FRANCE ENVIRONMENTAL

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July 31, 2017

Richmond Public Schools
301 North Ninth Street
Richmond, Virginia 23219

ATTN: Mr. Tommy Kranz

RE: Indoor Air Quality (IAQ) Assessment
George Mason Elementary School
813 N. 26th Street
Richmond, Virginia
FEI Project Number: FEI-17IAQ412

Dear Mr. Kranz:

FEI conducted Indoor Air Quality (IAQ) sampling which includes Total Fungal Spore Trap Air Samples (mold), Temperature, Relative Humidity, Carbon Dioxide and Carbon Monoxide by utilizing an electronic recording monitor (TSI IAQ-Calc Model 7545). Spot check measurements were collected for Ozone (O^3), Hydrogen Sulfide (H_2S), Oxygen (O^2) Volatile Organic Compounds (VOC's), Methane (CH_4) and Natural Gas in the subject spaces throughout the building on July 28, 2017 prior to and during normal building operation.

The results of the sampling did not indicate that any elevated airborne concentration of tested contaminates were present at or above the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) causing any danger to public health, safety, or the environment.

A description of the possible contaminants tested, the recommended levels and monitoring results are found below.

Total Fungal Spores (Mold)

The six (6) air sample collected from the basement, main floor and upper floor of the school were compared to the air sample collected from the outside of the building. The sample results for the air samples collected did ***not*** indicate airborne fungal amplification is occurring when compared to the outside building sample at the time of the air sampling. In addition, the inspector did not observe any visible signs of water intrusion or suspect mold growth. The results of the air samples along with the inspector's limited general observations would indicate a mold issue is not likely present. (see laboratory results attached)

Microbiological interpretation of sample results pose a challenge for the health and safety professionals as there are at present no strict numerical guidelines which are appropriate for assessing whether microbial levels inside buildings are "safe" or "normal" spore levels. There are currently no regulatory standards for evaluating airborne fungi concentrations for this or any other facility. As these organisms are present everywhere the standard of care is to perform a

risk-based analysis. In general, industry standards effective interpretation is based on the comparison of indoor and outdoor samples. Typically you would expect indoor counts to be 30 to 80 percent of outdoor spore counts, with the same general distribution of spore types present. Also, variation is an inherent part of biological air sampling. The presence or absence of a few genera in small numbers should not be considered abnormal.

TEMPERATURE (T)

Measurement and recording of the air temperature is used to determine comfort level parameters associated with the indoor environment. The monitoring device was placed in various areas and spot sample measurements were collected. The American Society of Heating, Refrigerating and Air-conditioning Engineers Inc. (ASHRAE) provide guidance on comfort ranges for temperature depending on the season. These numbers generally range from 68°F to 79°F during the summer months. The ranges are dependent on available humidity with the lower end of the temperature range coinciding with the higher humidity. These ranges should be acceptable for sedentary or slightly active persons. All tested readings were within the acceptable levels.

RELATIVE HUMIDITY (RH)

Measurement and recording of the relative humidity is used to indicate comfort level parameters associated with the indoor air. Overly dry or overly humid air is indicators of air quality issues caused by the HVAC system. ASHRAE has set standards that present guidelines for human occupation. Relative humidity levels below (30%) are associated with increased discomfort and drying of the mucus membranes and skin. High humidity can result in condensation and the subsequent development of mold and fungi along with the increase of dust mite propagation. Ideal indoor relative humidity for winter months is 35% and 50% is optimal in the summer months. Relative humidity levels ≤ 65% are considered acceptable by ASHRAE standards; however, ideal levels are between 30% and 60%. In winter, the use of a humidifier can help regulate levels in cold months and in the summer a dehumidifier or air-conditioning system is recommended. The indoor readings were all within the acceptable levels.

CARBON DIOXIDE (CO_2)

Measurement of carbon dioxide is used as an indicator of potential poor air circulation or limited fresh air intake and mixing. The monitoring device was placed in various areas and spot sample measurements were collected.

