

**INDOOR ENVIRONMENTAL QUALITY INVESTIGATION
SUMMARY REPORT FOR
GLENWOOD MIDDLE SCHOOL**

PREPARED FOR:

**HOWARD COUNTY PUBLIC SCHOOL SYSTEM
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**INDOOR ENVIRONMENTAL QUALITY INVESTIGATION
SUMMARY REPORT FOR
GLENWOOD MIDDLE SCHOOL**

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INDOOR ENVIRONMENTAL QUALITY INVESTIGATION SUMMARY REPORT FOR GLENWOOD MIDDLE SCHOOL

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INDOOR ENVIRONMENTAL QUALITY INVESTIGATION SUMMARY REPORT FOR GLENWOOD MIDDLE SCHOOL

EXECUTIVE SUMMARY

Aria Environmental, Inc. (AE) was contracted by Howard County Public School System (HCPSS) to perform indoor environmental quality investigations at Glenwood Middle School due to a complaint lodged by a teacher about high humidity and mold in the building. AE conducted an initial investigation for humidity and mold on August 28 and 30, 2013 with follow up visits on September 11, 2013, and October 9, 10, 18 and 28, 2013. The initial investigation and follow up visits included interviews and meetings with faculty, staff and administrators, HCPSS facilities and building services personnel and Global Facilities Solutions (a mechanical engineering consultant); visual inspections of the classrooms, boiler room and crawlspace; and measurements for temperature, humidity, carbon monoxide, carbon dioxide, particulate matter and fungal identification and counting. The initial investigation identified some building-related issues that were affecting humidity including a summertime failure of the chilled water system that resulted in high humidity and subsequent mold growth. To expedite preparation for school opening in August 2013, areas where mold was present were cleaned by a professional services contractor in addition to the routine cleaning by custodians. Additional adjustments and repairs made after the initial investigation included:

- 1) Exhaust fans were taken out of service to reduce negative pressure in the building. The fans had been operated in modes other than the economizer mode for which they were intended and the result was strong negative pressure in the building relative to the outdoors.
- 2) Repair to one stage of the chiller that was not functioning on August 28th such that the chilled water to the unit was approximately 4°F higher than optimal resulting in unpleasant temperature and humidity levels in the school.

AE performed additional air monitoring for the presence of mold spores and for temperature, humidity, carbon monoxide, carbon dioxide and particulate matter at Glenwood Middle School for follow up and seasonal comparisons on December 17, 2013, June 11, 2014, July 31, 2014 and October 20, 2014 and after significant changes to the crawlspaces on March 20, 2014. Within the month prior to the March 20, 2014 sampling, abandoned intact and loose paper-wrapped fiberglass insulation and other organic debris were removed from the crawlspaces and open-ended pipes and voids in cement walls were sealed as much as possible. Also, damaged pipe insulation above ceiling tiles throughout the school was removed and replaced with new insulation.

This report summarizes the results of air sampling for fungi and indoor air quality measurements for temperature, relative humidity, carbon dioxide, carbon monoxide and particulate matter for the approximately 1 year period since the initial complaint. Methods used in the investigation and background information are presented in the November 1, 2013 report. Certificates of analysis are attached to each individual report including the initial November 1, 2013 report and five addenda.

Overall, the results show a great deal of variability within the building and between sampling dates, depending on the season. Activities such as sweeping have been shown to have a significant effect on increasing spore counts and particle concentrations. HCPSS has taken actions to control relative humidity and reduce the potential for mold growth. These actions appear to have reduced spore counts over the one year monitoring period since the initial complaint, and no visible mold or mildew-type odors are detectable in the areas assessed.

Indoor Environmental Quality Investigation Summary Report For Glenwood Middle School

I. BACKGROUND

A representative from Aria Environmental, Inc. (AE) visited Glenwood Middle School between October 18, 2013 and October 20, 2014 to perform air monitoring in response to an ongoing indoor air quality complaint at the school. Indoor air samples were collected repeatedly from classrooms 7, 11, 15, 20, 26, 29, and Art Room 38. Classrooms 23, 24 and 31 were added for comparison purposes. Samples were collected in the crawlspace accessed in the administrative workroom on June 11, July 31 and October 20, 2014, in the crawlspace accessed from classroom 31 on March 20 and October 20, 2014 and in the crawlspace under classroom 15 on October 28, 2013. Table 1 presents the dates and locations of spore trap sampling. Indoor air quality measurements for temperature, relative humidity, carbon monoxide and particulate matter were usually also collected on these days.

