VanDriel OHS Consulting

Building A Healthy Workplace

"Parkview Elementary Indoor Air Quality Report: Post-Renovation"

PREPARED FOR	School District 83
PREPARED BY	Ivan Cheung M.Sc.
REVIEWED BY	Robin Van Driel M.Sc., CIH, ROH, CRSP
SITE LOCATION	605 Parksville Street, Sicamous, BC
REPORT DATE	December 10, 2019

1. Introduction

VanDriel OHS Consulting ("VOHS") was retained by School District 83 to perform an indoor air quality (IAQ) investigation at Parkview Elementary School located at 605 Parksville Street, Sicamous, BC. This investigation occurred following re-occupancy of the building after several weeks of school closure.

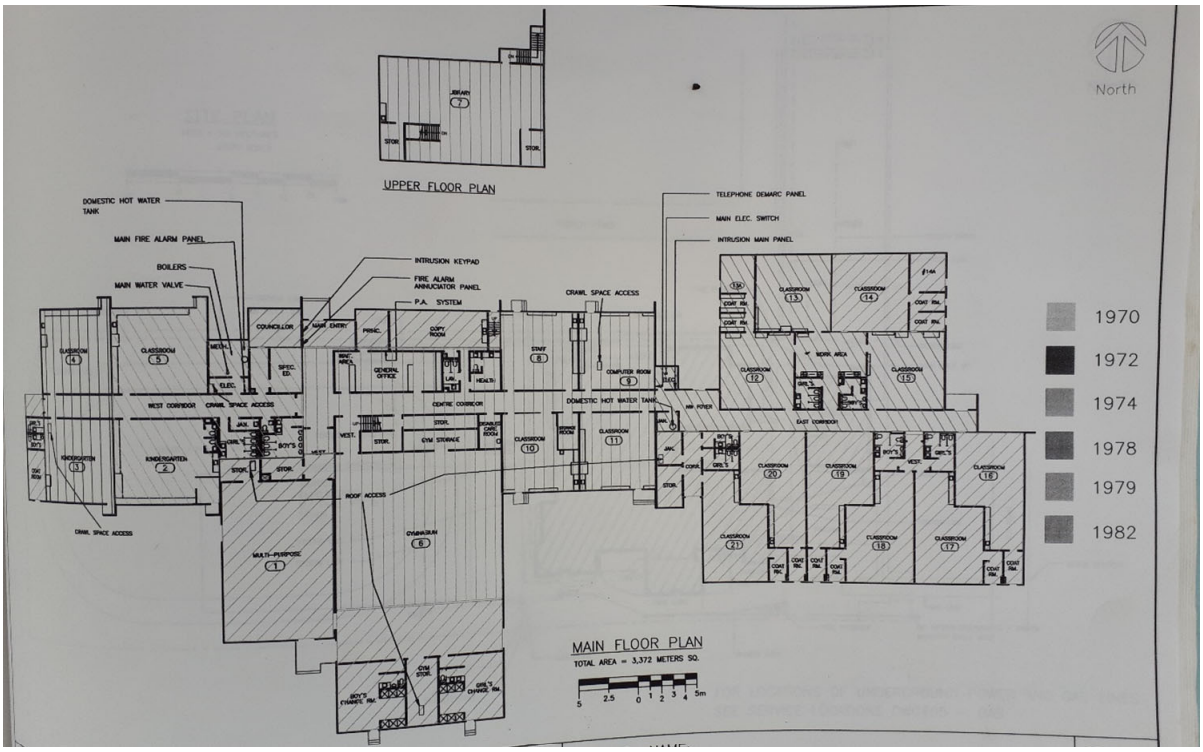


Figure 1: Floor plan of Parkview Elementary School. Not to scale.

2. Investigation Method and Analysis

The investigation was carried out on November 15, 2019. The investigation included the collection of non-viable airborne mould spores, volatile organic compounds (VOCs), measurements of temperature, relative humidity, carbon monoxide (CO), and an estimation of ventilation effectiveness by using carbon dioxide (CO_2) as a proxy measurement.

2.1 Non-Viable Airborne Mould Spore Samples

Nine air samples for non-viable mould spores were collected throughout the building to determine the amount of mould spores in the air. These samples were collected from the following locations:

1. Outdoor – Main Entrance
2. Outdoor – South entrance by playground
3. Front office
4. Classroom 19
5. Classroom 12
6. Classroom 15
7. Kindergarten Room 3
8. Storage Room 4
9. Inside office floor vents; southwest corner of building

Spore samples were collected onto Air-o-Cell cassettes. Air was drawn through the cassette using a Zefon Air-o-Cell Biosampler at a constant flow rate of 15 L/min, as determined by the calibration using the Biosampler calibration device. Samples were collected in occupied spaces and areas where IAQ concerns were reported for a total of 10 minutes. The sample collected from the vents was collected for 7 minutes. Two outdoor samples were collected for comparison purposes. Fungal spores trapped in the Air-o-Cell cassette were counted and identified by their morphology at various locations of the Air-o-cell filter following the *American Society for Testing and Materials (ASTM) D7391 Standard*. Indoor samples were compared with the outdoor samples based on the count and morphology of spores.

A determination of the amount of background particulate matter, fibrous materials, and skin fragments was also made, ranging from 1 (very low) to 5 (very high), to determine whether there are other substances that may be present in the environment. Appendix A shows the calibration certificate of the bio-sampler. Appendix B contains the laboratory results. Appendix C contains the laboratory chain of custody form.

The indoor samples are compared with the outdoor samples by counts and genus to evaluate whether there is a source of fungi that is not typical of the outdoor environment and is potentially growing indoors.

2.2 Volatile Organic Compounds

A photoionization detector, ppbRAE (RAE Systems, San Jose, CA) was used to detect a variety of volatile organic compounds. The gas monitor detects any compounds (mostly volatile organic compounds) that may become energized (as a positively charged ion) by the UV lamp inside the monitor. The ionized molecules release electrons when no longer exposed to the UV light. Based on the relative strength the energy released relative to that released from known concentrations of isobutylene, the concentration of all possible VOCs (i.e. total volatile organic compounds, or TVOC) is shown on the monitor display and recorded. A survey with the gas monitor was conducted by visiting the areas that were previously sampled with the VOC canisters during site visits conducted on September 19, 2019 and October 2, 2019.

The measurements in each location were reported as the range of measurements from that location, due to the variability in measurements from many sources of TVOC, particularly body odours. Any specific issues found during the survey were noted. As there is no specific compound that is identified using the gas monitor, the TVOC survey can only be used as a survey/walkthrough device to identify sources of VOCs in the building.

2.3 Temperature, Relative Humidity, Carbon Dioxide and Carbon Monoxide

An indoor air quality monitor, Q-trak (TSI Inc., Shoreview, MN), with sensors for air temperature, relative humidity (RH), carbon dioxide (CO_2) and carbon monoxide (CO) was placed in rooms where IAQ concerns were reported. These rooms include:

- Classroom 19, adjacent to the teacher's desk while the room was occupied;
- Classroom 15, at the front of the room while the room was occupied;
- Classroom 18, adjacent to the teacher's desk while the room was occupied; and
- Front office, while the room was occupied.