The ASHRAE Standard 62.1-2013 identifies indoor CO_2 concentrations as a surrogate determination of ventilation efficiency. For a building under normal occupancy load and operating in its normal conditioning, a comparison of indoor air and outdoor air CO_2 concentrations can be used to indicate relative ventilation efficiency for the occupied spaces. Provided the occupant density does not exceed the recommended levels in ASHRAE Standard 62.1-2013, when the peak indoor CO_2 concentration exceeds the outdoor concentration by more than 700 parts per million (ppm), the ventilation rate for that space is inadequate for the occupant loading. An indoor CO_2 concentration of 700 ppm above the outdoor concentration is not a significant risk to health; however, other bio-effluents from occupants and pollutants from building components may accumulate to irritant levels or result in discomfort for the occupants due to inadequate ventilation. At the time of the survey, the average outdoor CO_2 concentration measured by FEI was 447 ppm; thus, the maximum indoor CO_2 concentration recommended by ASHRAE during the sampling interval was 1,147 ppm. Measured Carbon Dioxide Level measured during the spot sampling within the subject spaces ranged from 399 to 557 parts per

million (ppm). These readings during site visits were below ASHRAE recommended maximum indoor concentrations.

CARBON MONOXIDE (CO)

Carbon monoxide is colorless and odorless gas and is a normal constituent of exhaust gases from incomplete combustion. Potential sources inside a building that may generate carbon monoxide include gas heating systems, gas stoves, gas hot water heaters, cigarette smoke, and portable kerosene heaters. Measurement of the high and low level of carbon monoxide is used to determine problems associated with air intake contamination or contamination potentials from other sources within the building. The monitoring device recorded high and low levels for carbon monoxide in various areas. For office areas, levels of carbon monoxide are normally between (0 ppm – 5 ppm). Concentrations greater than 5 ppm may indicate the presence of exhaust gases in the indoor environment and should be investigated. ASHRAE recommends maintaining the carbon monoxide level below 9 ppm. The carbon monoxide readings were within the acceptable guidelines.

ADDITIONAL GAS SAMPLING (AIRBORNE CONTAMINANTS):

FEI conducted physical measurements of Airborne Contaminant Sampling in the subject spaces and outside the building for comparison purposes. Direct read instruments (BW Technologies GasAlert Micro5 and Gas Alert Micro5 PID with multiple gas sensors) were utilized to test for Ozone O3; Volatile Organic Compounds (VOCs); Hydrogen Sulfide (H2S); and Lower Explosive Limit (LEL) for Methane. These are some of the typical indoor air contaminants that have been linked to indoor air quality issues. Some of these gases are found in Sewer Gas that some occupant(s) were concerned may entering the subject space. The results of the testing are summarized below.

OZONE (O_3)

Ozone is found in the atmosphere when sunlight reacts with air containing hydrocarbons and nitrogen oxides. It is a key component in smog. Typically, HVAC systems will diminish and dissipate ozone levels that penetrate inside buildings. Indoor ozone levels are generated by electrostatic copying machines, laser printers and electrostatic cleaners. Exposure to excessive levels of ozone may cause respiratory irritation. American Conference of Governmental Industrial Hygienists (ACGIH) recommends a Threshold Limit Value (TLV) of 0.1 ppm, the Occupational Safety and Health Administration (OSHA) has an 8-hour Time Weighted Average (TWA) of 0.1 ppm and Short Term Exposure Level (STEL) of 0.3 ppm. The readings within the subject space were below all recommended levels.

VOLATILE ORGANIC COMPOUNDS (VOC) USING PHOTO-IONIZATION DETECTION (PID)

Volatile Organic Compounds (VOCs) are gases generated from thousands of chemicals and solids. Common sources of VOCs are cleaners, solvents, paints, copiers, printers, glues, permanent markers, photographic solutions and perfumes. VOCs are known to cause eye; nose; throat irritation; headaches; loss of coordination; and nausea. OSHA and American Conference of Governmental Industrial Hygienists (ACGIH) both have 8-hour TWA recommended limits of 50 ppm and Short Term Exposure Limit (STEL) of 100 ppm. The readings within the subject space were below all recommended levels.