Table 1 – Spore Sampling Locations and Dates at Glenwood Middle School

Location	Date of Spore Sampling						
	October 18, 2013	October 28, 2013	December 17, 2013	March 20, 2014	June 11, 2014	July 31, 2014	October 20, 2014
7			X	X	X	X	X
11	X		X	X	X	X	X
15	X	X	X	X	X	X	X
20				X	X	X	X
23						X	
24					X		
26	X		X	X	X	X	X
29	X		X	X	X	X	X
31						X	
38				X	X	X	X
Crawlspace Admin					X	X	X
Crawlspace Rm 31				X			X
Crawlspace Rm 15		X					

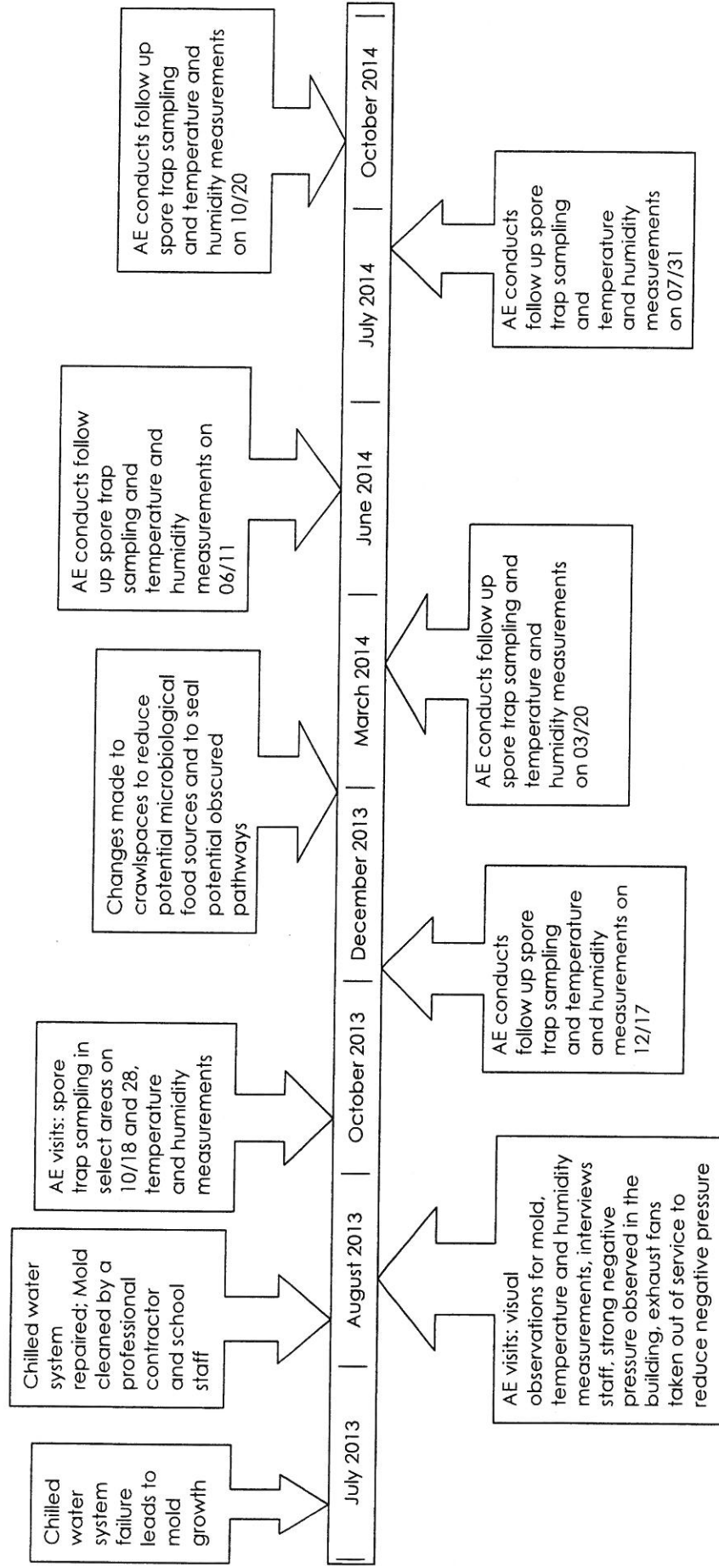
X indicates that spore trap samples were collected on this date and location.
Bold room numbers indicate a complaint area.

