
Location New Jersey
Temp 77

Classification
Status pass
Frequency Yearly EOM
Department Lab
Humidity 32

Calibration Specifications

Group # 1
Group Name Arizona Test Dust
Test Performed: Yes **As Found Result: Fail** **As Left Result: Pass**

Test Instruments Used During the Calibration

				(As Of Cal Entry Date)	
Test Instrument ID	Description	Manufacturer	Serial Number	Last Cal Date	Next Cal Date
DUST TRAK DRX MASTER 8533151105	TSI Dust Trak DRX Aerosol Monitor	TSI	8533151105	3/22/2016	3/22/2017

Notes about this calibration

Photometric Calibration Ratio: 0.75

Size Calibration Ratio: 0.94

Calibration Result Calibration Successful
Who Calibrated Kevin Cole

Advanced Labs, Inc. hereby certifies that this instrument is calibrated and functions to meet the manufacture's specifications using NIST traceable standards, or is derived from accepted values of physical constants.

INSTRUMENT CALIBRATION REPORT

Advanced Labs, Inc.

Pine Environmental Services, Inc

Instrument ID 19456
Description TSI 982 Probe
Calibrated 5/3/2016

Manufacturer TSI
Model Number 982
Serial Number P12200032
Location New Jersey
Temp 74

Classification
Status pass
Frequency Yearly EOM
Department Lab
Humidity 43

Calibration Specifications

Group # 1
Group Name Carbon Dioxide
Stated Accy Pct of Reading
Range Acc % 0.0000
Reading Acc % 3.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
0.00 / 0.00	ppm	0.00	ppm	270.00	0.00	0.00%	Pass
1000.00 / 1000.00	ppm	1000.00	ppm	1,090.00	1,002.00	0.20%	Pass

Group # 2
Group Name Carbon Monoxide
Stated Accy Pct of Reading
Range Acc % 0.0000
Reading Acc % 3.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
0.00 / 0.00	ppm	0.00	ppm	0.00	0.00	0.00%	Pass
100.00 / 100.00	ppm	100.00	ppm	184.00	100.20	0.20%	Pass

Group # 3
Group Name Relative Humidity
Stated Accy Pct of Reading
Range Acc % 0.0000
Reading Acc % 3.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
30.00 / 29.60	%	29.60	%	18.40	29.60	0.00%	Pass

Group # 4
Group Name Temperature
Stated Accy Plus / Minus
Range Acc % 0.0000
Reading Acc % 0.0000
Plus/Minus 1.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
70.00 / 70.00	°F	70.00	°F	69.80	70.00	0.00%	Pass

Test Instruments Used During the Calibration

Test Instrument ID	Description	Manufacturer	Serial Number	(As Of Cal Entry Date) Last Cal Date	Next Cal Date
CO/CO2_34LS-375	100 ppm CO, 1000 ppm CO2	Calgaz	MAO-375-1		6/9/2019
MICHELL DM-509-TX-01	Relative Humidity Meter	Michell	273296	6/25/2015	6/25/2016
NITROGEN_34 LS-114	Nitrogen 99.999%	Calgaz	GAP-114-5	9/1/2014	9/25/2018
ZERO_AIR_103 L-1	Zero Grade Air THC <1.0 PPM	Liquid Technology	JAO-1-12	10/1/2014	10/10/2018

INSTRUMENT CALIBRATION REPORT

Advanced Labs, Inc.

Pine Environmental Services, Inc

Instrument ID 19456
Description TSI 982 Probe
Calibrated 5/3/2016

Notes about this calibration

Calibration Result Calibration Successful
Who Calibrated Kevin Cole

Advanced Labs, Inc. hereby certifies that this instrument is calibrated and functions to meet the manufacture's specifications using NIST traceable standards, or is derived from accepted values of physical constants.

INSTRUMENT CALIBRATION REPORT

Pine Environmental Services, LLC.

92 North Main St, Building 20
Windsor, NJ 08561
Toll-free: (800) 301-9663

Pine Environmental Services, Inc.