OXYGEN (O_2)

The OSHA Respiratory Protection Standard considers having an Oxygen level below 19.5% to be oxygen-deficient and dangerous to human life. At concentrations of 16% to 19.5% workers

engaged in any form of exertion can rapidly become symptomatic as their tissues fail to obtain the oxygen necessary to function properly. There are signs of increased breathing rates, accelerated heartbeat, and impaired thinking or coordination occurs more quickly. Momentary loss of coordination may be devastating to a worker. Ranges between 12% to 16% oxygen cause tachypnea (increased breathing rates), tachycardia (accelerated heartbeat) and impaired attention, thinking and coordination even in people who are resting. Levels of 10% to 14% create faulty judgment, intermittent respiration, and exhaustion can be expected even with minimal exertion. Having air with 6% to 10% oxygen can result in nausea, vomiting, lethargic movements and perhaps unconsciousness. Less then 6% oxygen produces convulsions, then apnea (cessation of breathing), followed by cardiac standstill. These symptoms occur immediately. OSHA does not recognize a safe PEL for oxygen. The reading within the subject spaces were 20.9% and within guidelines.

HYDROGEN SULFIDE (H_2S)

Hydrogen Sulfide (H_2S) is produced by the breakdown of human or animal wastes and organic materials. It may also occur in natural gas and petroleum. It has distinct “rotten egg” odor that is sometime called “sewer gas”. Low concentration may cause shortness of break, burning eyes, coughing and other irritations to the respiratory system, eyes, nose and/or throat. Moderate concentrations can cause more severe eye and respiratory irritation (including coughing, difficulty breathing, accumulation of fluid in the lungs), headache, dizziness, nausea, vomiting, staggering and excitability. High concentrations can cause shock, convulsions, inability to breathe, extremely rapid unconsciousness, coma and death. Effects can occur within a few breaths, and possibly a single breath. American Conference of Governmental Industrial Hygienists (ACGIH) recommends a Threshold Limit Value (TLV) of 1.0 ppm as an 8-hour Time Weighted Average (TWA) and 5.0 ppm as Short Term Exposure Limit (STEL), the Occupational Safety and Health Administration (OSHA) has an 8-hour TWA of 20 ppm and STEL of 50 ppm. National Institute for Occupational Safety and Health (NIOSH) established a recommended exposure limit (REL) at 10 ppm for a 10 minute period. The readings within the subject spaces were below all recommended levels.

METHANE (CH_4) VIA LOWER EXPLOSION LIMIT (LEL) OR NATURAL GAS

Methane is produced from both man-made (anthropogenic) and natural sources. Anthropogenic sources include land filling activities, decomposition of organic material in made ground, natural gas pipelines and coal mines. Natural methane sources include coal measures deposits and marshland.

Methane is an odorless, colorless flammable gas and is lighter than air. Because methane is lighter than air, it tends to rise and accumulate near the higher, stagnant parts of enclosed buildings. It is most likely to accumulate during hot, humid weather. It is also used to manufacture organic chemicals. Methane can be formed by the decay of natural materials and is common in landfills, marshes, septic systems and sewers.

Methane can form an ***EXPLOSIVE*** mixture in air at levels as low as 5 percent. You can smell leaking methane only when commercial gas utility companies add a chemical smell to it or when it mixes naturally with hydrogen sulfide, causing a "rotten egg" smell. If you can smell it, the level may be too high to be safe.

Methane can also be found in coal gas. Pockets of methane exist naturally underground. In homes, methane may be used to fuel a water heater, stove and clothes dryer.

Methane evaporates quickly. Therefore, most of the methane that ends up in lakes, streams, or soil is eventually released into the air. However, methane that is formed underground and moves through soil can remain unchanged for many years.

Breathing: Most exposures occur when people inhale methane. Methane can go into homes through sewer traps or foundation cracks. People can be exposed by inhaling the chemical at work, cooking on a gas stove, or entering confined spaces such as manholes, silos, animal waste pits, septic tanks and sewers.

Drinking/Eating: Because methane evaporates quickly, it is usually not found in food or drinking water. Very low level exposure can occur when contaminated water is used for drinking and/or for food preparation or when children eat contaminated soil.

Touching: Methane gas does not pass readily through intact skin. Methane in its extremely cold liquefied form can, however, cause burns to the skin and eyes.

