



INSPECTION REPORT

Prepared by:	Lars Knobloch
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Email Address:	lars@nordiccompaniesinc.com
Project Number:	7900
Prepared for:	Chris Arnold
On-site contact:	Amy Hiles
Test Location:	1422 Louisiana St Grand Forks Air Force Base
Collected Date:	11/15/19
Report Date:	11/24/19



A handwritten signature in black ink that reads 'Lars Knobloch'.

Lars Knobloch, CIE
Nordic Companies, Inc



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1.0 STATEMENT OF LIMITATIONS

The following assessment is based on findings of the physical inspection and testing. Findings are current and accurate for the date and time they were found, but do not reflect expected or predictable mold growth and infestation on and within the property. This report addresses only those areas physically inspected and sampled.

Nordic Environmental is not responsible or liable for the non-discovery of any water damage, water problems, mold contamination, or other conditions of the Subject Property which may occur or may become evident after the inspection and testing time and date. Nordic Environmental is neither an insurer nor guarantor against water problems, mold problems or other defects at the Subject Property and improvements, systems or components inspected.

Nordic Environmental makes no warranty, expressed or implied as to the fitness for use of condition of the systems or components inspected. Nordic Environmental is not responsible or liable for any future water problems, mold problems or any other future failures or repairs. Remediation recommendations are suggested guidelines, not a detailed remediation protocol. More or less actions may be necessary and will be determined by the remediation company chosen by the property owners or other responsible party.

Currently there are no Federal regulations for evaluating potential health effects of fungal contamination. This information is subject to change as more information regarding fungal contaminants becomes available. This document was designed to follow currently known industry guidelines for the interpretation of microbial sampling, analysis and remediation. Since interpretation of mold analysis report is scientific work in progress, it may as such be changed without notice.

This Mold Testing Report prepared by Nordic Environmental is based on information supplied by the client and on conditions readily observable or measurable on the date of this study. Any inspection and/or testing conducted by Nordic Environmental are not meant to determine whether a building is safe or unsafe for occupants in regard to indoor air quality.

Indoor building conditions vary constantly, therefore the findings and results presented in this report should be considered relative to and representative of the conditions that existed at the time of the inspection and testing. The results and recommendations presented herein should not be relied upon exclusively for the prevention of all possible, injuries or losses. These services are a supplement to, and not a substitute for, the client's responsibility for protecting the health and safety of employees, students, residents and others and for complying with applicable laws and regulations. Nordic Environmental warrants that its work is performed in a competent and professional manner. No other warranties are expressed or implied.



2.0 BACKGROUND

The investigation was conducted by Lars Knobloch, Certified Indoor Environmentalist (CIE) – referred to as the Consultant.

The investigation was requested and authorized by Chris Arnold. Mr. Arnold is the Director of Buildings and Grounds at Grand Forks Public Schools. The contact on site was Amy Hiles. Ms. Hiles is the Head Custodian at Nathan Twining Elementary and Middle School.

When interviewed about the condition in question, Mr. Arnold expressed a concern about the air quality in the north wing due to recent flooding in the tunnels below the school.

When interviewed about the conditions in question, Ms. Hiles reported that there was 4 to 5 inches of water in the tunnels at the North wing below the school after a heavy rainfall in the fall of 2019. The water was pumped out and the tunnels were dried out.

Nordic Environmental's scope of work included inspecting areas of the property specified by Ms. Hiles for visible mold or moisture damage, measuring relative humidity indoors and outdoors, measuring moisture content in suspected areas, collecting total spore air samples, interpreting the results, and providing recommendations.

The goal with the investigation is to determine if an unusual mold condition exists in the specified areas, to determine why and where it is occurring in accessible areas, and to determine what needs to be done to properly correct the problem.



3.0 OBSERVATIONS

The subject property is an elementary and middle school built with a slab on grade structure in the 50's. Several additions have been built since then. Interior finishes include gypsum board and masonry block walls and suspended tile ceilings. Most floors are carpet.

The heating system is radiant hot water heat installed in tunnels below the school. Hot air is radiating from the tunnels through supply vents installed above the tunnels throughout the building.

No signs of microbial growth or water damage was observed in areas specified by Ms. Hiles.

Suspected microbial growth was observed on pipe insulation in the tunnel near classroom #2.

The total of 6 air samples were collected during the investigation:

- 1 sample collected outdoors for background control
- 1 sample collected in classroom #2
- 1 sample collected in classroom #1
- 1 sample collected in the library
- 1 sample collected in the computer lab
- 1 sample collected in the office

The total of 2 tape samples were collected during the investigation:

- 1 sample collected from the pipe insulation
- 1 sample collected from the pipe elbow

4.0 PHOTOGRAPHS



Figure 1: Subject property



Figure 2: Classroom #2



Figure 3: Tunnel near classroom #2



Figure 4: Suspected microbial growth on pipe insulation in tunnel near Classroom #2



Figure 5: Suspected microbial growth on pipe insulation in tunnel near Classroom #2



Figure 6: Suspected microbial growth on 90° plastic elbow in tunnel near Classroom #2



Figure 7: Suspected microbial growth on pipe insulation in tunnel near Classroom #2



Figure 8: Classroom #1



Figure 9: Library



Figure 10: Computer room



Figure 11: Office



5.0 INDICATOR MEASUREMENTS

The following tools were used during the investigation:

Zefon's Bio-Pump Plus - Air sampling

Surveymaster's Protimeter - Detecting moisture

TSI's AIR CALC - Measure temperature, relative humidity, carbon dioxide (CO), carbon dioxide (CO₂), dew point.

Nordic Environmental collected measurements for temperature and relative humidity:

Location	Relative Humidity (RH)	Temperature
Outside	51%	30F
Classroom #1	29%	68F
Classroom #2	31%	68F
Library	41%	65F
Computer Lab	27%	72F
Office	30%	72F

The US Environmental Protection Agency (EPA) recommends maintaining indoor relative humidity below 60% and ideally in a range between 30% and 60% to prevent mold growth, and American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) recommends that relative humidity should be maintained at or below 65%.