The data for air temperature, RH, CO_2 and CO were recorded every minute. The data was downloaded by Ivan Cheung of VOHS. The temperature and relative humidity in each room were compared to the American Society of Heating, Refrigerating and Air-Conditioning Engineers *ASHRAE Standard 55 – Thermal Environmental Conditions for Human Occupancy* (2013). Specifically, the comfortable range is within 19-23 °C and 30-60 % relative humidity. Increasing temperature can have a greater capacity for water vapour.

Carbon monoxide (CO) is a colourless, odourless, toxic gas that is a product of incomplete combustion. CO pollution occurs where combustion gasses are not properly exhausted or are re-entrained into the building. *ASHRAE Standard 62 Ventilation for Acceptable Indoor Air* (1989) indicates that levels of carbon monoxide should not exceed 9 ppm, however levels of 5 ppm indicate the undesirable presence of combustion pollutants.

Carbon dioxide (CO_2) is used as a surrogate for ventilation effectiveness. In particular, the total increase in CO_2 and the time it takes to reach an equilibrium after someone leaves the room were examined. When a room has inadequate ventilation, the CO_2 level can reach at least 700 ppm above the ambient outdoor level (which is 1100 ppm), indicating that the ventilation cannot remove CO_2 generated by the number of occupants in that room based on *ASHRAE Standard 62 Ventilation for Acceptable Indoor Air*. This can lead to symptoms of headache, dizziness, and a feeling of stuffiness in the room.

2.4 Ventilation Effectiveness

Measurement of CO_2 in rooms after occupants leave was done to estimate the ventilation rate based on the tracer gas decay method following ASTM E741. Once all the occupants leave each room, the CO_2 is removed by dilution ventilation at an exponential rate, as expressed in the following equation:

$$C(t) = C_0 \times e^{-\lambda t}$$

Where C is concentration of CO_2 above ambient conditions, C_0 is the initial concentration when occupants leave the room less that of ambient conditions, t is time elapsed since occupants leave the room, and λ represents the air change rate. To yield an air change rate in air change per hour (ACH), the time unit is in hours. By setting equation in terms of the air change rate, it can be found that the slope of the line of best fit of ln [(CO_2 in room) – (CO_2 outside)] vs. time yields the estimated air change rate.

$$\lambda = -\frac{\ln C(t) - \ln C_0}{t - t_0}$$

According to ASHRAE *Standard 62 Ventilation for Acceptable Indoor Air*, the outdoor breathing airflow required to create an indoor environment with acceptable IAQ can be determined based on the floor area and expected maximum number of occupants. In a classroom, the amount of ventilation coming from outdoors (Q) in an elementary classroom should be at least above the following:

$$Q = 5.0 \times Occupants + 0.6 \times floor\ area\ (in\ m^2), \qquad where\ Q\ is\ in\ L/s$$

Based on an expected maximum number of occupant of 20 and the floor area of 46 m^2 for larger classrooms (Room 18 and 19) and 36 m^2 for smaller classrooms (Room 15), the required airflow in the classroom should be at least 127.6 L/s in larger classrooms and 121.6 L/s in smaller classrooms. The air change rate will be compared with the ASHRAE standard.

3. Results and Interpretation

3.1 Non-Viable Airborne Mould Spore Samples

The two locations that had fungal spore concentrations higher than outdoor samples were the storage room and the office vents (Table 1). The storage room sample contained mostly basidiospores, which can be found outdoors. During the previous two site visits, the items in the storage room were removed. The odour in the storage room now indicates that there may be some dirt carried from the items in the storage room.

The sample collected in the office vents in the floor (Figure 2) had a higher concentration than the outdoor samples. In addition, most of the spores found were either *Aspergillus* sp. or *Pencillium* sp. This is typical of the environment in the crawlspace, as determined in previous reports. A sample was collected from the office vents when it was discovered that vents on the floor supplied air into the front office and the councilor's room (see Figure 1 for exact location). These vents were found to run through but not into the crawlspace.

Table 1: Concentration of Fungal Spore in Counts per Cubic Meter (Count/m^3) and Relative Amount of Fungal Spore (%) of Air Samples at Parkview Elementary.

	Outdoor Main Entrance	Outdoor Playground	Room 19	Room 15	Room 12	Room 4	Room 3	Front office	Inside Office Vents
Concentration (Count/m^3)	560	250	120	134	80	1420	200	60	1718
Ascospore (%)	17.9	0	16.7	14.9	0	7	0	0	0
Aspergillus sp. / *Pencillium* sp. (%)	3.6	0	33.3	5.2	50	0	50	33.3	87.3
Basidiospores (%)	60.7	100	16.7	74.6	50	91.5	50	66.7	11.6
Cladosporium sp. (%)	17.9	0	16.7	5.2	0	0	0	0	0.5
Myxomycetes (%)	0	0	16.7	0	0	1.4	0	0	0.5
Skin fragments (1-5)	1	1	2	2	2	1	1	2	2
Fibres (1-5)	1	1	1	1	1	1	1	1	2
Background (1-5)	1	2	3	3	2	1	1	3	3

Rounding may lead to a total percent of counts slightly above or below 100%.

In the other rooms (classrooms, kindergarten room, and front office), the concentration of fungal spores are below the concentration of outdoor samples (Table 1). All of the spores found in these rooms can be attributed to the outdoor environment. The amount of fibrous materials, skin fragments, and background dust is consistent with the locations of the samples.

Figure 2: Floor supply vent in the southeast corner (left) and southwest corner (right) in the front office. Similar supply vents are located in the councilor room and the principal's office.

3.2 Volatile Organic Compounds

Table 2 lists the total VOCs identified in the building. The main sources of TVOCs in a school building can include off-gassing from plastic objects (plastic balls, gym surface coating), body odour, and certain food items. At locations where there is higher human occupancy (such as the west section of the building), it is expected that there is a higher TVOC concentration. Examples include the gym (after students completed physical education activities), the west corridor, and the classrooms in the west section (Rooms 12 to 20).

The rooms that have an atypical concentration include the front office and the councilor room. An examination of several vents in the front office revealed that these have a higher concentration of TVOC than the rest of the office area and the copy room. This suggests that there is a source of TVOC in the vents leading into the office area, though the actual substance cannot be characterized.

The councilor room had a higher TVOC concentration than the classrooms and corridors. As the air handling unit that supplies the front office also supplies the councilor room, it is likely that the room may have accumulated more of the unknown substance through the supply vents as well. The higher concentration of TVOC suggest that more ventilation may be required.

Table 2: Total Volatile Organic Compounds as detected by a Photoionization Detector at Various Locations at Parkview Elementary.

Locations	Concentration (ppb)
Outside	0 – 20
Central Corridor	20 – 60
West Corridor	25 – 55
East Corridor	60 – 100
Copy room	80 – 110
Front office	80 – 110
Supply air vents from front office during operation	100 – 150
Room 20 (Classroom)	60 – 70
Room 19 (Classroom)	45 – 55
Room 18 (Classroom)	55 – 65
Room 17 (Classroom)	65 – 75
Room 16 (Classroom)	55 – 65
Room 15 (Classroom)	50 – 60
Room 12 (Classroom)	55 – 65
Music Room	50 – 60
Computer Room	40 – 60
Breakroom	60 – 80
Washrooms around school	60 – 90
Councilor Room	130 – 140
Kitchen	60 – 70
West Supply Closet	150 – 170
East Supply Closet	100 – 110
Multipurpose room	15 – 20
Gym (near the end of a class)	130 – 160
Room 5 (Classroom)	60 – 80
Room 4 (Storage room)	30 – 90
Room 3 (Classroom)	10 – 30
Room 2 (Classroom)	60 – 80

3.3 Temperature, Relative Humidity, Carbon Dioxide and Carbon Monoxide

The temperature and RH range are within comfortable range indoors within the three classrooms and the front office (Table 3). CO was detected up to 0.4 ppm in those rooms as well.