The Occupational Safety and Health Administration (OSHA) lower explosive limit (LEL) for methane is 5%. Methane is considered an asphyxiant at extremely high concentrations and can displace oxygen in the blood. The Lower Explosive Limit (LEL) reading in the subject spaces were within the acceptable guidelines.

Natural Gas

Used for heating homes and running appliances such as water heaters and stoves. It contains methane (also known as swamp gas or marsh gas), which is a hydrocarbon. Methane occurs naturally in the earth's crust and is also formed by decaying organic matter such as manure or sewage. Natural gas has no odor; mercaptans (which smell like rotten eggs) are added in low concentrations so that leaks can be detected. Natural gas is highly flammable and will spontaneously combust if there is a source of ignition. Natural gas becomes a liquid at - 120 degrees Celsius and is called LNG (liquefied natural gas).

The table below displays the spot check readings that were performed in the subject spaces on July 28, 2017. All of readings were within recommended ranges.

Table 1 Air Quality Spot Check Results (7/28/17)

Location in Structure	Temp. (°F)	Relative Humidity %	Carbon Dioxide (CO_2) PPM	Carbon Monoxide (CO) PPM	Ozone (O_3) PPM	Volatile Organic Compounds (VOC) PPM	Hydrogen Sulfide (H_2S) PPM	Oxygen (O_2) %	Lower Explosive Limit (Natural Gas - Methane) PPM
Recommended Range / PEL	68-75	≤65	<1,120	<9.0	<0.1	<50	<1	19.5-23.5	<1,000
Basement Hallway	70.5	45.8	407	0.2	0.00	0.4	0.0	20.9	6.0
Basement Music Room	69.7	46.5	401	0.6	0.00	0.4	0.0	20.9	0
Basement Art Room	69.7	46.5	411	0.5	0.00	0.2	0.0	20.9	0

Location in Structure	Temp. (°F)	Relative Humidity %	Carbon Dioxide (CO2) PPM	Carbon Monoxide (CO) PPM	Ozone (O3) PPM	Volatile Organic Compounds (VOC) PPM	Hydrogen Sulfide (H2S) PPM	Oxygen (O2) %	Lower Explosive Limit (Natural Gas - Methane) PPM
Recommended Range / PEL	68-75	≤65	<1,120	<9.0	<0.1	<50	<1	19.5-23.5	<1,000
Basement Mechanical Room	70.1	46.2	402	0.4	0.00	0.1	0.0	20.9	145.0
Basement Boys Restroom	70.5	46.4	421	0.6	0.00	0.2	0.0	20.9	0
Basement Girls Restroom	70.3	46.8	406	0.8	0.00	0.2	0.0	20.9	0
Main Floor Outside Office	70.8	49.2	425	0.5	0.00	0.2	0.0	20.9	0
Main Floor Top of Stairs	72.2	47.2	433	0.6	0.00	0.2	0.0	20.9	0
Main Floor by Entrance	72.3	46.8	501	0.5	0.00	0.6	0.0	20.9	0
Main Floor Hallway	71.8	45.9	477	1.0	0.00	0.1	0.0	20.9	0
Top Floor top of Stairs	71.0	45.8	425	0.9	0.00	0.1	0.0	20.9	0
Top Floor Hallway	71.2	45.5	452	1.0	0.00	0.2	0.0	20.9	0
Top Floor Office	70.8	45.6	465	0.5	0.00	0.1	0.0	20.9	0
Top Floor Classroom	70.8	45.2	451	0.4	0.00	0.0	0.0	20.9	0
Exterior	91.0	52.5	447	2.0	0.00	1.2	0.0	20.9	0

**Wind direction at the time of the sampling was from North to South and ranged from 4-6 mph.

**Sampling was conducted during a typical day

CONCLUSIONS:

The results of the sampling of the interior areas of the building did not indicate any elevated airborne concentrations of tested contaminates were present at or above the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL).

If you have any questions, or if we can be of additional service, please call us at 804.716.0560.

Respectfully submitted,

FRANCE ENVIRONMENTAL, INC.