The Institute of Medicine (IOM) concluded that there is an association between exposure to damp indoor environments and cough, wheeze, upper respiratory tract (nasal and throat) symptoms, and exacerbation of asthma. Also, the IOM concluded that there is an association between the presence of mold and bacteria in damp indoor environments and hypersensitivity pneumonitis. A statistical analysis of well-designed, published research studies estimated percentage increases in health outcomes for subjects living in houses with dampness and mold compared to those living in houses without these conditions. The percentage increases estimated were 50% for current asthma, 33% for ever-diagnosed asthma, 30% for asthma development, 50% for cough, 44% for wheeze, and 52% for upper respiratory tract symptoms. (DHHS (NIOSH) Publication No. 2013–102)



6.0 SAMPLING METHODOLOGY

Airborne mold testing was performed utilizing Zefon International's Air-O-Cell® sampling cassettes following all manufacturer-supplied recommended sampling procedures.

The Air-O-Cell is a direct-read total particulate air sampling device. It works using the inertial impaction principle similar to other spore trap devices. It is designed for the rapid collection and analysis of airborne particulate including bioaerosols such as mold spores, pollen, insect fragments and skin cell fragments.

The method involves drawing a known quantity of air through a sterile sampling cassette. Subsequent to sampling, the cassette is sealed and transferred to a microbiology laboratory under chain of custody protocol for microscopic analysis. This method collects and enumerates both viable and non viable mold spores.

6.1 Air-O-Cell Cassette

The Air-O-Cell spore trap cassette is used with a portable air pump (15 liters/minute for 1 to 10 minutes) to collect airborne aerosols including mold, pollen and other airborne particulates. Air is drawn through a small opening at the top of the cassette and spores are trapped on a sticky coated glass slide inside the cassette. These cassettes are efficient at collecting spores as small as 2.6µm.

6.2 Tape Samples

These samples could be collected using clear adhesive tape or an adhesive slide for microscopic examination of suspect stains, settled dust and spores. Tape lifts are an excellent, non-destructive method of sampling. The laboratory is usually able to determine if there is mold growth, a high concentration of settled spores, or just a normal background level.



7.0 CHAIN OF CUSTODY

OrderID: 161923762



EMSL ANALYTICAL, INC.
LABORATORY PRODUCTS TRAINING

161923762
EMSL Order Number (Lab Use Only):

EMSL ANALYTICAL, INC.
14375 23RD AVE NORTH
MINNEAPOLIS, MN 55447
PHONE: (763) 449-4922
FAX: (763) 449-4924

Company : Nordic Environmental		EMSL-Bill to: ☒ Same ☐ Different If Bill to is Different please note in Comments**			
Street: 3628 Pierce Street South		Third Party Billing requires written authorization from third party			
City: Fargo	State/Province: ND	Zip/Postal Code: 58104	Country: USA		
Report To (Name): Lars Knobloch		Fax #:			
Telephone #: 701-566-1446		E-mail Address: lars@nordiccompaniesinc.com; miranda@nordiccompaniesinc.com			
Project Name/ Number: TWINING					
Please Provide Results: ☐ Fax ☒ E-mail		PO#	State Samples Taken:		
Turnaround Time (TAT) Options* - Please Check ☐ 3 Hour ☐ 6 Hour ☒ 24 Hour ☐ 48 Hour ☐ 72 Hour ☐ 96 Hour ☐ 1 Week ☐ 2 Week					
*Analysis completed in accordance with EMSL's Terms and Conditions located in the Analytical Price Guide. TATs are subject to methodology requirements					
Non Culturable Air Samples (Spore Traps)					
• M001 Air-O-Cell • M049 BioSIS • M030 Micro 5		• M173 Allegro M2 • M003 Burkard • M174 MoldSnap • M004 Allergenco • M043 Cyclex • M176 Relle Smart • M032 Allergenco-D • M002 Cyclex-d • M130 Via-Cell • M172 Versa Trap			
Other Microbiology Test Codes					
• M041 Fungal Direct Examination • M005 Viable Fungi ID and Count • M006 Viable Fungi ID and Count (Speciation) • M007 Culturable Fungi • M008 Culturable Fungi (Speciation) • M009 Gram Stain Culturable Bacteria • M010 Bacterial Count and ID - 3 Most Prominent • M011 Bacterial Count and ID - 5 Most Prominent • M013 Sewage Contamination in Buildings		• M014 Endotoxin Analysis • M015 Heterotrophic Plate Count • M180 Real Time Q-PCR-ERMI 36 • Panel • M018 Total Coliform (Membrane Filtration) • M020 Fecal Streptococcus (Membrane Filtration) • M210-215 Legionella Detection • M026 Recreational Water Screen • M027 Mycotoxin Analysis • M029 Enterococci • M019 Fecal Coliform • M133 MRSA Analysis • M028 Cryptococcus neoformans Detection • M120 Histoplasma capsulatum Detection • M033-39 Allergen Testing • M044 Group Allergen (Cat, Dog, Cockroach, Dustmites) • Other See Analytical Price Guide			
Preservation Method (Water):					
Name of Sampler: Lars Knobloch		Signature of Sampler:			
Sample #	Sample Location	Sample Type	Test Code	Volume/Area	Date/Time Collected
2955 7914	OUTSIDE	AIR	M001	750 L	11/15/19 11:15am
2955 7901	CLASSROOM #2	↓	↓	150 L	11:25am
2955 8077	CLASSROOM #1	↓	↓	↓	11:40am
2955 8024	LIBRARY	↓	↓	↓	11:55am
2955 7904	COMPUTER LAB	↓	↓	↓	12:05pm
2955 8028	OFFICE	↓	↓	↓	12:20pm
Client Sample # (s):		Total # of Samples: 6		RECEIVED EMSL ANALYTICAL, INC. MINNEAPOLIS, MN NOV 18 AM 9:41	
Relinquished (Client):		Date: 11/15/19	Time:		
Received (Client):		Date:	Time:		
Comments:					