Outdoor spore trap air samples were collected for comparison purposes in at least one location for every sampling date, and three outdoor samples were collected on October 20, 2013 to evaluate variation in outdoor spore counts.

The background associated with the initial complaint is detailed in the Indoor Environmental Quality Investigation report dated November 1, 2013. Figure 1 is a timeline of events related to the investigation.

Indoor Environmental Quality Investigation Summary Report For Glenwood Middle School

Figure 1 - Indoor Air Quality Investigation Timeline for Glenwood Middle School 2013-2014



Indoor Environmental Quality Investigation Summary Report For Glenwood Middle School

II. OBSERVATIONS AND MEASUREMENTS

A. Observations and Measurements at Glenwood Middle School

Temperature (T), Relative Humidity (RH), Carbon Dioxide (CO₂) and Carbon Monoxide (CO)

Industry guidelines or standards for seasonal temperature and humidity ranges for thermal comfort are established by the American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) standard 55-2013. These ranges are presented in Table 2. The U.S. Environmental Protection Agency (EPA) also recommends maintaining relative humidity below 60% and ideally between 30 and 50%.

The room air temperature in all indoor sample locations and dates at Glenwood Middle School (excluding crawlspaces) ranged from 69.1 to 76.3°F with an overall average of 72.8°F. Eighty-six (86) temperature measurements were collected. The temperatures are considered acceptable for thermal comfort regardless of season.

A total of 86 relative humidity measurements were collected indoors at Glenwood Middle School from August 2013 to October 2014. The relative humidity ranged from 16.8 to 79.3 % with an overall average of 55.1% in all indoor sample locations and dates (excluding crawlspaces). Fifty-two (52) out of 86 measurements were above the EPA's recommendation of 60% relative humidity for mold control. The relative humidity measurements were mostly above 60% in the summer seasons.

**Table 2- Acceptable Ranges of Temperature and
Relative Humidity in Summer and Winter^a**

Relative Humidity	Winter Temperature	Summer Temperature
30%	68.5°F – 76.0°F	74.0°F – 80°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

^aadapted from ASHRAE Standard 55-2013

Carbon dioxide and carbon monoxide measurements are used to assess ventilation system performance. The exhaled breath of building occupants is the main indoor source of carbon dioxide; therefore, the build-up of carbon dioxide indicates inadequate ventilation. Indoor concentrations of carbon dioxide ranged from 342 to 1,115 ppm in all indoor sample locations and dates at Glenwood Middle School (excluding crawlspaces). The concentration of concern for carbon dioxide is set by ASHRAE standard 62.1-2013 as 700 ppm above outdoor air. Sixty-three (63) carbon dioxide measurements were taken during the specified time period at Glenwood Middle School. All measurements were within the comfort parameters established by ASHRAE except for one measurement in Room 20 on June 11, 2014 (1,115 ppm) when the room was occupied by 4 people at the time of monitoring. Most carbon dioxide measurements were performed after school or on days when students were off; therefore, only one or two AE employees were present during monitoring.

Carbon monoxide (CO) is mainly attributed to incomplete combustion. Seventy (70) CO measurements were collected at Glenwood Middle School during the specified time period. Concentrations of CO ranged from 0 to 3 ppm indoors, and all CO concentrations were below the ASHRAE concentration of concern of 9 ppm.

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Particulate Monitoring

Particulate matter or PM is the term for a mixture of solid particles and liquid droplets found in the air. It does not distinguish between the types of particles in the air (e.g., pollen, skin cells, mold spores, soil, etc.). Particulate matter includes "inhalable coarse particles," with diameters larger than 2.5 micrometers and smaller than 10 micrometers (PM 10) and "fine particles," with diameters that are 2.5 micrometers and smaller (PM 2.5). Particle loads expected to be a part of the school environment include carpet and clothing fiber, soil tracked from outside, paper dust, chalk dust, and dust and fibers from building materials. ASHRAE Standard 62.1-2013 suggests target indoor concentrations for PM 2.5 and PM 10 of 15 $\mu\text{g}/\text{m}^3$ and 50 $\mu\text{g}/\text{m}^3$, respectively. These concentrations are taken from the EPA's National Ambient Air Quality Standards (NAAQS) based on annual arithmetic means deemed acceptable for outdoor air quality. Occupational standards and guidelines for particles are nearly an order of magnitude higher than concentrations typically found in non-occupational settings and are not appropriate for comparison.