Derek D. Dambacher, REA
Senior Project Manager

TOTAL FUNGAL AIR SAMPLE
LABORATORY RESULTS

AmeriSci Bio-Chem
13635 GENITO ROAD
MIDLOTHIAN, VIRGINIA 23112
TEL: (804) 763-1200 • FAX: (804) 763-1800

Analyzed By:
Jill G. Carrillo

AmeriSci Job #:
317071103
FINAL REPORT

Client: **France Environmental, Inc.**
Address: **7834 Forest Hill Ave**
Suite 7
Richmond, VA 23225

Client Job#: 17IAQ412
Client Job Name: George Mason ES

Date Received: 07/29/17
Date Reported: 07/29/17

Air Cassette Analytical Report (SOP# 3.24.01)

AmeriSci Number	317071103-01			317071103-02			317071103-03			317071103-04		
Sample Number	A1			A2			A3			A4		
Sample Name	Basement - Art Room			Basement - Music Room			Basement - Hallway			Main Hall Outside Office		
Analysis Date	7/29/2017			7/29/2017			7/29/2017			7/29/2017		
Volume (L)	25			25			25			25		
Limit of Detection (LOD) (Count/M ^{3})	40			40			40			40		
Background Density	1			1			1			1		
Other	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**
Pollen	ND	n/a	ND	ND	n/a	ND	ND	n/a	ND	ND	n/a	ND
Fibers	40	n/a	1	40	n/a	1	80	n/a	2	120	n/a	3
Mycelial Fragments	ND	n/a	ND	40	n/a	1	ND	n/a	ND	ND	n/a	ND
Fungal Identification	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**
Alternaria sp.	ND			ND			ND			ND		
Ascospores	320	16	8	200	17	5	920	16	23	600	16	15
Aspergillus/Penicillium	ND			ND			280	5	7	ND		
Basidiospores	1600	80	40	1000	83	25	4600	79	115	3000	80	75
Cercospora sp.	ND			ND			ND			ND		
Cladosporium sp.	80	4	2	ND			ND			160	4	4
Curvularia sp.	ND			ND			ND			ND		
Myxomycetes/Periconia/Smuts	ND			ND			ND			ND		
Pithomyces sp.	ND			ND			ND			ND		
Total Fungal Spores	**2000**	**100**	**50**	**1200**	**100**	**30**	**5800**	**100**	**145**	**3760**	**100**	**94**

ND = None Detected

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Analyzed By:
Jill G. Carrillo

AmeriSci Job #:
317071103
FINAL REPORT

Client: **France Environmental, Inc.**
Address: **7834 Forest Hill Ave**
Suite 7
Richmond, VA 23225

Client Job#: 17IAQ412
Client Job Name: George Mason ES

Date Received: 07/29/17
Date Reported: 07/29/17

Air Cassette Analytical Report (SOP# 3.24.01)

AmeriSci Number	317071103-05			317071103-06								
Sample Number	A5			A6								
Sample Name	1st Floor Main Hall			Exterior - Front								
Analysis Date	7/29/2017			7/29/2017								
Volume (L)	25			25								
Limit of Detection (LOD) (Count/M ^{3})	40			40								
Background Density	1			2								
Other	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**
Pollen	ND	n/a	ND	ND	n/a	ND						
Fibers	ND	n/a	ND	80	n/a	2						
Mycelial Fragments	40	n/a	1	ND	n/a	ND						
Fungal Identification	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**	**Count/M ^{3}**	**%**	**Raw Count**
Alternaria sp.	ND			40	<1	1						
Ascospores	440	14	11	>12000	46	300						
Aspergillus/Penicillium	320	10	8	1120	4	28						
Basidiospores	2200	71	55	>12000	46	300						
Cercospora sp.	ND			40	<1	1						
Cladosporium sp.	80	3	2	960	4	24						
Curvularia sp.	80	3	2	ND								
Myxomycetes/Periconia/Smuts	ND			40	<1	1						
Pithomyces sp.	ND			40	<1	1						
Total Fungal Spores	**3120**	**100**	**78**	**26240**	**100**	**656**						

ND = None Detected
Results relate only to the items tested and are reported mathematically to significant figures.

Name/Title: Jill G. Carrillo / Analyst
Signature:
Date: 07/29/17

Name/Title: Jill G. Carrillo / Analyst
Reviewed By:
Date: 07/29/17