Instrument ID 19456
Description TSI 982 Probe
Calibrated 5/27/2016 4:19:25PM

Manufacturer Tsi
Model Number 982
Serial Number/ Lot Number P12200032
Location New Jersey
Department

State Certified
Status Pass
Temp °C 26.6
Humidity % 45

Calibration Specifications

Group # 1
Group Name CO2
Stated Accy Pct of Reading
Range Acc % 0.0000
Reading Acc % 3.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
1000.00 / 1000.00	PPM	1000.00	PPM	994.00	1,002.00	0.20%	Pass

Group # 2
Group Name CO
Stated Accy Pct of Reading
Range Acc % 0.0000
Reading Acc % 3.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
100.00 / 100.00	PPM	100.00	PPM	97.40	99.50	-0.50%	Pass

Test Instruments Used During the Calibration (As Of Cal Entry Date)

Test Standard ID	Description	Manufacturer	Model Number	Serial Number / Lot Number	Last Cal Date/ Opened Date	Next Cal Date / Expiration Date
NJ CO / CO2 - DAP-375-1	NJ 100 CO/1000 CO2 34 Liters	American Gas Group	GP10733	DAP-375-1		3/9/2019
NJ NITROGEN - KAO-114-5	Nitrogen 99.999% 34 liters	American Gas Group	GP12307	KAO-114-5		10/28/2018

Notes about this calibration

Calibration Result Calibration Successful
Who Calibrated Dave German

INSTRUMENT CALIBRATION REPORT

Advanced Labs, Inc.

Pine Environmental Services, Inc

Instrument ID 29815
Description TSI 9565P VelociCalc
Calibrated 5/2/2016

Manufacturer TSI
Model Number 9565P
Serial Number 9565P1324046
Location New Jersey
Temp 70

Classification
Status pass
Frequency Yearly EOM
Department Lab
Humidity 33

Calibration Specifications

Group # 1
Group Name Barometric Pressure
Stated Accy Pct of Reading
Range Acc % 0.0000
Reading Acc % 2.0000
Plus/Minus 0.000

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
30.000 / 29.980	inHg	29.980	inHg	30.000	29.980	0.00%	Pass

Group # 2
Group Name Differential Pressure
Stated Accy Pct of Reading
Range Acc % 0.0000
Reading Acc % 1.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
-4.00 / -4.00	inH2O	-4.00	inH2O	-4.04	-4.04	1.00%	Pass
4.00 / 4.00	inH2O	4.00	inH2O	4.02	4.02	0.50%	Pass
8.00 / 8.00	inH2O	8.00	inH2O	8.01	8.01	0.13%	Pass
12.00 / 12.00	inH2O	12.00	inH2O	12.02	12.02	0.17%	Pass

Test Instruments Used During the Calibration

Test Instrument ID	Description	Manufacturer	Serial Number	(As Of Cal Entry Date) Last Cal Date	Next Cal Date
DWYER 477A-1 NY0213061	Dwyer 477A-1 Digital Manometer	Dwyer	NY0213061	6/12/2015	6/12/2016
OMEGA HX93AC/DP25-E	Omega HX93AC/DP25-E	Omega Engineering	1010368 035025 035026	8/25/2015	8/25/2016
OMEGA PX02K1-16A5T /DP25-E-A	Omega PX02K1-16A5T/DP25-E-A	Omega Engineering	168377/8375030	8/25/2015	8/25/2016
OMEGA WT4401-D	Omega WT4401-D	Omega Engineering	101105	8/25/2015	8/25/2016

Notes about this calibration

Calibration Result Calibration Successful
Who Calibrated David Galego

INSTRUMENT CALIBRATION REPORT

Advanced Labs, Inc.

Pine Environmental Services, Inc

Instrument ID 29815
Description TSI 9565P VelociCalc
Calibrated 5/2/2016

Advanced Labs, Inc. hereby certifies that this instrument is calibrated and functions to meet the manufacture's specifications using NIST traceable standards, or is derived from accepted values of physical constants.