Particle measurements were taken with an Aerocet 531 particulate monitor. The particle monitor takes a two minute averaged sample of particle concentrations in 5 size fractions (PM 1, PM 2.5, PM 7, PM 10 and total suspended particles (TSP)). Results of seventy-one (71) particulate measurements revealed that PM 2.5 and PM 10 particle concentrations were well below the ASHRAE target concentrations in all areas monitored with 5 exceptions for PM10. The PM 10 concentration was elevated in five measurements on March 20, 2014 in Room 11, on June 11, 2014 in Room 7 and October 20, 2014 in Art Room 38. All elevated particle measurements were related to custodians sweeping during or immediately prior to monitoring.

B. Air Monitoring for Fungal Identification and Counting

Currently, there are no government standards to which to compare microbial spore trap sampling results to determine if one level is high or low. In order to address this issue, it is the industry standard to compare indoor air sample results to outdoor air sample results. The air indoors should have similar types of spores and similar or lower spore counts than the air outdoors. An indication of poor indoor air quality from fungi exists when there is a combination of visible mold growth, mildew odors, differing mold spore types than those found in outdoor air and higher spore counts indoors over outdoors. Mold exists naturally in the indoor and outdoor environment. Fungal spore concentrations are variable by time of day, season, and with the weather.

Although no visible sources of mold amplification and growth were observed, non-viable spore trap samples were collected from select classrooms (classrooms 7, 11, 15, 20, 23, 24, 26, 29, 31 and 38), three crawlspace locations and three outdoor locations to determine whether there were a difference between mold spore loads inside the building versus outside. Classrooms 7, 15, 26, and 29 are complaint areas and classrooms 11, 20, 23, 24, 31 and 38 are non-complaint areas.

The spore trap samples were collected using AllergenCo-D cassettes attached to a sampling pump calibrated to 15 liter per minute (LPM) air flow. The samples were collected for a period of ten minutes, the time period recommended for spore trap sampling in a clean indoor environment. The spore trap samples were submitted to Aerobiology Laboratory for analysis. The sample results are reported as the spores per cubic meter of air (spores per m^3) of hyphal fragments and total fungal spores. Depending upon the morphology of the spores, they were counted by their unique genus or were grouped into spores exhibiting common characteristics (e.g., *Penicillium*/*Aspergillus* group).

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Indoor spore counts, not including the crawlspace samples, ranged from 87 to 39,789 total spores per cubic meter of air (m³). Total spore counts in crawlspace samples ranged from 7 to 46,826 spores per m³. All indoor samples had total spore counts lower than the outdoor samples with seven exceptions presented in Table 3.

Table 3 – Total Spore Counts above Outdoor Counts at Glenwood Middle School from October 2013 to October 2014.

Date	Location	Total Spore Count (Spores per m ³)	Outdoor Spore Count (Spores per m ³)
October 18, 2013	Room 26	22,942	20,204
October 28, 2013	Crawlspace under Rm 15	46,826	3,834
December 17, 2013	Room 26	9,134	3,786
December 17, 2013	Room 29	6,054	3,786
December 17, 2013	Room 15	4,413	3,786
June 11, 2014	Room 24 After Cleaning	39,789	35,364
October 20, 2014	Crawlspace in Rm 31	40,337	30,762

Some individual spore types were in concentrations greater than the outdoor spore type concentration. Largest differences were seen in samples collected in the Fall in general, and in crawlspaces and rooms with known disturbances or activities such as cleaning and sweeping in classrooms or walking on the exposed soil in the crawlspaces. *Penicillium*/*Aspergillus* group spores were among the samples with the highest differences between indoor and outdoor concentrations. *Chaetomium* or *Stachybotrys* spores were detected in a few samples but mostly at low concentrations. Hyphal elements were detected in some samples but few samples were higher than the outdoor sample hyphal element counts.

