VOLATILE ORGANIC COMPOUND SAMPLING
ARTS AND SCIENCE BUILDING
SIR WILFRED GRENFELL COLLEGE
CORNER BROOK, NL

Prepared for:

SIR WILFRED GRENFELL COLLEGE
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ATTENTION: MR. DAVID STURGE

Prepared by:
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January 10, 2014

Pinchin LeBlanc Environmental Project: 07-03-00068

EXECUTIVE SUMMARY

Pinchin LeBlanc Environmental Limited (Pinchin) was retained by Mr. David Sturge of Sir Wilfred Grenfell College (SWGC) to conduct Volatile Organic Compounds (VOC) sampling by use of 3M Organic Vapour Monitor 3520 dosimeter badges. Monitoring was also conducted for temperature (^{0}C) and relative humidity (%) in the sample locations. The sampling was conducted in the Resource Centre Copier Room and the C and C Office Hallway located on the second floor of the Arts & Science building of SWGC in Corner Brook, NL. Ms. Karla Coles performed the assessment on December 9 - 10, 2013.

An initial assessment was conducted from October 12 - 14, 2013 as a result of air quality concerns during the application of the floor sealant in the gymnasium. The TVOC readings collected throughout the Arts & Science Building on October 12, 2013 exceeded the Health Canada suggested comfort level of 0.4 ppm where complaints may be expected. It was recommended to increase fresh air levels into the Gymnasium and exhaust VOC laden air to the outside.

For this round of sampling, spot check monitoring for the IAQ parameters, temperature and relative humidity was conducted and two (2) VOC station air samples were placed in the Resource Centre Copier Room and the Hallway of the C and C. All measured parameters were within acceptable levels.

TABLE OF CONTENTS

Appendices

1.0 INTRODUCTION AND SCOPE

1.1 Statement of Understanding

Pinchin LeBlanc Environmental Limited (Pinchin) was retained by Mr. David Sturge of Sir Wilfred Grenfell College (SWGC) to conduct Volatile Organic Compounds (VOC) sampling by use of 3M Organic Vapour Monitor 3520 dosimeter badges. Monitoring was also conducted for temperature (^{0}C) and relative humidity (%) in the sample locations. The sampling was conducted in the Resource Centre Copier Room and the C and C Office area located on the second floor of the Arts & Science building of SWGC in Corner Brook, NL. Ms. Karla Coles performed the assessment from December 9 - 10, 2013.

An initial assessment was conducted from October 12 - 14, 2013 as a result of air quality concerns during the application of floor sealant in the gymnasium. The TVOC readings collected throughout the Arts & Science Building on October 12, 2013 exceeded the Health Canada suggested comfort level of 0.4 ppm where complaints may be expected. It was recommended to increase fresh air levels into the Gymnasium and exhaust VOC laden air to the outside. Sampling was continuous until the levels dropped below the Health Canada Guideline.

Subsequent sampling programs have indicated that airborne TVOC level were below the Health Canada Guideline.

Previous Reports are presented in Appendix I and II.

1.2 Scope of Work

This assessment was limited to the Resource Centre and the C and C office area located on the second floor of SWGC and involved the following activities:

- Development of a sampling strategy;
- Measurement of the following indoor air quality (IAQ) factors:
  - Temperature;
  - Relative Humidity; and
  - Volatile Organic Compounds
- Preparation of this report.

1.3 Assessment Methodology

The investigator interviewed the SWGC representative to discuss the sampling strategy and occupants in the Resource Centre and the C and C offices to discuss the history of the office space and any indoor air quality complaints. It was reported that since the sealant was applied to

the gymnasium floor, there are still concerns with the odour migrating to other areas of the building.

1.4 Test Methods

IAQ parameter measurements for temperature and relative humidity were made using direct reading equipment. The consultant collected spot check measurements using a TSI brand Q-Trak IAQ monitor. The instrument was calibrated prior to use.

Continuous monitoring for volatile organic compounds (VOC's) was conducted with the use of 3M Organic Vapour Monitor 3520 dosimeter badges. This type of monitoring relies on passive diffusion to adsorb chemicals from an atmosphere having a greater chemical concentration outside the monitor compared to the concentration inside the monitor. It occurs because molecules naturally tend to move from an area of high concentration to an area of low concentration. A sorbent material inside the monitor adsorbs the gas or vapour until the concentration inside the monitor is greater than that outside. The monitors were placed in the Resource Centre Copier Room and the C and C Hallway.