Controlled Document - Microbiology COC - R2 - 1/12/2010



8.0 LAB RESULTS



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<http://www.EMSL.com / Indianapolislab@emsl.com>

EMSL Order: 161923762

Customer ID: NORD25

Customer PO:

Project ID:

Attn: Lars Knobloch

Nordic Environmental
3628 Pierce St. South
Fargo, ND 58104

Phone: (701) 566-1446

Fax:

Collected: 11/15/2019

Received: 11/18/2019

Analyzed: 11/19/2019

Project: TWINING

Test Report: Air-O-Cell™ Analysis of Fungal Spores & Particulates by Optical Microscopy (Methods MICRO-SOP-201, ASTM D7331)

Test Report: Air-Q-0001 - Analysis of Fungal Spores & Particulates by Optical Microscopy (Method: MICRO-SOP-201, Rev: 03/2017)									
Lab Sample Number:	161923762-0001			161923762-0002			161923762-0003		
Client Sample ID:	2955 7914			2955 7901			2955 8077		
Volume (L):	75			150			150		
Sample Location:	OUTSIDE			CLASSROOM #2			CLASSROOM #1		
Spore Types	Raw Count	Count/m³	% of Total	Raw Count	Count/m³	% of Total	Raw Count	Count/m³	% of Total
Alternaria (Ulocladium)	-	-	-	-	-	-	-	-	-
Ascospores	-	-	-	-	-	-	-	-	-
Aspergillus/Penicillium	-	-	-	-	-	-	3	70	50
Basidiospores	1	40	16.7	1	20	33.3	3	70	50
Bipolaris++	-	-	-	-	-	-	-	-	-
Chaetomium	-	-	-	-	-	-	-	-	-
Cladosporium	5	200	83.3	1	20	33.3	-	-	-
Curvularia	-	-	-	-	-	-	-	-	-
Epilicium	-	-	-	-	-	-	-	-	-
Fusarium	-	-	-	-	-	-	-	-	-
Ganoderma	-	-	-	-	-	-	-	-	-
Myxomycetes++	-	-	-	1	20	33.3	-	-	-
Pithomyces++	-	-	-	-	-	-	-	-	-
Rust	-	-	-	-	-	-	-	-	-
Scopulariopsis/Microascus	-	-	-	-	-	-	-	-	-
Stachybotrys/Memnoniella	-	-	-	-	-	-	-	-	-
Unidentifiable Spores	-	-	-	-	-	-	-	-	-
Zygomycetes	-	-	-	-	-	-	-	-	-
Total Fungi	6	240	100	3	60	100	6	140	100
Hyphal Fragment	-	-	-	-	-	-	-	-	-
Insect Fragment	-	-	-	-	-	-	-	-	-
Pollen	-	-	-	-	-	-	-	-	-
Analyt. Sensitivity 600x	-	44	-	-	22	-	-	22	-
Analyt. Sensitivity 300x	-	13*	-	-	7*	-	-	7*	-
Skin Fragments (1-4)	-	1	-	-	1	-	-	1	-
Fibrous Particulate (1-4)	-	1	-	-	1	-	-	1	-
Background (1-5)	-	1	-	-	1	-	-	1	-

++ Includes other spores with similar morphology; see EMSL's fungal glossary for each specific category.

Nathan Husted

Nathan Husted, Microbiology Laboratory Manager
or other approved signatory

No discernable field blank was submitted with this group of samples.

Samples received in good condition unless otherwise noted. High levels of background particulate can obscure spores and other particulates, leading to underestimation. Background levels of 5 indicate an overloading of background particulates, prohibiting accurate detection and quantification. Present = Spores detected on overloaded samples. Results are not blank corrected unless otherwise noted. The detection limit is equal to one fungal spore, structure, pollen, fiber particle or insect fragment. * Denotes particles found at 300x. - Denotes not detected. Due to method stopping rules, raw counts in excess of 100 are extrapolated based on the percentage analyzed. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. The report reflects the samples as received. When the information supplied by the customer can affect the validity of the result, it will be noted on the report.

Samples analyzed by EMSL Analytical, Inc. Indianapolis, IN AIHA-LAP, LLC-AIHA-LAP Accredited #157245

Initial report from: 11/19/2019 09:29:47

For information on the fungi listed in this report, please visit the Resources section at www.emsl.com

MIC_M001_0002_0001 1.71 Printed: 11/19/2019 09:29 AM

Page 1 of 2

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Customer ID: NORD25
Customer PO:
Project ID:

Attn: Lars Knobloch
Nordic Environmental
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Fargo, ND 58104

Phone: (701) 566-1446
Fax:
Collected: 11/15/2019
Received: 11/18/2019
Analyzed: 11/19/2019

Project: TWINING

Test Report: Air-O-Cell™ Analysis of Fungal Spores & Particulates by Optical Microscopy (Methods MICRO-SOP-201, ASTM D7351)