There is variability in fungal genera/species regarding spore production as well as how much water is required for mold growth. Water activity is defined as a measurement of the water that is available for biological and chemical reactions. The water activity scale starts at 0 (dry) and goes to 1 (pure water). Fungi that require high amounts of water are called hydrophilic, grow at water activities of 0.9 or higher, and include *Stachybotrys*, *Chaetomium*, *Trichoderma*, *Acremonium* and *Fusarium*. Mesophilic fungi such as *Cladosporium* or *Alternaria* grow on damp building materials with water activities between 0.8 and 0.9. Xerotolerant and xerophilic fungi are fungi that can grow at water activities below 0.8 but grow more optimally above 0.8 (xerotolerant) or fungi that prefer water activities below 0.8 (xerophilic). *Aspergillus* and *Penicillium* spores fall into the xerotolerant and xerophilic range depending on the species. Spore morphology (size, shape, number of cells and cell wall thickness) can have an effect on how readily a specific spore-type can become airborne as well. *Aspergillus* and *Penicillium* spores readily become airborne and are commonly seen in indoor and outdoor spore samples. Their presence in spore samples does not necessarily indicate a problem.

Tables 4a-4g present the spores per cubic meter of air measured in classrooms 7, 11, 15, 20, 26, 29 and 38 on October 18 and 28, 2013, December 17, 2013, March 20, 2014, June 11, July 31 and October 20, 2014 where sampled. The tables show natural variability in the spore counts within the building.

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Table 4a: Spore Concentrations on December 17, 2013, March 20, 2014, June 11, 2014, July 31, 2014 and October 20, 2014 at Glenwood Middle School in Classroom 7

Spores/m ³	Classroom (CR) Number and Date of Spore Trap Sampling for Selected Spore Types					
	CR7 12/17/2013	CR7 03/20/14	CR7 06/11/14 Before Cleaning	CR7 06/11/14 After Cleaning	CR7 07/31/14	CR7 10/20/14
Ascospores	20	-	240	320	20	93
Basidiospores	260	147	427	133	2,560	4,693
Cladosporium	33	20	127	200	1,333	1,093
Penicillium/Aspergillus group	233	127	20	27	13	367
Total	553	314	814	774	3,926	6,467

Bold represents spore concentrations that were higher than outdoors.

Table 4b: Spore Concentrations on October 18, 2013, December 17, 2013, March 20, 2014, June 11, 2014, July 31, 2014 and October 20, 2014 at Glenwood Middle School in Classroom 11

Spores/m ³	Classroom (CR) Number and Date of Spore Trap Sampling for Selected Spore Types					
	CR11 10/18/13	CR11 12/17/13	CR11 03/20/14	CR11 06/11/14	CR11 07/31/14	CR11 10/20/14
Ascospores	7	33	20	1,333	320	113
Basidiospores	4,480	260	93	800	7,467	6,613
Cladosporium	333	73	133*	240	2,133	1,200
Penicillium/Aspergillus group	27	53	1,973*	20	133	407
Total	4,947	426	2,306	2,419	10,087	8,593

Bold represents spore concentrations that were higher than outdoors.

*Sampling occurred after custodian swept this classroom.

Table 4c: Spore Concentrations on October 18, 2013, October 28, 2013, December 17, 2013, March 20, 2014, June 11, 2014, July 31, 2014 and October 20, 2014 at Glenwood Middle School in Classroom 15

Spores/m ³	Classroom (CR) Number and Date of Spore Trap Sampling for Selected Spore Types						
	CR15 10/18/13	CR15 10/28/13	CR15 12/17/13	CR15 03/20/14	CR15 06/11/14	CR15 07/31/14	CR15 10/20/14
Ascospores	47	33	-	7	300	213	20
Basidiospores	12,373	620	127	20	2,720	1,947	22,400
Cladosporium	1,067	33	107	20	100	587	1,493
Penicillium/Aspergillus group	1,440	287	4,153	40	13	453	1,600
Total	15,055	1,013	4,413	87	3,147	3,267	25,693

Bold represents spore concentrations that were higher than outdoors.

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Table 4d: Spore Concentrations on March 20, 2014, June 11, 2014, July 31, 2014 and October 20, 2014 at Glenwood Middle School in Classroom 20

Spores/m ³	Classroom (CR) Number and Date of Spore Trap Sampling for Selected Spore Types			
	CR20 03/20/14	CR20 06/11/14	CR20 07/31/14	CR20 10/20/14
Ascospores	-	273	7	53
Basidiospores	53	400	127	3,840
Cladosporium	40	87	247	207
Penicillium/Aspergillis group	13	80	53	587
Total	113	847	467	4,740

Bold represents spore concentrations that were higher than outdoors.