All sampling was performed in compliance with current professional practice[1].

1.5 Sample Analysis

The VOC samples were analyzed at Maxxam Analytics in Bedford, NS.

2.0 ASSESSMENT AND FINDINGS

2.1 Facility Description

The Arts & Science building is a three storey structure with basement. The gymnasium is located in the southwest corner of the building. The Resource Centre and the C and C office area are located on the second floor on the south wing of the building.

2.1.1 Results of Interview

The following information was reported to the consultant by the SWGC representative:

- The HVAC unit has been turned off since the floor sealant application and three exhaust fans have been placed in the gymnasium exhausting to the exterior. The HVAC unit was turned on for a brief time on November 27, 2013 but turned off again, the same day, due to odour complaints by the occupants in the area. During this round of sampling, all HVAC units were running as per normal operations.

[1] American Industrial Hygiene Association: Field Guide for the Determination of Biological Contaminants in Environmental Samples. H.K. Dillon, P.A. Heinsohn, and J.D. Miller, Eds. AIHA, Fairfax, VA (1996).

2.2 Results of Indoor Air Quality Monitoring

2.2.1 Thermal Comfort

2.2.1.1 Background

Temperature and relative humidity contribute substantially to occupants' sense of comfort in a space. Due to individual differences, it is difficult to provide a thermal environment that will satisfy all occupants. ASHRAE Standard 55-2010, Thermal Environmental Conditions for Human Occupancy, suggests sets of thermal factors that can be expected to satisfy at least 80% of occupants. A comprehensive thermal assessment to comply with the Standard would require a review of all of the following factors: dry bulb air temperature; globe temperature (measuring the air temperature plus the effects of radiant heating or cooling by radiant heating systems or hot or cold adjacent surfaces); air speed; clothing type; occupant activity; floor temperature; differences between air temperature and temperatures of ceilings or walls; differences between temperatures at the ankles and head; and stability of temperature with time.

In many indoor environments without significantly cool or warm surfaces or drafts and with stable temperatures, the dry bulb temperature alone can be used to predict occupants' satisfaction with the thermal environment. Based on ASHRAE Standard 55-2010, under these conditions the following temperature ranges would be expected to satisfy at least 80% of persons seasonally dressed and performing mostly sedentary office-type activities:

- In summer, 23 – 27°C at typical relative humidity of 30%.
- In winter, 21 – 25°C at typical relative humidity of 30%.

While ASHRAE Standard 55 does not recommend ranges for acceptable relative humidity, too high or too low levels of relative humidity should be avoided. Relative humidity should be maintained between 30% and 65%. The lower limit is specified to help prevent dry nasal passages, itchy eyes, coughing, and exacerbation of cold and flu symptoms. The upper limit is set to prevent potential microbiological growth on building finishes.

2.2.1.2 Summary of Data

Throughout the investigation, the outdoor temperature was approximately -5.0°C and the outdoor relative humidity was approximately 87%. Based on the exterior temperature, and the time of year, the best-suited comfort range would be the winter range (21 to 25°C).

Spot check indoor temperature measurements collected were both 18.0 °C.

Spot check relative humidity measurements collected was 25.3% in the Copier Room and 26.4% in the C and C office area.

2.2.1.3 Conclusions and Recommendations

Temperature

Spot check measurements were below the ASHRAE recommended winter range (21 to 25 °C).

Relative Humidity

Spot check measurements were below the ASHRAE recommended range (30 - 65 %).

Recommendation: Temperature and relative humidity should be maintained within their recommended ranges to avoid occupant discomfort.

2.2.2 Volatile Organic Compounds (VOC) Monitoring

2.2.2.1 Background

The air sample results are compared to current standards and guidelines as published by the American Conference of Governmental Industrial Hygienists (ACGIH) 2013 edition. The Newfoundland and Labrador Occupational Health and Safety Act & Regulation 70/90, under the heading Hazardous Substances, Section 42 (7) (c) states that exposure of a worker to hazardous substances is as minimal as is reasonably practicable, and where a threshold limit value has been established by the American Conference of Governmental Industrial Hygienists (ACGIH), exposure shall not exceed the threshold limit value (TLV).

The American Conference of Governmental Industrial Hygienists (ACGIH) is an organization devoted to the administrative and technical aspects of occupational and environmental health. The organization has contributed substantially to the development and improvement of worker health protection. One way it has achieved this is by the establishment of industry accepted maximum allowable levels for exposure to airborne chemicals. These levels are published yearly in a booklet entitled *Threshold Limit Values and Biological Exposure Indices*.