Lab Sample Number:	161923762-0004			161923762-0005			161923762-0006		
Client Sample ID:	2955 8024			2955 7904			2955 8028		
Volume (L):	150			150			150		
Sample Location:	LIBRARY			COMPUTER LAB			OFFICE		
Spore Types	Raw Count	Count/m³	% of Total	Raw Count	Count/m³	% of Total	Raw Count	Count/m³	% of Total
Alternaria (Ulocladium)	3	70	46.7	-	-	-	-	-	-
Ascospores	-	-	-	-	-	-	-	-	-
Aspergillus/Penicillium	-	-	-	-	-	-	-	-	-
Basidiospores	1	20	13.3	-	-	-	-	-	-
Bipolaris++	-	-	-	-	-	-	-	-	-
Chaetomium	1	20	13.3	-	-	-	-	-	-
Cladosporium	1	20	13.3	3	70	100	1	20	100
Curvularia	-	-	-	-	-	-	-	-	-
Epiloccum	-	-	-	-	-	-	-	-	-
Fusarium	-	-	-	-	-	-	-	-	-
Ganoderma	-	-	-	-	-	-	-	-	-
Myxomycetes++	-	-	-	-	-	-	-	-	-
Pithomyces++	1	20	13.3	-	-	-	-	-	-
Rust	-	-	-	-	-	-	-	-	-
Scopulariopsis/Microascus	-	-	-	-	-	-	-	-	-
Stachybotrys/Memnoniella	-	-	-	-	-	-	-	-	-
Unidentifiable Spores	-	-	-	-	-	-	-	-	-
Zygomycetes	-	-	-	-	-	-	-	-	-
Total Fungi	7	150	100	3	70	100	1	20	100
Hyphal Fragment	3	70	-	-	-	-	-	-	-
Insect Fragment	-	-	-	-	-	-	-	-	-
Pollen	-	-	-	-	-	-	-	-	-
Analyt. Sensitivity 600x	-	22	-	-	22	-	-	22	-
Analyt. Sensitivity 300x	-	7*	-	-	7*	-	-	7*	-
Skin Fragments (1-4)	-	1	-	-	1	-	-	1	-
Fibrous Particulate (1-4)	-	1	-	-	1	-	-	1	-
Background (1-5)	-	1	-	-	1	-	-	1	-

++ Includes other spores with similar morphology; see EMSL's fungal glossary for each specific category.

Nathan Husted

Nathan Husted, Microbiology Laboratory Manager
or other approved signatory

No discernable field blank was submitted with this group of samples.

Samples received in good condition unless otherwise noted. High levels of background particulate can obscure spores and other particulates, leading to underestimation. Background levels of 5 indicate an overloading of background particulates, prohibiting accurate detection and quantification. Present = Spores detected on overloaded samples. Results are not blank corrected unless otherwise noted. The detection limit is equal to one fungal spore, structure, pollen, fiber particle or insect fragment. --- Denotes particles found at 3000x. -/- Denotes not detected. Due to method stopping rules, raw counts in excess of 100 are extrapolated based on the percentage analyzed. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. The report reflects the samples as received. When the information supplied by the customer can affect the validity of the result, it will be noted on the report.

Samples analyzed by EMSL Analytical, Inc. Indianapolis, IN. IMA-LAP, LLC-ENLAP Accredited #157245

Initial report from: 11/19/2019 09:29:47

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Customer ID: NORD25
Customer PO:
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Phone: (701) 566-3257
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Collected: 11/15/2019
Received: 11/21/2019
Analyzed: 11/22/2019

Proj: TWINING

Test Report: Microscopic Examination of Fungal Spores, Fungal Structures, Hyphae, and Other Particulates from Tape Samples (EMSL Method MICRO-SOP-200)

Lab Sample Number	Client Sample ID	Location	Fungal Identification	Category
161924086-0001	001	PIPE INSULATION	Alternaria (Ulocladium)	Rare
			Aureobasidium	Low
			Bipolaris++	Rare
			Cladosporium	Low
			Epilcoccum	Rare
			Fibrous Particulate	Rare
			Myxomycetes++	Low
			Pollen	Rare
161924086-0002	002	PIPE ELBOW	Stachybotrys/Memnoniella	Rare
			Aureobasidium	High
			Cladosporium	Low
			Fiberglass	Low

No discernable field blank was submitted with this group of samples.

Bipolaris++ = Bipolaris/Dreschiera/Exserohilum Myxomycetes++ = Myxomycetes/Periconia/Smut
+ = Sample contains fruiting structures and/or hyphae associated with the spores.
- Denotes Not Detected

Category	Count/Area Analyzed
Rare	1 to 10
Low	11 to 100
Medium	101 to 1000
High	> 1000

Nathan Husted, Microbiology Lab Manager
or Other Approved Signatory

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Samples analyzed by EMSL Analytical, Inc. Indianapolis, IN AHA-LAP, LLC-EMSLAP Accredited #157245

Initial report from: 11/22/2019 09:37:12

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Test Report DEVER2-7.50.2 Printed: 11/22/2019 09:37:12AM

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9.0 INTERPRETATION

Since mold/fungi is found widespread in any normal indoor or outdoor environment, air samples collected from suspect areas should be compared to air samples collected from the outdoors, and from non-suspect areas.

A general rule is that the total spore count, and the spore count from each individual fungi collected in the outdoor sample, should be less than or close to equal to indoor samples. Higher levels of the total and/or individual fungi could indicate of a possible indoor amplification. The most common fungi that are known to be found elevated indoors due to actual microbial growth is:

Aspergillus
Chaetomium
Cladosporium
Fusarium
Penicillium
Stachybotrys
Ulocladium

As a general rule, total indoor airborne spore concentrations in a typical clean HVAC supplied building are less than the “average” regional outside concentrations, and/or less than approximately 2,000 cts/m³. Aspergillus /Penicillium and other hyaline spores are on average less than 700 cts/m³. Indicator fungi such as Stachybotrys, Chaetomium, Ulocladium are often recovered in low concentrations in indoor samples as a result of normal infiltration.

The presence of certain fungi indoors could be significant as they can produce mycotoxins that can cause health effects in humans and animals. The most common symptoms are cold and flu symptoms, sore throat, headache, dermatitis, diarrhea and fatigue.

REFERENCES

Environmental Analysis Associates Inc, Air-O-Cell Method Interpretation Guide 2014.