The concentration of CO_2 increased with human occupancy. At certain times, the concentration rose slightly above the threshold of 700 ppm above ambient concentration (i.e. 1082 ppm). This can occur earlier in the day if there are more classroom activities that involves more physical movement compared to sitting at a desk. As the samples were not collected from breathing zones of the occupants, air does not mix efficiently in a room, the CO_2 concentration may be higher than expected. Since there was no plateau concentration of CO_2 observed during sampling with up to 30 minutes of occupancy (Figure 3), it is expected that extended human occupancy and/or more vigorous human activity in a classroom would reach above the threshold limit, leading to some IAQ complaints.

Table 3: Temperature, Relative Humidity, Carbon Dioxide, and Carbon Monoxide in various locations at Parkview Elementary.

	Average CO_2 (range) (ppm)	**Temp range (°C)**	**RH range (%)**	**Average CO (range) (ppm)**
Front Office	618 (587 – 716)	19.6 – 20.9	36.5 – 43.5	0.2 (0 – 0.4)
Room 19 (during class for the first half and PE class in the 2nd half)	768 (621 – 1051)	20.6 – 22.6	34.6 – 37.8	0.1 (0 – 0.4)
Room 15 (During and after lunch class, before assembly in gym)	777 (559 – 1013)	19.2 – 21.0	37.2 – 42.2	0 (0 – 0.1)
Room 18 (End of day; data collection started right before roll call)	984 (792 - 1171)	20.0 – 22.0	38.2 – 44.3	0
Outside	382 (366 – 416)	3.9 – 5.9	66.0 – 90.4	0.1 (0 – 0.1)

3.4 Ventilation Effectiveness

Based on the slope of the line of best fit (Figure 4), the larger classrooms (Room 18 and 19) had approximately 0.03 air changes per hour, while the smaller classroom (Room 15) had approximately 0.017 air changes per hour. Based on the approximate volume of the larger classrooms (115 m^3) and smaller classroom (90 m^3), this corresponds to roughly 1 L/s and 0.4 L/s respectively. This is well below the ASHRAE standard's recommended airflow for an acceptable indoor environment in these classrooms.

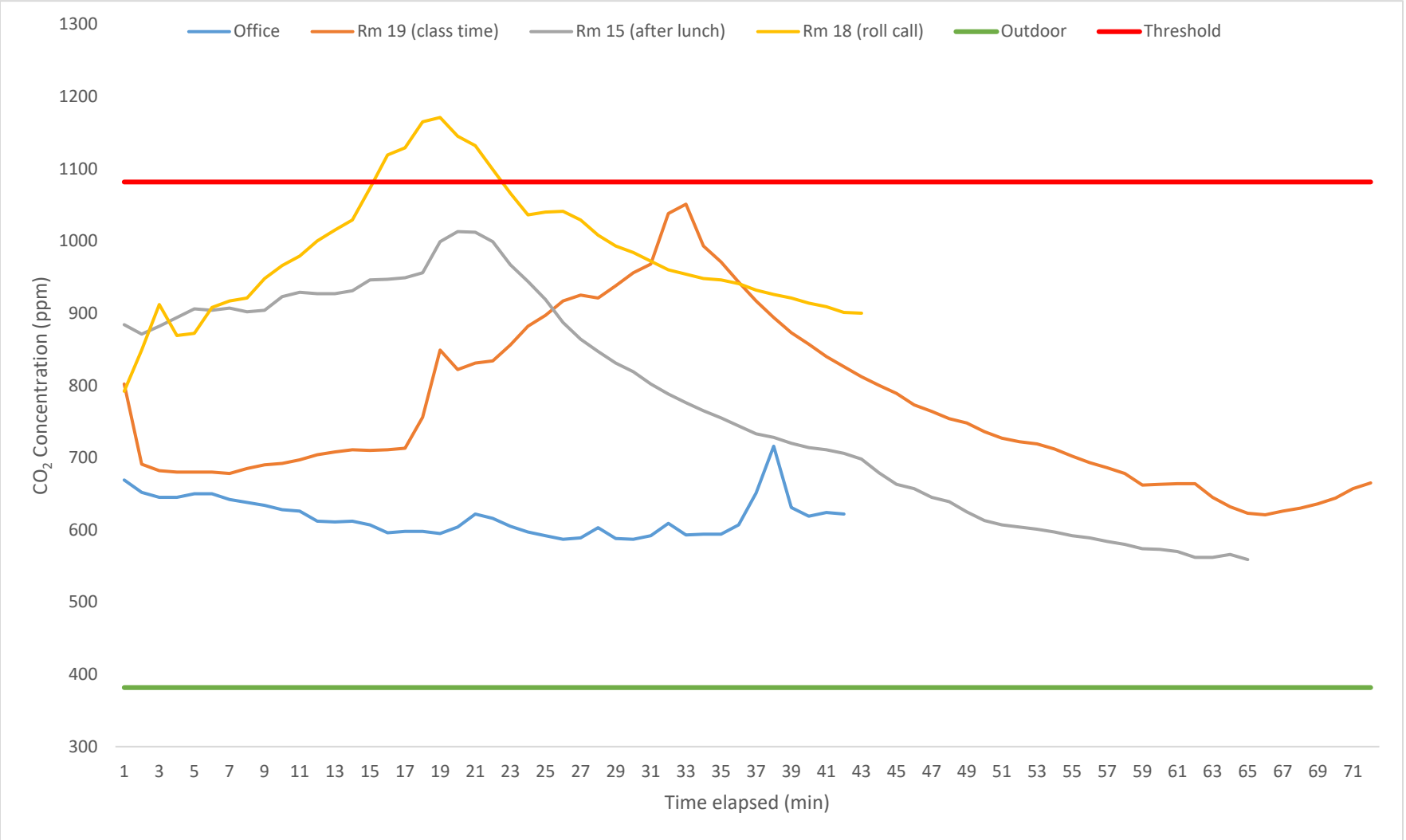


Figure 3: CO_2 concentration in rooms at Parkview Elementary. The concentration rises with human occupancy and human activity. Given enough time and/or more vigorous activity, the amount of CO_2 can rise above the guideline threshold of 700 ppm above ambient outdoor concentration. The CO_2 concentration also drops when occupants leave the room.