Table 4e: Spore Concentrations on October 18, 2013, December 17, 2013, March 20, 2014, June 11, 2014, July 31, 2014 and October 20, 2014 at Glenwood Middle School in Classroom 26

Spores/m ³	Classroom (CR) Number and Date of Spore Trap Sampling for Selected Spore Types					
	CR26 10/18/13	CR26 12/17/13	CR26 03/20/14	CR26 06/11/14	CR26 07/31/14	CR26 10/20/14
Ascospores	20	67	-	1,493	20	7
Basidiospores	22,062	3,200	53	4,800	333	12,882
Cladosporium	720	4,267	13	227	27	100
Penicillium/Aspergillis group	80	1,600	27	107	320	6,235
Total	22,942	9,134	93	6,661*	720	19,291

Bold represents spore concentrations that were higher than outdoors.

*Sampling occurred after custodian swept this classroom.

Table 4f: Spore Concentrations on October 18, 2013, December 17, 2013, March 20, 2014, June 11, 2014, July 31, 2014 and October 20, 2014 at Glenwood Middle School in Classroom 29

Spores/m ³	Classroom (CR) Number and Date of Spore Trap Sampling for Selected Spore Types					
	CR29 10/18/13	CR29 12/17/13	CR29 03/20/14	CR29 06/11/14	CR29 07/31/14	CR29 10/20/14
Ascospores	73	---	7	1,280	7	27
Basidiospores	3,627	67	173	3,520	87	16,946
Cladosporium	513	7	20	60	13	747
Penicillium/Aspergillis group	187	5,973	53	40	273	3,517
Total	4,447	6,054	253	4,914	400	21,337

Bold represents spore concentrations that were higher indoors than outdoors on the day of monitoring.

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**Table 4g: Spore Concentrations on March 20, 2014, June 11, 2014,
July 31, 2014 and October 20, 2014 at Glenwood Middle School in Classroom 38**

Spores/m ³	Classroom (CR) Number and Date of Spore Trap Sampling for Selected Spore Types			
	CR38 03/20/14	CR38 06/11/14	CR38 07/31/14	CR38 10/20/14
Ascospores	-	2,400	93	20
Basidiospores	300	3,467	420	6,720
Cladosporium	80	373	140	3,947
Penicillium/Aspergillus group	27	87	347	2,453
Total	407	6,508	1,013	14,020

Bold represents spore concentrations that were higher
indoors than outdoors on the day of monitoring.

Table 5 presents a comparison of the outdoor spore concentrations for six days of monitoring for select spore types. The outdoor spore concentrations were within the range of expected concentrations for Maryland as reported by EMLab in their MoldRANGE tables. Variations in outdoor spore concentrations are a function of diurnal rhythms of spore release, weather-related factors (e.g., wind, rain, snow cover, temperature), and physical spatial factors. The EPA has stated that there is no practical way to eliminate mold and mold spores from the indoor environment. Mold exists naturally in the indoor and outdoor environment. Moisture control is the key to controlling mold.

**Table 5: Outdoor Spore Concentrations on October 18, 2013, October 28, 2013,
December 17, 2013, March 20, 2014, June 11, 2014, July 31, 2014 and
October 20, 2014 at Glenwood Middle School**

Spores/m ³	10/18/13	10/28/13	12/17/13	03/20/14	06/11/14	07/31/14	10/20/14*
Ascospores	173	507	13	80	1,704	853	373-400
Basidiospores	13,845	2,880	3,413	2,107	29,819	32,735	18,317- 26,496
Cladosporium	5,120	107	40	127	3,627	1,493	307-3,413
Penicillium/Aspergillus group	80	140	313	53	20	260	800-1,427
Total	20,204	3,834	3,786	2,388	35,364	35,636	24,557- 30,762

* Three outdoor samples were collected on 10/20/14

III. CONCLUSIONS AND RECOMMENDATIONS

Aria Environmental, Inc. (AE) was contracted by Howard County Public School System (HCPSS) to perform indoor environmental quality investigations at Glenwood Middle School due to a complaint lodged by a teacher about high humidity, mold and adverse health effects. AE conducted an initial investigation on August 28 and 30, 2013 with follow up visits on September 11, 2013, and October 9, 10, 18 and 28, 2013. AE performed additional air monitoring for the presence of mold spores and for temperature, humidity, carbon monoxide, carbon dioxide and particulate matter at Glenwood Middle School for follow up and seasonal comparisons on December 17, 2013, June 11, 2014, July 31, 2014 and October 20, 2014 and after significant improvements to the crawlspaces on March 20, 2014.