The air sample collected outdoors had the total of 240 Count/m³. The most dominant fungi were Basidiospores (40 Count/m³) and Cladosporium (200 Count/m³).
These findings are statistically considered normal for the time of the year.

The air sample collected in classroom #2 had the total of 60 Count/m³. The most important fungi were Basidiospores (20 Count/m³) and Cladosporium (20 Count/m³).
These findings are not considered to be significant and indicate of a normal fungal ecology.

The air sample collected in classroom #1 had the total of 140 Count/m³. The most important fungi were Aspergillus/Penicillium (70 Count/m³) and Basidiospores (70 Count/m³).
These findings are not considered to be significant and indicate of a normal fungal ecology.

The air sample collected in the library had the total of 150 Count/m³. The most important fungi were Basidiospores (20 Count/m³), Chaetomium (20 Count/m³), and Cladosporium (20 Count/m³).
These findings are not considered to be significant and indicate of a normal fungal ecology.

The air sample collected in the computer lab had the total of 70 Count/m³. The most important fungi were Cladosporium (70 Count/m³).
These findings are not considered to be significant and indicate of a normal fungal ecology.

The air sample collected in the office had the total of 20 Count/m³. The most important fungi were Cladosporium (20 Count/m³).
These findings are not considered to be significant and indicate of a normal fungal ecology.

The tape-lift sample collected from the pipe insulation identified several fungi such as Alternaria, Aureobasidium, Bipolaris, Cladosporium, Epicoccum, Myxomycetes, and Stachybotrys.

The tape-lift sample collected from the pipe elbow identified Aureobasidium (high levels) and Cladosporium.



10.0 CONCLUSIONS AND RECOMMENDATIONS

Microbial growth was observed on piping for the buildings heating system in the tunnel below Classroom #2.

However, all air samples collected in the classrooms had a normal or accepted spore count compared to the exterior sample, statistics, and industry guidelines. This indicates that the indoor air was not impacted by air borne mold spores in the tested areas.

Although the air samples were unable to identify a significant mold problem, light mold was discovered on pipe insulation in the tunnel below classroom #2. A visual inspection in the tunnels was not included in the scope of work for this assessment, therefore, the extent of a potential mold problem could not be determined.

With that, Nordic Environmental recommends that a visual inspection should be completed in the tunnels, and additional tape-lift samples should be collected from suspect areas. Collecting a few air samples in the tunnels should also be considered.

11.0 FUNGAL INFO

***Acremonium* (Hyphomycetes)**

Naturally found in soils, decaying organic matter, and plant debris. Can be found in food and the indoor environment. *Acremonium* is a common allergen, can produce a trichothecene mycotoxin, and volatile organic compounds (VOCs).

***Agrocybe* (Basidiomycetes)**

Medium to large mushrooms growing in grassy areas, on wood mulch, and pine needles. Some species are edible.

***Alternaria* (Hyphomycetes)**

A common saprobe found on decaying wood, decaying plants, food, soil, and outdoor air. Some species are plant pathogens. Indoors, it can be found in house dust, carpet, damp areas around showers and window frames, and anywhere condensation occurs. Because of its abundance and ubiquity, *Alternaria* is one of the most important, fungal allergens and is recognized as the chief fungal cause of hay fever. Infection is extremely rare.

***Arthrinium* (Hyphomycetes)**

A cosmopolitan fungus isolated from plant debris and soil. Often isolated from air near grassy places, but rarely found indoors. Not reported to cause human or animal infection.

***Arnium* (Ascomycetes)**

Most commonly isolated from dung. Not generally associated with human disease and is most often considered benign.

Ascomycetes

Constitutes the largest class of fungi characterized by the production of sexual spores in structures called asci. This includes plant pathogens, saprobes, and decomposers. With a few exceptions, most Ascomycetes do not grow in buildings and are seldom agents of wood rot. Ascomycetes are the perfect stages of molds like *Aspergillus* and *Penicillium*. At high levels, Ascomycetes spores may cause allergies.

Since most Ascomycetes are plant pathogens, ascospores are common during the growing season of plants

and rare during winter, such as those of the Ascomycetes genera: *Daldinia*, *Hypoxylon*, *Paraphaeosphaeria*, *Phaeosphaeria*, and *Leptosphaeria*.

Ascospores

Sexual spores produced by Ascomycetes



***Aspergillus* (Hyphomycetes)**

Teleomorph: *Emericella* (Ascomycetes), *Eurotium* (Ascomycetes)

Found in soil, compost piles, decaying vegetation, stored grain, and other kinds of organic matter. Can be found indoors in water-damaged buildings. A few species can cause aspergillosis in humans with compromised or defective immune systems. Most people are naturally immune to this infection of the lung. *Aspergillus fumigatus* is the most common cause of aspergillosis, followed by *A. flavus* and *A. niger*. Some species are able to produce mycotoxins, depending on the strain, substrate, and/or food source. Other species are used in the manufacture of food, such as *A. oryzae* or *A. soyae* for soy sauce.

***Aureobasidium* (Hyphomycetes)**

A common saprobe frequently isolated from soil, plant surfaces, seeds, grains, fruits and other food, human skin, and nails. Common indoors in humid areas such as bathrooms, kitchens, poorly maintained HVAC systems, and window frames. Allergies to *Aureobasidium* are common but infections are rarely reported.

Basidiomycetes

A class of fungi characterized by spores formed on basidia. Includes the mushrooms, toadstools, boletes, wood bracket fungi, and puffballs. Some species are edible, such as *Agaricus bisporus*, the commercially cultivated mushroom. A few species cause wood brown rot, white rot, and dry rot in buildings.

Basidiospores

Sexual spores produced by Basidiomycetes.

***Beauveria* (Hyphomycetes)**

Found in plant debris and soil. Some species are well known parasites of insects. It is also isolated from food materials and indoor environments.