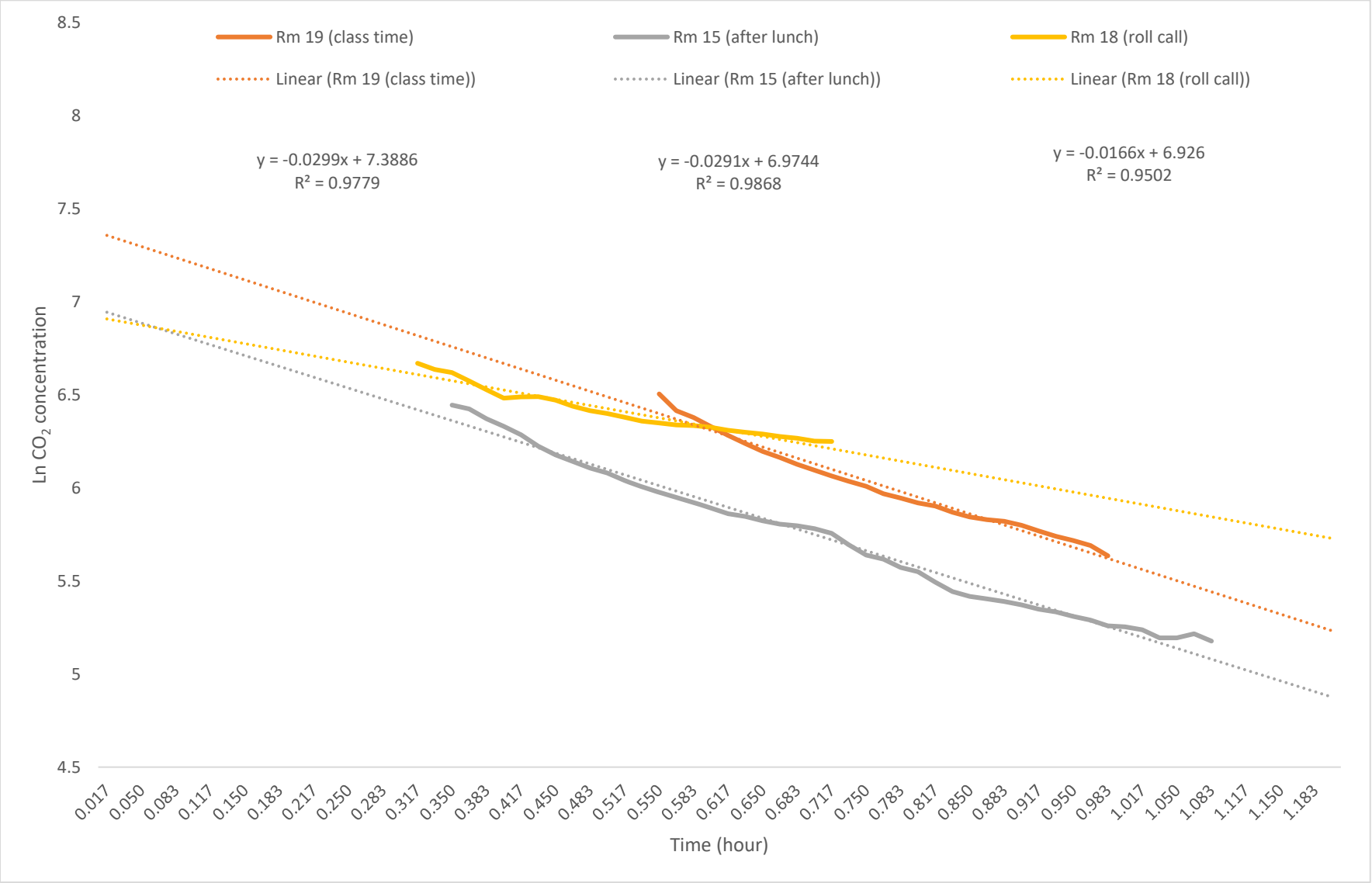


Figure 4: Ln CO_2 concentration vs. time in three classrooms at Parkview Elementary. The slope of the line of best fit represents the air change rate (1/hour). The equation of the line of best fit is displayed below the legend corresponding to each of the classrooms.

4. Recommendations

- Communicate the findings of this investigation to the occupants and joint health and safety committee.

- Clean the duct system responsible for supplying air to the office. Particularly, focus on the ducts that run through the crawlspace. Inspect the ducts to ensure there are no penetrations that allow crawlspace air to enter the ducts.

- Increase the ventilation rate for the classrooms. Examine the ventilation rate in classrooms after the increase to ensure that it meets the minimal airflow as recommended by *ASHRAE Standard 62 Ventilation for Acceptable Indoor Air*. Consider retaining a ventilation engineer to confirm that the ventilation rate is sufficient.

5. Limitations

- The TVOC measurement only indicates the sources and concentration of VOC and does not characterize them.

- A strong limitation of using CO_2 as the tracer gas in this analysis is that humans and other organisms can produce it, leading to underestimated air change rates as measured. Despite that, there is approximately a hundred-fold difference between the measured air change rate and the ASHRAE standard recommended ventilation rate.

- This report was intended only for the sole use of School District 83 and not for other third parties, no other warrantee, expressed or implied was made. VOHS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

- The information and conclusions provided in this report was based on the scope of work agreed upon.

- Nothing in this report is intended to express any legal opinion or whether conditions conform to regulatory requirements.

- The report has been prepared in accordance with best occupational health and safety and industrial hygiene practices and professional expertise of those who were involved and signed.

- Changes to the properties use, condition, circumstances or environment could impact and alter the conclusions of this report.

- VOHS Group is not responsible for any damages resulting from carrying out the defined scope of work. VOHS Group is only responsible for damages resulting from negligence of VOHS Group.

Report Completed By

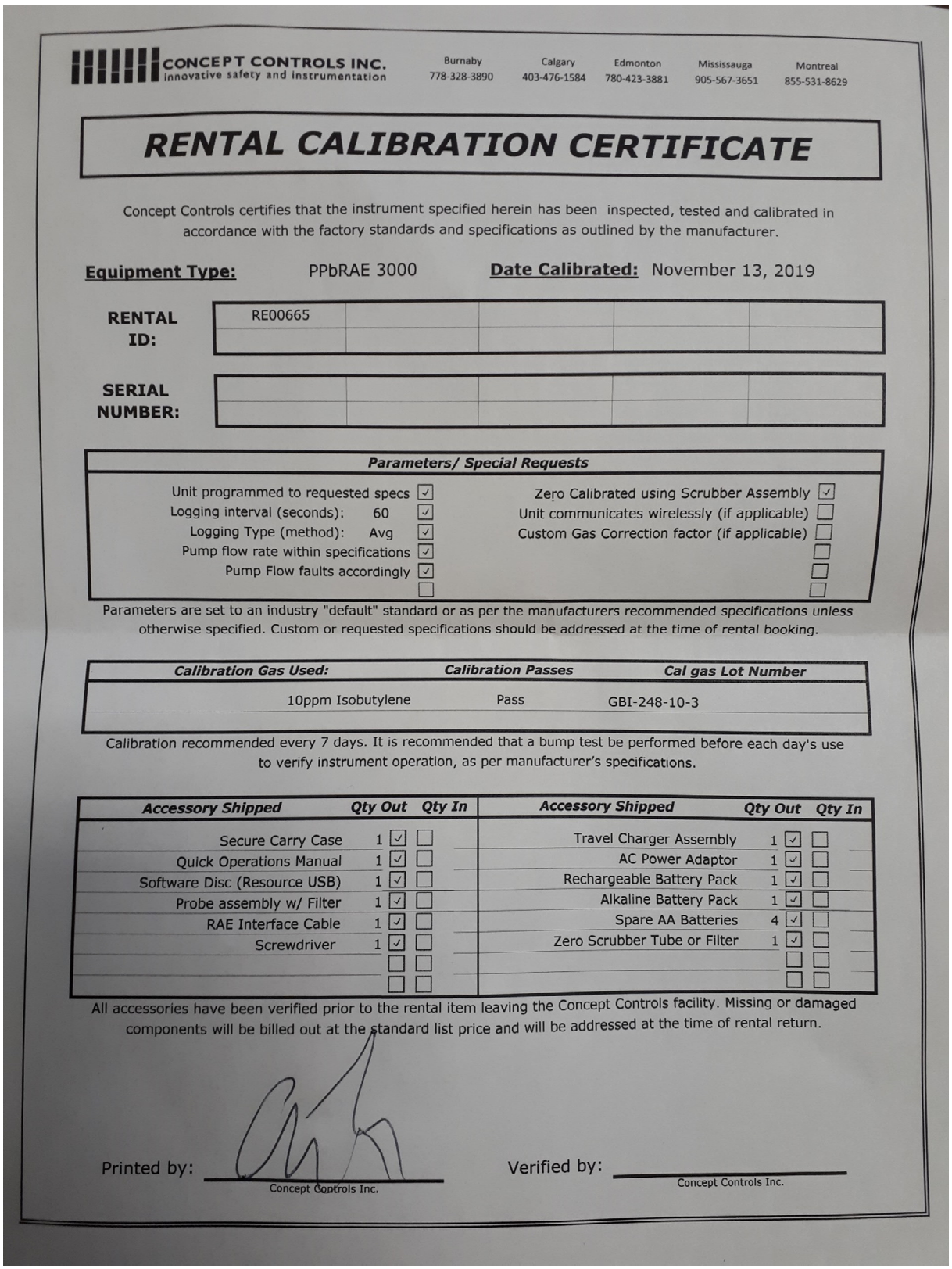
Ivan Cheung, M.Sc.
Occupational Hygiene Specialist
(604) 379-1897 | ivan@vohsgroup.com