The ACGIH defines the TLV-TWA as the "TWA concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, for a working lifetime without adverse effect"[2].

In addition as a "rule of thumb" if a guideline hasn't been establish for an office environment, 1/10 of the TLV-TWA established by the ACGIH for an industrial setting is applied.

The term "volatile organic compounds" (VOCs) refers to all organic compounds with a boiling point of greater than 50°C and less than 260°C. Common VOC sources in buildings include

[2] American Conference of Governmental Industrial Hygienist: 2010 TLV® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices. ACGIH, Cincinnati, OH (2010).

furnishings, construction materials, occupant operations, maintenance and custodial chemicals, infiltration of external contaminants, and the occupants themselves.

Due to the fact that individual VOCs that are present are usually at very low concentrations, the concept of total VOCs (TVOC) was developed. Elevated VOC concentrations can cause irritation and discomfort. Measurements of TVOC record the total VOCs present (i.e. all chemicals) without distinguishing between the different chemicals.

Although currently, there are no regulated indoor air quality guidelines for TVOC levels for non-industrial settings some exposure limits have been recommended.

Health Canada's "Indoor Air Quality in Office Buildings: A Technical Guide," 1995, indicates "In an exposure range of 0.3 to 3.0 mg/m^3, (0.13 to 1.3 ppm as measured by G460) odours, irritation, and discomfort may appear in response to the presence of TVOCs together with thermal comfort factors and stressors. Above 3.0 mg/m^3 (1.3 ppm as measured by G460), one may expect complaints; above 25.0 mg/m^3 (10.9 ppm as measured by G460) temporary discomfort and respiratory irritation have been demonstrated for a common mix of chemicals in an office building." Since measurements above 1.3 ppm can result in complaints this value is used as a reference guideline.

2.2.2.2 Summary of Data

Continuous monitoring for volatile organic compounds (VOC's) was conducted with 3M Organic Vapour Monitor 3520 dosimeter badges. Station samples were collected in a fixed location which gives the best estimate of general airborne concentrations in the area.

One (1) VOC station sample was set up in both the Resource Centre Copier Room and the C and C Hallway. The following table gives a summary of the volatile organic compound results.

Volatile Organic Compounds (VOC) Monitoring
Sir Wilfred Grenfell College
Second Floor, Arts and Science Building, Corner Brook NL

COMPOUND NAME	Station Sample Copier Room (24 hours) (mg/m^3)	Station Sample C and C Hallway (24 hours) (mg/m^3)	ACGIH TLV-TWA (mg/m^3)	ACGIH TLV-STEL (mg/m^3)
Benzene	ND	ND	1.6	8
Toluene	ND	ND	75	---
Ethylbenzene	ND	ND	87	---
Xylene (Total)	ND	ND	434	651

Volatile Organic Compounds (VOC) Monitoring Sir Wilfred Grenfell College Second Floor, Arts and Science Building, Corner Brook NL				
COMPOUND NAME	**Station Sample Copier Room (24 hours) (mg/m^3)**	**Station Sample C and C Hallway (24 hours) (mg/m^3)**	**ACGIH TLV-TWA (mg/m^3)**	**ACGIH TLV-STEL (mg/m^3)**
Styrene	ND	ND	85	170
Isopropylbenzene	ND	ND	246	---
3-Ethyltoluene	ND	ND	---	---
1.3,5–Trimethylbenzene	ND	ND	123	---
1,2,4-Trimethylbenzene	ND	ND	123	---
Heptane	ND	ND	1640	2050
Octane	ND	ND	1401	---
n-Nonane	ND	ND	1050	---
Decane	ND	ND	---	---
n-Undercane	ND	ND	---	---
n-Dodecane	ND	ND	---	---
Methylcyclohexane	ND	ND	1610	---
Chloroform	ND	ND	49	---
1,1,1-Trichloroethane	ND	ND	1910	2460
Trichloroethylene	ND	ND	54	135
1,1,2-Trichloroethane	ND	ND	55	---
Tetrachloroethylene	ND	ND	170	685
Chlorobenzene	ND	ND	46	---
1,4-Dichlorobenzene	ND	ND	60	---
1,2-Dichlorobenzene	ND	ND	150	301