***Bipolaris* (Hyphomycetes)**

A common saprobe and plant pathogen frequently isolated from plant debris and soil. It is also a common cause of leaf spot on golf course turf. A few species are capable of causing disease in humans.

***Botrytis* (Hyphomycetes)**

Teleomorph: *Sclerotinia* (Ascomycetes)

Most species are important plant pathogens, such as *B. cinerea*, which can cause gray mold disease on various plant parts. Can be found in food and indoor environment, particularly on plants, fruits, and vegetables.

***Cercospora* (Hyphomycetes)**

Teleomorph: *Mycosphaerellaceae*

Widespread plant pathogens that cause leaf spot on many plants.



***Chaetomium* (Ascomycetes)**

A common fungus in soils, dung, decaying organic matter, seeds, and wood or other cellulose-containing materials. Can be found indoors in water-damaged buildings on sheet rock, wallpaper, and other paper products. It is a common cause of food spoilage. Some species are allergenic but rarely cause human infections.

Chromelosporium

Teleomorph: *Peziza* (Ascomycetes)

***Chrysonilia* (Hyphomycetes)**

Teleomorph: *Neurospora* (Ascomycetes)

This genus is widespread; being found in food and indoors. *Chrysonilia sitophila* is popularly referred to as the red bread mold that occurs on breads, baked goods, meat, and fruits.

***Chrysosporium* (Hyphomycetes)**

Teleomorph: Various Ascomycetes

A common soil saprobe occasionally isolated from human or animal skin and nail.

Chrysosporium inops is xerophilic and occurs in food.

***Cladosporium* (Hyphomycetes)**

Teleomorph: *Mycosphaerella* (Ascomycetes)

Widely distributed as plant pathogens and saprobes. It is the most frequently found fungus in outdoor air. Indoors, it usually occurs at low concentrations in damp or humid areas but may be found in high concentrations in waterdamaged building materials. Its ability to sporulate heavily and to get airborne makes it an important fungal allergen. Frequently isolated as a contaminant in foods. Only occasionally associated with disease in humans; one species can cause chronic subcutaneous infection.

Coelomycetes

An artificial class of fungi characterized by asexual spores that are produced within a cavity lined by fungal tissue or fungal and host tissues. Most are saprobes or pathogens on plants, fungi, and lichens.

***Coprinus* (Basidiomycetes)**

These mushrooms are popularly referred to as the inky caps because their gills dissolve into a black inky fluid at maturity. Found on wood, dung, humus, and soil. Some species are edible.

***Curvularia (Hyphomycetes)***

Teleomorph: *Cochliobolus* (Ascomycetes)

A common saprobe found in soil, plants, cereals, and cellulosic materials such as paper and archives. Some species are plant pathogens but can also occur indoors. It is allergenic and may cause infections in immunocompromised people.

Dicyma (Hyphomycetes)

Teleomorph: *Ascotricha* (Ascomycetes)

Doratomyces

A saprobe commonly found on decaying plant materials, straw, dung, wood, and in soil. It produces dark, sooty colonies. It has the ability to penetrate cellophane and to decompose cellulose. *Doratomyces stemonitis* is suspected to be the causal agent of “speck rot” on potatoes.

Dreschlera (Hyphomycetes)

Mostly plant pathogens that cause leaf spot, seedling blight, leaf stripe, or net blotch.

Emericella (Ascomycetes)

Anamorph: *Aspergillus* (Hyphomycetes)

Usually found in soil, potatoes, grain, citrus, and stored seeds. Can be found in food and the indoor environment. *Emericella nidulans* can produce a sterigmatocystin mycotoxin and can be pathogenic to man and animals.

Epicoccum (Hyphomycetes)

A cosmopolitan saprobe isolated from air, soil, grain, seeds, textiles, paper products, and food materials. Can be a plant pathogen and is a common cause of leaf spots of various plants. Can be found in indoor environments, where it can grow under conditions of low humidity. It is a known allergen and is occasionally isolated from human skin and sputum.

Eurotium (Ascomycetes)

Anamorph: *Aspergillus* (Hyphomycetes)

Can be found in stored food, fruit juices, grains, nuts, milled rice, spices, meat products, and peas. Also, commonly occurs in indoor environments. *Eurotium herbariorum* may cause keratitis and indigestion in man.

Exophiala (Hyphomycetes)

Widely distributed as a saprobe in soil, water, on plants and decaying wood. It is an occasional contaminant of feet and nails. *Exophiala* infections have also been reported in animals, including fish.



***Fusarium* (Hyphomycetes)**

Soil-borne fungi containing many plant pathogens that cause root rot, stem rot, fruit rot, and vascular wilt. Common on commodities, such as rice, bean, soybean, and other crops. Some species are important mycotoxin producers, and others notably *F. oxysporum*, *F. solani* and *F. moniliforme*, are recognized as opportunistic pathogens of man and animals.

***Ganoderma* (Basidiomycetes)**

Large, very hard, woody bracket fungi that grow on living and dead trees. Some species are common on oaks, chestnuts, and conifers such as hemlock, spruce, and pine. Many species are being investigated for possible medicinal uses.

***Geotrichum* (Ascomycetes Yeast)**

Teleomorph *Dipodascus*, *Galactomyces* (Ascomycetes)

Commonly found in soil, water, air, decaying leaves, rotting paper, and textiles. Involved in spoilage of food like bakery products, dairy products, juices, fruits, and vegetables. Can be found in indoor environments with some species producing strong odors.

Hyphomycetes

A group of fungi in which asexual spores called conidia are produced from special conidiogenous cells.

***Helvella* (Ascomycetes)**

A saddle-shaped fruiting body of a fungus found on soil, or sometimes on rotting wood. Occasionally found growing on soil under houses.