Anna Rybczynski BSc., CRSP
OHS Consultant
(236) 838-8009 |anna@vohsgroup.com

Report Reviewed By

Robin Van Driel M.Sc., CIH, ROH, CRSP
Principal, Sr. Occupational Hygienist
(778) 879-8009 | robin@vohsgroup.com

Appendix A: Certificate of Calibration



CONCEPT CONTROLS INC.
innovative safety and instrumentation

Burnaby	Calgary	Edmonton	Mississauga	Montreal
778-328-3890	403-476-1584	780-423-3881	905-567-3651	855-531-8629

RENTAL CALIBRATION CERTIFICATE

Concept Controls certifies that the instrument specified herein has been inspected, tested and calibrated in accordance with the factory standards and specifications as outlined by the manufacturer.

Equipment Type: PPbRAE 3000 **Date Calibrated:** November 13, 2019

RENTAL ID: RE00665

SERIAL NUMBER:

Parameters/ Special Requests

Unit programmed to requested specs	☑	Zero Calibrated using Scrubber Assembly	☑
Logging interval (seconds): 60	☑	Unit communicates wirelessly (if applicable)	☐
Logging Type (method): Avg	☑	Custom Gas Correction factor (if applicable)	☐
Pump flow rate within specifications	☑		☐
Pump Flow faults accordingly	☑		☐
	☐		☐

Parameters are set to an industry "default" standard or as per the manufacturers recommended specifications unless otherwise specified. Custom or requested specifications should be addressed at the time of rental booking.

Calibration Gas Used:	*Calibration Passes*	*Cal gas Lot Number*
10ppm Isobutylene	Pass	GBI-248-10-3

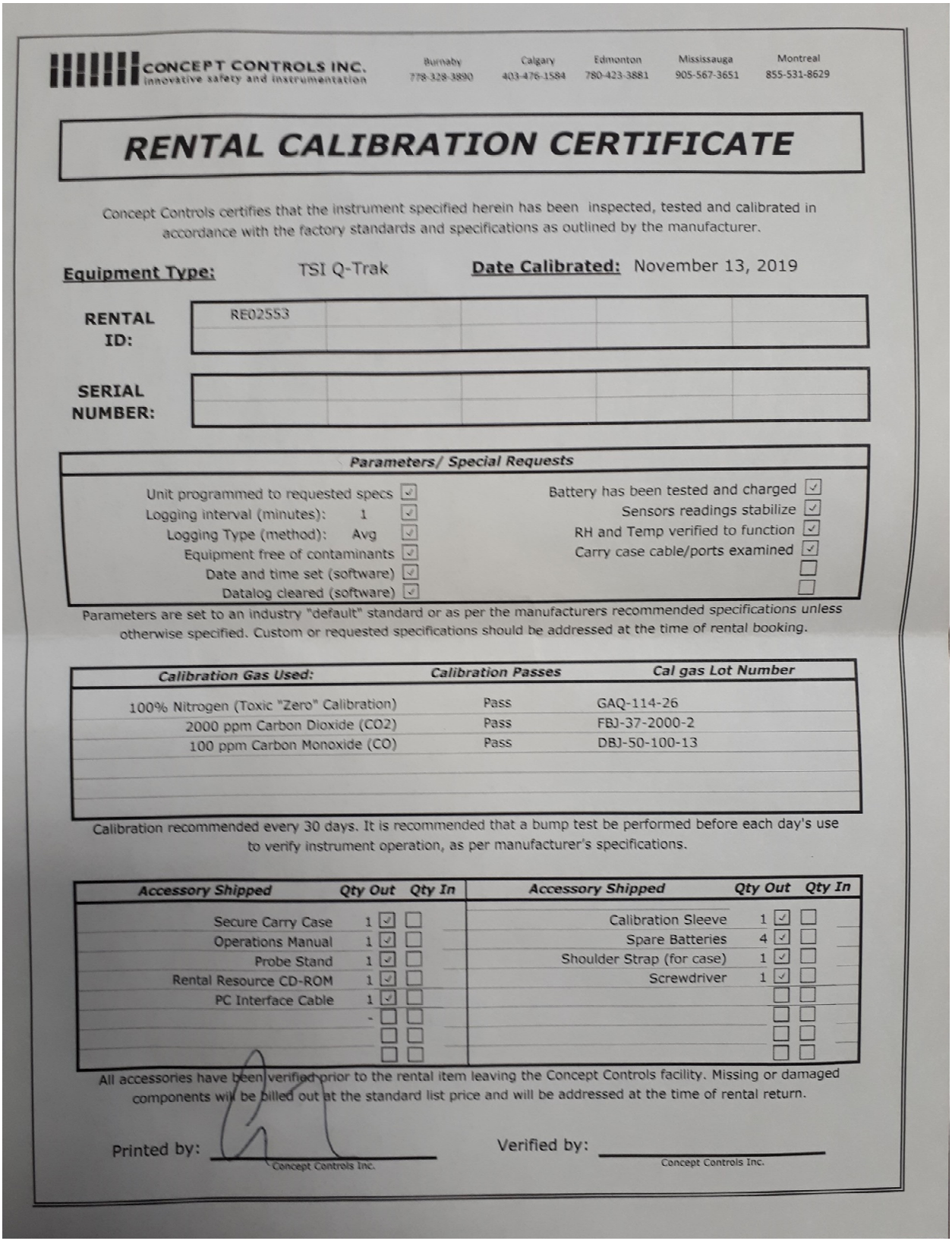
Calibration recommended every 7 days. It is recommended that a bump test be performed before each day's use to verify instrument operation, as per manufacturer's specifications.