Volatile Organic Compounds (VOC) Monitoring Sir Wilfred Grenfell College Second Floor, Arts and Science Building, Corner Brook NL				
COMPOUND NAME	**Station Sample Copier Room (24 hours) (mg/m^3)**	**Station Sample C and C Hallway (24 hours) (mg/m^3)**	**ACGIH TLV-TWA (mg/m^3)**	**ACGIH TLV-STEL (mg/m^3)**
Methyl Isobutyl Ketone	ND	ND	82	307
Methyl Butyl Ketone (2-hexanone)	ND	ND	20	40
Naphthalene	ND	ND	52	79
d-Limonene	ND	ND	---	---
Total Volatile Organic Compounds	0	0	---	---
Sample Duration	24 hours	24 hours		
Sample ID	GM9353	GM9383		
Date	December 9 - 10, 2013	December 9 - 10, 2013		

Notes:

- mg/m^3 = milligrams of contaminant per cubic meter of air.
- ACGIH TLV-TWA = American Conference of Governmental Industrial Hygienists 8-hour Threshold Limit Value-Time-Weighted Average.
- ACGIH TLV-STEL Value = American Conference of Governmental Industrial Hygienists 15-minute Threshold Limit Value-Short-Term Exposure Limit.
- --- = No exposure value limits for compound.
- ND – Not Detected

Results of the VOC sampling indicated None Detected for the twenty-eight (28) compounds analyzed for in all samples collected.

Sample results are included in Appendix III.

2.2.2.3 Conclusions and Recommendations

All VOC measurements recorded during the assessment were within the Health Canada recommended guideline for a normal office environment.

Recommendation: No recommendations are required.

3.0 LIMITATIONS

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Air sampling results (if any) will apply only to the time and conditions of the testing and may not be used to reliably predict conditions on other days.

Should you have any questions or require additional information, please contact either of the undersigned at our office (902-461-9999).

Yours Truly,

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APPENDIX I

PREVIOUS REPORT ISSUED NOVEMBER 14, 2013

TOTAL VOLATILE ORGANIC COMPOUND SAMPLING
SIR WILFRED GRENFELL COLLEGE
CORNER BROOK, NL

Prepared for:

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November 14, 2013

Pinchin LeBlanc Environmental Project: 07-03-00068

EXECUTIVE SUMMARY

Pinchin LeBlanc Environmental Limited (Pinchin) was retained by Mr. Steve Hynes of Sir Wilfred Grenfell College (SWGC) to conduct Total Volatile Organic Compounds (TVOC) sampling. The assessment was conducted throughout the Arts & Science building of SWGC in Corner Brook, NL. Ms. Karla Coles performed the assessment from October 12 - 14, 2013.

The assessment was conducted as a result of air quality concerns during the application of the floor sealant in the gymnasium. It was reported that one coat of sealant was put on the gymnasium floor and there was concerns with the smell migrating to other areas of the building. It was decided that the sampling would begin in the area of the gymnasium and expand, if necessary, until measurements were within applicable guidelines.

At the time of the sampling it was noted that the gymnasium has been sealed shut with the ventilation system turned off. It was recommended to SWGC that the gymnasium needed air changes and the air inside the gymnasium had to be exhausted to the outside.

The TVOC readings collected throughout the Arts & Science Building on October 12, 2013 were well above the Health Canada suggested comfort level of 0.4 ppm where complaints may be expected. This solidified the notion that an increase in ventilation was needed. It was recommended to increase fresh air levels into the Gymnasium and exhaust VOC laden air to the outside.

The TVOC readings collected throughout the Arts & Science Building on October 13, 2013 were still above the Health Canada suggested comfort level of 0.4 ppm where complaints may be expected but improved drastically from the previous day. The gymnasium continued under negative pressure and windows, where possible, were left open. It was recommended to continue exhausting air from the gynasium.

The TVOC readings collected throughout the Arts & Science Building on October 14, 2013 were at levels that would be considered normal. They were either slightly above or at the Health Canada suggested comfort level of 0.4 ppm but the outdoor level was at 0.3 ppm. It was further recommended to continue exhausting air from the gymnasium building until the students return to classes the next day.

TABLE OF CONTENTS

1.0 INTRODUCTION AND SCOPE

1.1 Statement of Understanding

Pinchin LeBlanc Environmental Limited (Pinchin) was retained by Mr. Steve Hynes of Sir Wilfred Grenfell College (SWGC) to conduct Total Volatile Organic Compounds (TVOC) sampling. The assessment was conducted throughout the Arts & Science building of SWGC in Corner Brook, NL. Ms. Karla Coles performed the assessment from October 12 - 14, 2013.