***Memnoniella* (Hyphomycetes)**

Mainly isolated from soils and dead plant material in tropical countries but has also been isolated from indoor sources such as paper, wallpaper, and textiles. Exposure to this genus should be avoided as they can produce griseofulvins, a potentially toxic metabolite. Emerging research has proposed that *Memnoniella* species actually belong to *Stachybotrys*.

***Monodictys* (Hyphomycetes)**

Found on dead wood, stem, tree bark, damp linoleum, and paper. Isolated from soil and air.

Myxomycetes

Popularly called slime molds. These are not true fungi taxonomically. Some species are found in the soil, in decaying wood, or other organic matter, where they produce structures full of powdery resting spores.



***Mucor* (Zygomycetes)**

Often found in soil, plants, hay, stored seeds, and manure. They can be found indoors in house-dust, HVAC system dust, and poorly maintained carpets. They are rapid growers and can contaminate many kinds of stored food, including fruits and vegetables. A few species have been recovered from well-documented cases of zygomycosis. In general, infections due to members of this genus are rare.

***Nigrospora* (Hyphomycetes)**

Some species are common on plants, particularly in the tropics. Occasionally isolated from soil, air, and foodstuffs.

***Paecilomyces* (Hyphomycetes)**

Teleomorph: *Byssoschlamys* (Ascomycetes)

A common saprobe found on dead plants and compost. Some species are insect parasites while others cause food spoilage. It is rarely a human pathogen but can cause infection in animals. However, some species, such as *P. variotii*, *P. marquandii* and *P. lilacinus* are emerging as causative agents of disease in immunocompromised individuals.

***Penicillium* (Hyphomycetes)**

Many species are common contaminants on a variety of substrates. May be found indoors in air samples, carpet dust, or on wallpaper. Some species are able to produce mycotoxins, as summarized below. Human pathogenic species are rare, only limited to *P. marneffeii*, which causes disease in immunocompromised individuals. Some species are used for commercial production, such as *P. chrysogenum* for the antibiotic penicillin, *P. griseofulvum* for the antibiotic griseofulvin, and *P. roquefortii* for blue cheese.

***Periconia* (Hyphomycetes)**

A widespread fungus commonly found on various substrates, including stalks of grasses, herbaceous stems, dead leaves, or leaf spots. The spores of *Periconia* species are often indistinguishable from the spores of smut fungi like *Ustilago* species, when collected on air cassettes. Both genera can have spores that are brown, verruculose, or echinulate, ranging from 10-16 microns in diameter.

***Peziza* (Ascomycetes)**

Anamorph: *Chromelosporium*

Popularly referred to as cup fungi. They vary in size and color but are mostly shades of ocher or brown to grayviolet. Most species are commonly found on old straw, compost, peat, leaf litter, rotting wood, damp soil, and other moist substrates. Can be found indoors in wet basements and wet carpets.



***Phialophora* (Hyphomycetes)**

Teleomorph: Ascomycetes

Occurs in nature as a soft rot fungus on wood often causing a distinct blue stain. Can cause diseases in immunocompromised individuals.

***Phoma* (Coelomycete)**

Found in soil and plant materials as saprobes. Will grow on a variety of materials such as butter, paint, cement, and rubber. Occasionally pathogenic to plants and humans, but infection from this fungus is extremely rare.

***Pithomyces* (Hyphomycetes)**

This genus is common in soil and on dead or decaying plant materials. Requires high moisture level for spore germination. Can potentially produce cyclodepsipeptides, sporidesmolides, and sporidesmin.

***Rhinocladiella* (Hyphomycetes)**

Teleomorph: *Capronia* (Ascomycetes)

***Rhizopus* (Zygomycete)**

Frequently isolated from soil and agricultural products, such as cereals and vegetables. Can cause infection in immunocompromised, malnourished or severely burned people.

***Rhodotorula* (Yeast)**

A reddish yeast frequently isolated from air, soil, water, fruit juice, dairy products, and other substrates. Typically found as a saprobe in moist environments indoor such as carpeting, cooling coils, water tanks, humidifiers, and drain pans. Reported to be allergenic. Has been found to colonize terminally ill patients.

Rusts

Obligate parasitic fungi, which belong to Teliomycetes – Uredinales that cause plant diseases.

***Scopulariopsis* (Hyphomycetes)**

Teleomorph: *Microascus* (Ascomycetes)

Mainly soil-borne, but also frequently isolated from wood, grain, fruit, paper, and food such as meat and dairy products. Also isolated from indoor environments. Most species can liberate arsenic gaseous compounds that can lead to arsenic poisoning. Has recently been associated with invasive human infections.

***Scytalidium* (Hyphomycetes)**

Isolated from wood and soil.

***Serpula* (Basidiomycete)**

Wood-attacking fungi. *Serpula lacrymans* is popularly referred to as the dry rot fungus or house fungus.

***Smuts* (Teliumycetes)**

Obligate parasites and pathogens of plants that cause smut on various plant parts such as *Silene* anthers, corn kernels, onion bulbs, and rice grains.

***Sordaria* (Ascomycetes)**

Common on dung. One species, *S. fimicola* is fairly common and is found on other substrates besides dung.

***Sporobolomyces* (Yeast)**

Can be commonly detected in air samples. Frequently encountered indoors in water tanks, humidifiers, drain pans, etc.

***Sporoschisma* (Hyphomycetes)**

Found on rotten wood and dead stems.

***Sporothrix* (Hyphomycetes)**

Teleomorph: *Ophiostoma* (Ascomycetes)

Isolated from soil, live or dead plants, and peat moss. *S. schenckii* is an agent of human sporotrichosis, cutaneous infection, and ocular mycosis, usually in immunocompromised people.

***Sporotrichum* (Hyphomycetes)**

Teleomorph: *Phanerochaete* (Basidiomycetes)

Can get airborne and be inhaled where it can form giant cells in the lungs.