Accessory Shipped	*Qty Out*	*Qty In*	*Accessory Shipped*	*Qty Out*	*Qty In*
Secure Carry Case	1 ☑	☐	Travel Charger Assembly	1 ☑	☐
Quick Operations Manual	1 ☑	☐	AC Power Adaptor	1 ☑	☐
Software Disc (Resource USB)	1 ☑	☐	Rechargeable Battery Pack	1 ☑	☐
Probe assembly w/ Filter	1 ☑	☐	Alkaline Battery Pack	1 ☑	☐
RAE Interface Cable	1 ☑	☐	Spare AA Batteries	4 ☑	☐
Screwdriver	1 ☑	☐	Zero Scrubber Tube or Filter	1 ☑	☐
	☐	☐		☐	☐
	☐	☐		☐	☐

All accessories have been verified prior to the rental item leaving the Concept Controls facility. Missing or damaged components will be billed out at the standard list price and will be addressed at the time of rental return.

Printed by: _____ Concept Controls Inc.

Verified by: _____ Concept Controls Inc.



CONCEPT CONTROLS INC.
innovative safety and instrumentation

Burnaby	Calgary	Edmonton	Mississauga	Montreal
778-328-3890	403-476-1584	780-423-3881	905-567-3651	855-531-8629

RENTAL CALIBRATION CERTIFICATE

Concept Controls certifies that the instrument specified herein has been inspected, tested and calibrated in accordance with the factory standards and specifications as outlined by the manufacturer.

Equipment Type: TSI Q-Trak **Date Calibrated:** November 13, 2019

RENTAL ID: RE02553

SERIAL NUMBER:

Parameters/ Special Requests

Unit programmed to requested specs	☑	Battery has been tested and charged	☑
Logging interval (minutes): 1	☑	Sensors readings stabilize	☑
Logging Type (method): Avg	☑	RH and Temp verified to function	☑
Equipment free of contaminants	☑	Carry case cable/ports examined	☑
Date and time set (software)	☑		☐
Datalog cleared (software)	☑		☐

Parameters are set to an industry "default" standard or as per the manufacturers recommended specifications unless otherwise specified. Custom or requested specifications should be addressed at the time of rental booking.

Calibration Gas Used:	Calibration Passes	Cal gas Lot Number
100% Nitrogen (Toxic "Zero" Calibration)	Pass	GAQ-114-26
2000 ppm Carbon Dioxide (CO_2)	Pass	FBJ-37-2000-2
100 ppm Carbon Monoxide (CO)	Pass	DBJ-50-100-13

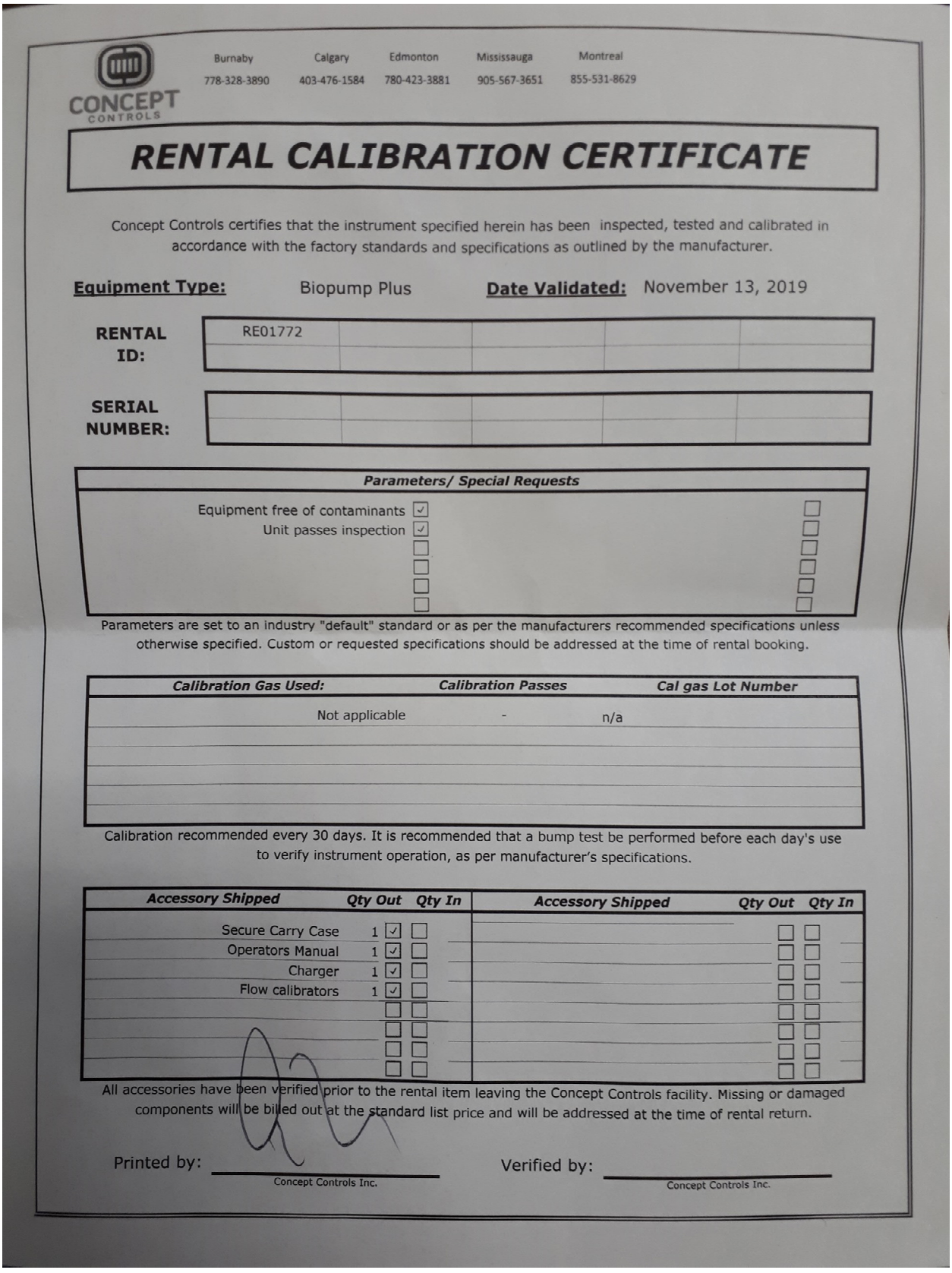
Calibration recommended every 30 days. It is recommended that a bump test be performed before each day's use to verify instrument operation, as per manufacturer's specifications.

Accessory Shipped	Qty Out	Qty In	Accessory Shipped	Qty Out	Qty In
Secure Carry Case	1 ☑	☐	Calibration Sleeve	1 ☑	☐
Operations Manual	1 ☑	☐	Spare Batteries	4 ☑	☐
Probe Stand	1 ☑	☐	Shoulder Strap (for case)	1 ☑	☐
Rental Resource CD-ROM	1 ☑	☐	Screwdriver	1 ☑	☐
PC Interface Cable	1 ☑	☐		☐	☐
	- ☐	☐		☐	☐
	☐	☐		☐	☐
	☐	☐		☐	☐

All accessories have been verified prior to the rental item leaving the Concept Controls facility. Missing or damaged components will be billed out at the standard list price and will be addressed at the time of rental return.

Printed by: _____ Concept Controls Inc.

Verified by: _____ Concept Controls Inc.