The assessment was conducted due to air quality concerns during the application of the floor sealant in the gymnasium.

1.2 Scope of Work

This assessment was conducted throughout the Arts & Science building of SWGC and involved the following activities:

- Development of a sampling strategy;
- Measurement of the following indoor air quality (IAQ) factors:
  - Concentration of total volatile organic compounds (TVOC); and,
- Preparation of this report.

1.3 Assessment Methodology

The investigator interviewed the SWGC representative to discuss the sampling strategy. It was reported that one coat of sealant was put on the gymnasium floor and there was concerns with the smell migrating to other areas of the building. It was decided that the sampling would begin in the area of the gymnasium expand, if necessary, until measurements were within applicable guidelines. There were two more coats of the sealant to be applied and the sampling was to be conducted during that work.

1.4 Test Methods

Spot-check sampling for total volatile organic compounds (TVOCs) was conducted with a miniRAE. The instrument is a portable gas detector that uses Photo-ionization technology to detect a large range of Volatile Organic Compounds (VOCs). Outdoor ambient air measurements were made in addition to samples collected in the building.

All sampling was performed in compliance with current professional practice[1.]

[1] American Industrial Hygiene Association: Field Guide for the Determination of Biological Contaminants in Environmental Samples. H.K. Dillon, P.A. Heinsohn, and J.D. Miller, Eds. AIHA, Fairfax, VA (1996).

2.0 ASSESSMENT AND FINDINGS

2.1 Facility Description

The Arts & Science building is a three storey structure with basement. The gymnasium is located in the southwest corner of the building.

2.1.1 Results of Interview

The following information was reported to the consultant by the SWGC representative:

- The HVAC unit had been turned off during the floor sealant application and all doors to the gymnasium were sealed.

2.2 Results of Indoor Air Quality Monitoring

2.2.1 Background

The term "volatile organic compounds" (VOCs) refers to organic compounds with a boiling point of greater than 50°C and less than 260°C. Offices or other non-industrial workplaces can contain many VOC sources such as paints, furniture, cleaners, personal care products and office equipment. Where VOCs are present at higher concentrations, there is a risk of adverse health effects such as unacceptable odours, eye, nose or throat irritation, or headache. Indoor air in office environments is usually a mixture of many VOCs present in varying concentrations, measured in micrograms per cubic metre ($\mu g/m^3$) or parts per million in air (ppm). The sum of the VOCs in an environment is termed the Total Volatile Organic Compound concentration (TVOC), frequently measured by direct reading instrumentation or laboratory methods. IAQ investigators use the TVOC concentration to estimate the risk of adverse health effects.

There is no legislated TVOC standard or even a consensus standard set to prevent all IAQ complaints from VOCs in office buildings. In the past, Health Canada published guidance based on work by the Danish researcher Lars Molhave, recommending a threshold of 200 $\mu g/m^3$ for no adverse health effects, and noting that discomfort could be expected above 3,000 $\mu g/m^3$. However, Molhave has recently withdrawn support for these thresholds and Pinchin no longer recommends use of the Health Canada TVOC guidelines.

The literature does include some guidance on typical and maximum acceptable concentrations. The US Environmental Protection Agency (US EPA) has conducted one of the largest IAQ investigations of IAQ in office buildings, including VOC concentrations. In the period of 1994-1998, the US EPA Building Assessment Survey and Evaluation (BASE) study surveyed 100 randomly selected office buildings across 37 cities and 25 states. These were not known to be "problem" buildings. The study found 25 VOC compounds to be present in every building tested. This study found TVOC levels in the 100 randomly selected office buildings to be about

400 µg/m^3, while some buildings ranged as high as 1,200 µg/m^3. Under the Canada Green Building Council Leadership in Energy and Environmental Design (LEED) program, newly built buildings receive IAQ credits for having TVOC concentrations under 500 µg/m^3 (0.2 ppm). Pinchin would consider an office environment with TVOC concentrations up to 1,000 µg/m^3 (0.4 ppm) to be at little risk of IAQ complaints. Complaints might be expected if concentrations were much above that level.

2.2.2 Summary of Data

The spot check measurements throughout the Arts & Science building are provided in table 2.2.2 presented below. It should be noted that all sampling results were instantaneous and recommendations provided to SWGC in real time while data was being collected.