Indoor Environmental Quality Investigation Summary Report For Glenwood Middle School

The room air temperature in all indoor sample locations and dates at Glenwood Middle School (excluding crawlspaces) ranged from 69.1 to 76.3°F with an overall average of 72.8°F. Eighty-six (86) temperature measurements were collected. The temperatures are considered acceptable for thermal comfort regardless of season.

A total of 86 relative humidity measurements were collected indoors at Glenwood Middle School from August 2013 to October 2014. The relative humidity ranged from 16.8 to 79.3% Rh with an overall average of 55.1% in all indoor sample locations and dates (excluding crawlspaces). Fifty-two (52) out of 86 measurements were above the EPA's recommendation of 60%. The relative humidity measurements were mostly above 60% in the summer seasons monitored. Humidity monitoring in the summer season is recommended.

Carbon dioxide and carbon monoxide measurements were within acceptable ranges for good indoor air quality in all areas except for one carbon dioxide measurement in Room 20 on June 1, 2014 when four people were in the classroom. Particulate matter measurements were within acceptable ranges for good indoor air quality in all areas except for seven measurements that were influenced by custodian's sweeping during or immediately prior to sampling.

Spore measurements collected in a total of 10 classrooms on seven different days over a one year period were generally lower than outdoor samples with outdoor total spore counts mostly exceeding indoor total counts. Indoor total spore counts, not including the crawlspace samples, ranged from 87 to 39,789 total spores per cubic meter of air (m³). Total spore counts in crawlspace samples ranged from 7 to 46,826 spores per m³. All indoor samples had total spore counts lower than the outdoor samples with seven exceptions: Room 26 on October, 18, 2013; the Crawlspace under Room 15 on October 28, 2013; Rooms 15, 26 and 29 on December 17, 2013; Room 24 after cleaning on June 11, 2014; and the Crawlspace under Room 31 on October 20, 2014.

Some individual spore types were in concentrations greater than the outdoor spore type concentration. The greatest differences were seen in samples collected in the crawlspaces and rooms with known disturbances or activities such as sweeping in classrooms or walking on the exposed soil in the crawlspaces. *Penicillium/Aspergillus* group spores were among the samples with the highest differences between indoor and outdoor concentrations. Most *Aspergillus* and *Penicillium* fungal species can grow under a wide range of conditions at lower building material water activity and readily become airborne; therefore, these spore types may not be very helpful indicators of the building conditions. *Chaetomium* and *Stachybotrys* spores were detected in a few samples but mostly at low concentrations. These hydrophilic (water-loving) species do not readily become airborne and require substantial moisture to grow. Hyphal elements were detected in some samples but few samples were higher than the outdoor sample hyphal element counts.

Overall, the results show a great deal of variability within the building and between sampling dates, depending on the season. Activities such as sweeping have been shown to have a significant effect on increasing spore counts and particle counts. HCPSS has taken actions to control relative humidity and reduce the potential for mold growth. These actions appear to have reduced spore counts over the one year monitoring period since the initial complaint. No visible mold or mildew type odors are detectable in the areas assessed. Relative humidity monitoring is recommended when outdoor humidity is high, and more humidity control may be necessary to maintain relative humidity below 60%.