CONCEPT CONTROLS

Burnaby	Calgary	Edmonton	Mississauga	Montreal
778-328-3890	403-476-1584	780-423-3881	905-567-3651	855-531-8629

RENTAL CALIBRATION CERTIFICATE

Concept Controls certifies that the instrument specified herein has been inspected, tested and calibrated in accordance with the factory standards and specifications as outlined by the manufacturer.

Equipment Type: Biopump Plus **Date Validated:** November 13, 2019

RENTAL ID: RE01772

SERIAL NUMBER:

Parameters/ Special Requests			
Equipment free of contaminants	☑		☐
Unit passes inspection	☑		☐
	☐		☐
	☐		☐
	☐		☐
	☐		☐

Parameters are set to an industry "default" standard or as per the manufacturers recommended specifications unless otherwise specified. Custom or requested specifications should be addressed at the time of rental booking.

Calibration Gas Used:	Calibration Passes	Cal gas Lot Number
Not applicable	-	n/a

Calibration recommended every 30 days. It is recommended that a bump test be performed before each day's use to verify instrument operation, as per manufacturer's specifications.

Accessory Shipped	Qty Out	Qty In	Accessory Shipped	Qty Out	Qty In
Secure Carry Case	1 ☑	☐		☐	☐
Operators Manual	1 ☑	☐		☐	☐
Charger	1 ☑	☐		☐	☐
Flow calibrators	1 ☑	☐		☐	☐
	☐	☐		☐	☐
	☐	☐		☐	☐
	☐	☐		☐	☐
	☐	☐		☐	☐

All accessories have been verified prior to the rental item leaving the Concept Controls facility. Missing or damaged components will be billed out at the standard list price and will be addressed at the time of rental return.

Printed by: _____ Concept Controls Inc.

Verified by: _____ Concept Controls Inc.

Appendix B: Laboratory Result

EMSL Canada Inc.
4506 Dawson Street Burnaby, BC V5C 4C1
Tel/Fax: (604) 757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order: 691903029
Customer ID: 55VAND29
Customer PO:
Project ID:

Attn: Ivan Cheung
VanDriel OHS Consulting
PO Box 19098 Fourth Ave PO
Vancouver, BC V6K 4R8

Phone: (778) 879-8009
Fax:
Collected: 11/15/2019
Received: 11/18/2019
Analyzed: 12/03/2019

Project: 1911/SD83

Test Report: Air-O-Cell(™) Analysis of Fungal Spores & Particulates by Optical Microscopy (Methods MICRO-SOP-201, ASTM D7391)

Lab Sample Number:	**691903029-0001**			**691903029-0002**			**691903029-0003**		
Client Sample ID:	**01**			**02**			**03**		
Volume (L):	**150**			**150**			**150**		
Sample Location	**Room 19**			**Office**					
Spore Types	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**
Alternaria (Ulocladium)	-	-	-	-	-	-	-	-	-
Ascospores	1	20	16.7	-	-	-	-	-	-
Aspergillus/Penicillium	2	40	33.3	1	20	33.3	-	-	-
Basidiospores	1	20	16.7	2	40	66.7	-	-	-
Bipolaris++	-	-	-	-	-	-	-	-	-
Chaetomium	-	-	-	-	-	-	-	-	-
Cladosporium	1	20	16.7	-	-	-	-	-	-
Curvularia	-	-	-	-	-	-	-	-	-
Epicoccum	-	-	-	-	-	-	-	-	-
Fusarium	-	-	-	-	-	-	-	-	-
Ganoderma	-	-	-	-	-	-	-	-	-
Myxomycetes++	1	20	16.7	-	-	-	-	-	-
Pithomyces++	-	-	-	-	-	-	-	-	-
Rust	-	-	-	-	-	-	-	-	-
Scopulariopsis/Microascus	-	-	-	-	-	-	-	-	-
Stachybotrys/Memnoniella	-	-	-	-	-	-	-	-	-
Unidentifiable Spores	-	-	-	-	-	-	-	-	-
Zygomycetes	-	-	-	-	-	-	-	-	-
Total Fungi	**6**	**120**	**100**	**3**	**60**	**100**	**-**	**None Detect**	**-**
Hyphal Fragment	1*	7*	-	-	-	-	-	-	-
Insect Fragment	-	-	-	-	-	-	-	-	-
Pollen	-	-	-	-	-	-	-	-	-
Analyt. Sensitivity 600x	-	21	-	-	21	-	-	21	-
Analyt. Sensitivity 300x	-	7*	-	-	7*	-	-	7*	-
Skin Fragments (1-4)	-	2	-	-	2	-	-	1	-
Fibrous Particulate (1-4)	-	1	-	-	1	-	-	1	-
Background (1-5)	-	3	-	-	3	-	-	1	-

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

Nicole Yeo, 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 Canada Inc. Mississauga, ON A2LA Accredited Cert #2845.08; AIHA-LAP, LLC - EMLAP #196142

Initial report from: 12/03/2019 13:54:35

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: 12/03/2019 13:54 PM

Page 1 of 4

EMSL Canada Inc.
4506 Dawson Street Burnaby, BC V5C 4C1
Tel/Fax: (604) 757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order: 691903029
Customer ID: 55VAND29
Customer PO:
Project ID:

Attn: Ivan Cheung
VanDriel OHS Consulting
PO Box 19098 Fourth Ave PO
Vancouver, BC V6K 4R8

Phone: (778) 879-8009
Fax:
Collected: 11/15/2019
Received: 11/18/2019
Analyzed: 12/03/2019

Project: 1911/SD83

Test Report: Air-O-Cell(™) Analysis of Fungal Spores & Particulates by Optical Microscopy (Methods MICRO-SOP-201, ASTM D7391)

Lab Sample Number:	691903029-0004			691903029-0005			691903029-0006		
Client Sample ID:	04			05			06		
Volume (L):	150			150			150		
Sample Location	Main			Room 4			Room 3		
Spore Types	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**
Alternaria (Ulocladium)	-	-	-	-	-	-	-	-	-
Ascospores	5	100	17.9	7	100	7	-	-	-
Aspergillus/Penicillium	1	20	3.6	-	-	-	5	100	50
Basidiospores	16	340	60.7	61	1300	91.5	7	100	50
Bipolaris++	-	-	-	-	-	-	-	-	-
Chaetomium	-	-	-	-	-	-	-	-	-
Cladosporium	5	100	17.9	-	-	-	-	-	-
Curvularia	-	-	-	-	-	-	-	-	-
Epicoccum	-	-	-	-	-	-	-	-	-
Fusarium	-	-	-	-	-	-	-	-	-
Ganoderma	-	-	-	-	-	-	-	-	-
Myxomycetes++	-	-	-	1	20	1.4	-	-	-
Pithomyces++	-	-	-	-	-	-	-	-	-
Rust	-	-	-	-	-	-	-	-	-
Scopulariopsis/Microascus	-	-	-	-	-	-	-	-	-
Stachybotrys/Memnoniella	-	-	-	-	-	-	-	-	-
Unidentifiable Spores	-	-	-	-	-	-	-	-	-
Zygomycetes	-	-	-	-	-	-	-	-	-
Total Fungi	**27**	**560**	**100**	**69**	**1420**	**100**	**12**	**200**	**100**
Hyphal Fragment	-	-	-	-	-	-	-	-	-
Insect Fragment	-	-	-	-	-	-	-	-	-
Pollen	-	-	-	-	-	-	-	-	-
Analyt. Sensitivity 600x	-	21	-	-	21	-	-	21	-
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.