***Stachybotrys* (Hyphomycetes)**

A common saprophyte found on many substrates like grains, decaying plant materials, textiles, and tobacco. Grows indoors on water-damaged cellulose rich materials, such as sheet rock, paper, ceiling tiles, insulation backing, gypsum board, and wallpaper. The presence of this fungus can be significant due to its ability to produce mycotoxins under certain environmental conditions. Exposure to the toxins can occur through inhalation, ingestion, or skin exposure. It is possible that *Stachybotrys* may play a role in the development of sick building syndrome, but probably only in conjunction with other factors. Until more information is available on the health risks of environmental exposure to *Stachybotrys*, caution should be taken when dealing with this fungus.

***Stemphylium* (Hyphomycetes)**

A common saprobe typically is found on dead plants and wood. It has been also isolated from air, paper, and cellulosic materials.



***Syncephalastrum* (Zygomycete)**

Often isolated from soil and dung in tropical and subtropical regions. Can also be a persistent laboratory contaminant.

***Taeniolella* (Hyphomycetes)**

Common on dead branches, wood, and senescent leaves. Was isolated from human cutaneous and subcutaneous lesions.

***Tetraploa* (Hyphomycetes)**

Teleomorph: *Massarina* (Ascomycetes)

Found on stems and leaf bases of many plants. *Tetraploa aristata* has been reported to cause keratitis.

***Thermomyces* (Hyphomycetes)**

A thermophilic fungus that grows rapidly at 40°C.

***Torula* (Hyphomycetes)**

Cosmopolitan fungi commonly found on wood, leaves, plant roots, and plant litter. Has also been isolated from air and soil. Some species cause stains in hardwoods.

***Trichoderma* (Hyphomycetes)**

Very common especially in soil and decaying wood, dead leaves, fallen timber, compost heaps, and activated sludge. Can be found indoors in water-damaged buildings. Has occasionally been associated with disease in immunocompromised individuals.

***Trichophyton* (Hyphomycetes)**

Some species are dermatophytes (growing on the skin) of humans or animals.

***Tritirachium* (Hyphomycetes)**

A saprobe commonly isolated from decaying plant materials. Easily gets airborne. Can cause corneal ulcers.

***Ulocladium* (Hyphomycetes)**

Found as a saprobe in soil, plant materials, rotten wood, paper, textiles and cellulose materials. Frequently collected in air and dust samples. Can grow indoors on water-damaged building materials. Has not been associated with disease in humans but can be very allergenic.

***Verticillium* (Hyphomycetes)**

Mostly soilborne, root-inhabiting fungi that cause vascular wilt and other diseases on plants. Some species also infect mushrooms, rusts, and other fungi, as well as nematodes, ticks, mites and other insects. Other species can attack wool and textiles or can decompose paper.

**Wallemia (Hyphomycetes)**

A very xerophilic fungus that has been isolated from soil, air, hay, textiles, and food such as jam, salted fish, and milk products. Can cause allergies.

Yeast

A growth form exhibited by some fungi in which the fungus exists as single budding cells.

Zygomycetes

A class of fungi where the asexual spores are mostly formed endogenously in sporangia. The majority of the species is saprobes.

11.1 Definitions

Allergen/allergenic

An allergen is an antigen, principally a protein, which can elicit symptoms of allergic disease in a previously sensitized individual. This antigen is specifically recognized by the individual's immune system, with subsequent development of specific antibody and/or cell mediated immunity. Fungi can elicit an allergic reaction ranging from mild to severe, anywhere from a stuffy nose, through hay fever and asthma to pneumonitis. In most cases, the physical condition of the host, the amount of allergen the host is exposed to (spores, fungal hyphae, dust, pollen, etc.) and the degree of sensitization of the individual determines the severity of the reaction. In general, common environmental or indoor air contaminating fungi most often affect humans as irritants that elicit an immune response that we generally associate with allergies (hypersensitivity).

Anamorph

The imperfect stage or asexual state of the fungus produced by mitosis.

Colony

An individual fungal growth on an agar culture plate or natural/manufactured substrate, when the fungus has grown sufficiently to be readily seen with a hand lens or low-power microscope.

Conidia (conidium, singular)

Asexual non-motile spores.

Conidiophore

The specialized hypha or cell on which conidia are produced.

Hyphae (singular hypha)

The individual filament or thread that make up a fungus.

**Hyphal Fragment**

A portion of the fungal mycelium that does not have any spores or other diagnostic fungal structures, and therefore, could not be identified.

Immunocompromised

Incapable of developing a normal immune response, usually as a result of disease (lupus, HIV), malnutrition, or immunosuppressive therapy (chemotherapy, corticosteroids).

Mycotoxin

Secondary metabolites produced by fungi, which are toxic to human and animals in small quantities. Production of a specific mycotoxin tends to be genus-, species-, or even strain-specific.

No Mold Detected

This result indicates that spores, hyphae, or any fungal structures were not observed from the sample.

Parasite

An organism that requires a living host to survive. It lives in or on the host and derives nutrients or other substances from the host. It is generally not able to live saprophytically, and it may often cause extensive damage to the host.

Pathogen

An organism that can cause a disease on another living organism.

Saprobe

A fungus that feeds by external digestion of dead organic matter, and usually has the ability to adapt rapidly on the substrate.

Spore

An individual reproductive body or propagule of fungi, similar to a seed of plant.

Spore-producing structures

Fungal parts involved in spore production such as hyphae, conidiophores, phialides, and fruiting bodies, among others.

Teleomorph

The perfect stage or sexual state of the fungus involved in producing meiotic or sexual spores.

Xerophilic

Able to grow under dry conditions.



For more information about the different fungi's; visit EMSL's website
www.fungalinfo.com



All samples are analyzed by EMSL Analytical

Thank you for your business. You are welcome to call Nordic Environmental any time should you have any questions.

A handwritten signature in black ink that reads "Lars Knobloch".

Lars Knobloch, CIE
Nordic Environmental