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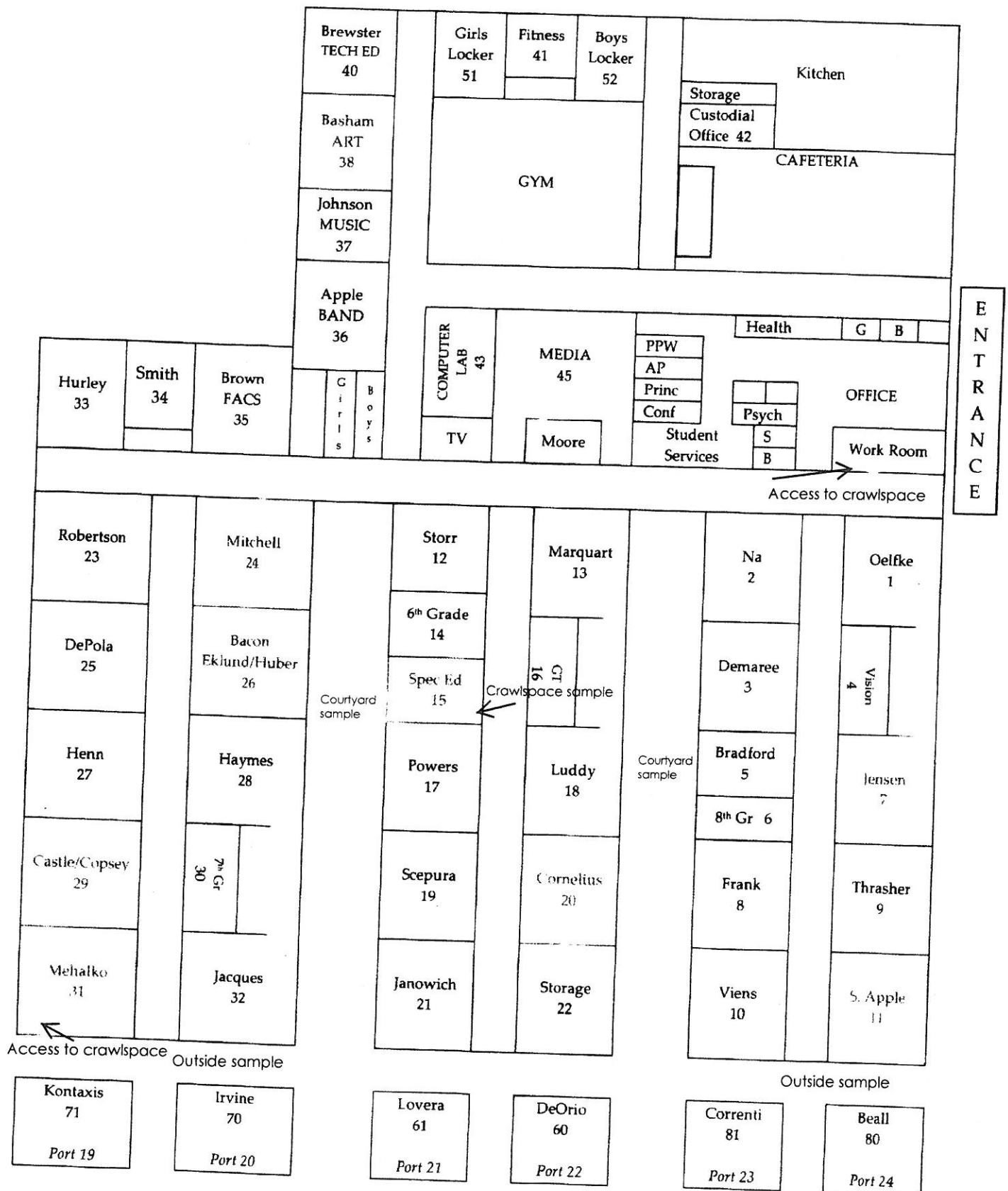
IV. LIMITATIONS

This report has been prepared for the exclusive use of the Howard County Public School System and/or their agents. This service has been performed in accordance with generally accepted environmental practices. No other warranty, expressed or implied, is made. Our conclusions and recommendations are based, in part, upon information provided to us by others and our site observations. We have not verified the completeness or accuracy of the information provided to us by others, unless otherwise noted. Our observations and recommendations are based upon conditions readily visible at the site at the time of our site visit, and upon current industry standards. Destructive sampling was not performed as part of this survey. No observations were made behind solid walls, ceilings or in pipe chases that weren't already openly visible.

By virtue of providing the services described in this report, the preparer does not assume the responsibility of the person(s) in charge of the site, or otherwise undertake responsibility for reporting to any local, state, or federal public agencies any conditions at the site that may present a potential danger to public health, safety, or the environment. It is the Client's responsibility to notify the appropriate local, state, or federal public agencies as required by law, or otherwise to disclose, in a timely manner, any information that may be necessary to prevent any danger to public health, safety, or the environment. Under this scope of services, the preparer assumes no responsibility regarding response actions (e.g. abatement, removal, etc.) initiated as a result of these findings. Response actions are the sole responsibility of the Client and should be conducted in accordance with local, state, and/or federal requirements, and should be performed by appropriately licensed personnel as warranted.

Attachment A:

Building Layout



As of 8/02/13

Glenwood Middle School Floor Plan

Sample Location Plan for An Indoor Air Quality Investigation From October 18, 2013 to October 20, 2014