Nicole Yeo, 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 Canada Inc. Mississauga, ON A2LA Accredited Cert #2845.08; AIHA-LAP, LLC - EMLAP #196142

Initial report from: 12/03/2019 13:54:35

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

EMSL Canada Inc.
4506 Dawson Street Burnaby, BC V5C 4C1
Tel/Fax: (604) 757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order: 691903029
Customer ID: 55VAND29
Customer PO:
Project ID:

Attn: Ivan Cheung
VanDriel OHS Consulting
PO Box 19098 Fourth Ave PO
Vancouver, BC V6K 4R8

Phone: (778) 879-8009
Fax:
Collected: 11/15/2019
Received: 11/18/2019
Analyzed: 12/03/2019

Project: 1911/SD83

Test Report: Air-O-Cell(™) Analysis of Fungal Spores & Particulates by Optical Microscopy (Methods MICRO-SOP-201, ASTM D7391)

Lab Sample Number:	691903029-0007			691903029-0008			691903029-0009		
Client Sample ID:	07			08			09		
Volume (L):	150			150			150		
Sample Location	Room 15			Room 12			South		
Spore Types	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**
Alternaria (Ulocladium)	-	-	-	-	-	-	-	-	-
Ascospores	1	20	14.9	-	-	-	-	-	-
Aspergillus/Penicillium	1*	7*	5.2	2	40	50	-	-	-
Basidiospores	6	100	74.6	2	40	50	12	250	100
Bipolaris++	-	-	-	-	-	-	-	-	-
Chaetomium	-	-	-	-	-	-	-	-	-
Cladosporium	1*	7*	5.2	-	-	-	-	-	-
Curvularia	-	-	-	-	-	-	-	-	-
Epicoccum	-	-	-	-	-	-	-	-	-
Fusarium	-	-	-	-	-	-	-	-	-
Ganoderma	-	-	-	-	-	-	-	-	-
Myxomycetes++	-	-	-	-	-	-	-	-	-
Pithomyces++	-	-	-	-	-	-	-	-	-
Rust	-	-	-	-	-	-	-	-	-
Scopulariopsis/Microascus	-	-	-	-	-	-	-	-	-
Stachybotrys/Memnoniella	-	-	-	-	-	-	-	-	-
Unidentifiable Spores	-	-	-	-	-	-	-	-	-
Zygomycetes	-	-	-	-	-	-	-	-	-
Total Fungi	**9**	**134**	**100**	**4**	**80**	**100**	**12**	**250**	**100**
Hyphal Fragment	1	20	-	-	-	-	-	-	-
Insect Fragment	-	-	-	-	-	-	-	-	-
Pollen	1	20	-	-	-	-	-	-	-
Analyt. Sensitivity 600x	-	21	-	-	21	-	-	21	-
Analyt. Sensitivity 300x	-	7*	-	-	7*	-	-	7*	-
Skin Fragments (1-4)	-	2	-	-	2	-	-	1	-
Fibrous Particulate (1-4)	-	1	-	-	1	-	-	1	-
Background (1-5)	-	3	-	-	2	-	-	2	-

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

Nicole Yeo, 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 Canada Inc. Mississauga, ON A2LA Accredited Cert #2845.08; AIHA-LAP, LLC - EMLAP #196142

Initial report from: 12/03/2019 13:54:35

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: 12/03/2019 13:54 PM

Page 3 of 4

EMSL Canada Inc.
4506 Dawson Street Burnaby, BC V5C 4C1
Tel/Fax: (604) 757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order: 691903029
Customer ID: 55VAND29
Customer PO:
Project ID:

Attn: Ivan Cheung
VanDriel OHS Consulting
PO Box 19098 Fourth Ave PO
Vancouver, BC V6K 4R8

Phone: (778) 879-8009
Fax:
Collected: 11/15/2019
Received: 11/18/2019
Analyzed: 12/03/2019

Project: 1911/SD83

Test Report: Air-O-Cell(™) Analysis of Fungal Spores & Particulates by Optical Microscopy (Methods MICRO-SOP-201, ASTM D7391)

Lab Sample Number:	691903029-0010		
Client Sample ID:	10		
Volume (L):	105		
Sample Location	Inside vent office		
Spore Types	**Raw Count**	**Count/m³**	**% of Total**
Alternaria (Ulocladium)	-	-	-
Ascospores	-	-	-
Aspergillus/Penicillium	51	1500	87.3
Basidiospores	8	200	11.6
Bipolaris++	-	-	-
Chaetomium	-	-	-
Cladosporium	1*	9*	0.5
Curvularia	-	-	-
Epicoccum	-	-	-
Fusarium	-	-	-
Ganoderma	-	-	-
Myxomycetes++	1*	9*	0.5
Pithomyces++	-	-	-
Rust	-	-	-
Scopulariopsis/Microascus	-	-	-
Stachybotrys/Memnoniella	-	-	-
Unidentifiable Spores	-	-	-
Zygomycetes	-	-	-
Total Fungi	**61**	**1718**	**100**
Hyphal Fragment	1*	9*	-
Insect Fragment	-	-	-
Pollen	-	-	-
Analyt. Sensitivity 600x	-	30	-
Analyt. Sensitivity 300x	-	9*	-
Skin Fragments (1-4)	-	2	-
Fibrous Particulate (1-4)	-	2	-
Background (1-5)	-	3	-

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

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

Nicole Yeo, Laboratory Manager
or other approved signatory

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 Canada Inc. Mississauga, ON A2LA Accredited Cert #2845.08; AIHA-LAP, LLC - EMLAP #196142

Initial report from: 12/03/2019 13:54:35

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

Appendix C: Chain of Custody Form

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

RD3Y-EHXF-TUFH

6919030 29

Client Information
VanDriel OHS Consulting
Vancouver, BC

Project Overview
PO Number
Project Name SD83
Project ID 1911
Client
Special Instructions
Bill To 55VAND29
Report As

Project Site
Address 1 605 Parksville Street
Address 2
City Sicamous
State BC
Country CAN

Testing Laboratory
EMSL Analytical
4506 Dawson Street
Burnaby, BC

Sample ID	Location	Date/Time Collected	Total Area/Volume	Test Method	TAT
01	Room 19	Nov 15, 2019 11:02 AM	150 L	Spore Trap	2 Week
02	Office	Nov 15, 2019 11:01 AM	150 L	Spore Trap	2 Week
03		Nov 15, 2019 11:10 AM	150 L	Spore Trap	2 Week
04	Main	Nov 15, 2019 11:13 AM	150 L	Spore Trap	2 Week
05	Room 4	Nov 15, 2019 11:05 AM	150 L	Spore Trap	2 Week
06	Room 3	Nov 15, 2019 11:08 AM	150 L	Spore Trap	2 Week
07	Room 15	Nov 15, 2019 11:08 AM	150 L	Spore Trap	2 Week
08	Room 12	Nov 15, 2019 11:17 AM	150 L	Spore Trap	2 Week
09	South	Nov 15, 2019 11:40 AM	150 L	Spore Trap	2 Week
10	Inside vent office	Nov 15, 2019 12:20 PM	105 L	Spore Trap	2 Week

Sampled By / Date — Nov 18, 2019 8:41 am

Relinquished By / Date — Nov 18, 2019 8:41 am

Received (Lab) / Date

NOV18 19 4:47PM
Courier

Page 1 of 1

Page 1 of 1

OrderID: 69190302 9