Spot Check Monitoring of TVOCs
Arts & Science Building, SWGC, Corner Brook, NL
October 12-14, 2013

Location	TVOC (ppm)
October 12, 2013 (PM)	
Outdoors	0.4
Gymnasium Entrance	**157.0**
Gymnasium Door #1	**195.7**
Gymnasium Door #2	**176.8**
Gymnasium Mid Hallway	**189.0**
Woman's Change Room	**147.7**
Gymnasium End Hallway	**162.3**
Pool Office	**150.5**
Pool Deck	**73.0**
Pool Viewing Area	**111.0**
Stairwell	**143.0**
Help Desk	**45.0**
Stage Craft	**12.0**
Computer Lab	**11.4**
Mid Stairwell	**27.6**
Room 282	**14.2**
Room 285	**24.6**
Office/Small Hallway	**24.3**
Crossroads	**26.6**
Bursar's Office	**21.7**
Campus Police Office	**14.5**
Main Entrance	**5.4**
Room 273	**2.5**
Woman's Washroom	**20.9**

Location	TVOC (ppm)
Chemistry Lab Hallway	**21.3**
Room 244	**22.4**
Room 236	**21.6**
Entrance #24	**20.2**
Student Services	**3.3**
Stairwell Adjacent Student Services	**15.2**
Room 332B	**8.8**
Room 332N	**6.9**
Room 305	**6.2**
Door #25	**11.8**
Bookstore	**16.6**
Cafeteria	**1.6**
Basement	**6.9**
October 13, 2013 (AM)	
Outdoors	0.3
Gymnasium Entrance	**5.4**
Gymnasium Mid Hallway	**5.9**
Gymnasium End Hallway	**4.6**
Cage	**3.7**
Equipment Room	**3.3**
Woman's Change Room	**3.4**
Men's Change Room	**3.6**
Pool Office	**4.2**
Pool Deck	**2.5**
Gymnasium Stairwell	**4.7**
Pool Viewing Area	**6.1**
Stage Craft	**3.9**
Computer Lab	**1.9**
Mid Stairwell	**1.4**
Room 364	**1.6**
Crossroads	**0.7**
Hallway Adjacent to Room 206	**0.7**
Room 310	**0.6**
Room 345	**1.4**
Basement	**0.7**
October 13, 2013 (PM)	
Outdoors	0.3
Gymnasium Entrance	**1.9**
Gymnasium Mid Hallway	**1.9**
Gymnasium End Hallway	**2.2**
Gymnasium	**1.3**

Location	TVOC (ppm)
Cage	**1.2**
Woman's Change Room	**2.8**
Men's Change Room	**2.1**
Pool Office	**2.0**
Pool Deck	**1.7**
Gymnasium Stairwell	**1.5**
Pool Viewing Area	**1.4**
Stage Craft	**1.1**
Computer Lab	**1.1**
Mid Stairwell	**0.9**
Room 364	**0.8**
Crossroads	**0.9**
Hallway Adjacent to Room 206	**2.1**
Basement	**0.7**
October 14, 2013 (PM)	
Outdoors	0.3
Gymnasium Entrance	**0.5**
Gymnasium Stairwell	0.4
Gymnasium Hallway	0.4
Cage	**0.5**
Woman's Change Room	**0.8**
Pool Office	**0.6**
Pool Deck	**0.8**
Pool Viewing Area	0.4
Stage Craft	0.4
Computer Lab	0.4
Mid Stairwell	0.4
Room 364	0.4
Crossroads	0.4
Hallway Adjacent to Room 206	0.4
Third Floor	0.4
Student Services	0.4
Basement	0.4

1. Total volatile organic compounds (TVOC) levels above 1.0 mg/m^3 (approximately 0.4 ppm), one may expect complaints.

* Numbers in **RED** are above the recommended value.

2.2.3.3 Conclusions

The TVOC readings collected throughout the Arts & Science Building on October 12, 2013 were well above the Health Canada suggested comfort level of 0.4 ppm where complaints may be

expected. This solidified the notion that an increase in ventilation was needed. It was recommended to increase fresh air levels into the Gymnasium and exhaust VOC laden air to the outside.

The TVOC readings collected throughout the Arts & Science Building on October 13, 2013 were still above the Health Canada suggested comfort level of 0.4 ppm where complaints may be expected but improved drastically from the previous day. The gymnasium continued under negative pressure and windows, where possible, were left open. It was recommended to continue exhausting air from the gymnasium.

The TVOC readings collected throughout the Arts & Science Building on October 14, 2013 were at levels that would be considered normal. They were either slightly above or at the Health Canada suggested comfort level of 0.4 ppm but the outdoor level was at 0.3 ppm. It was further recommended to continue exhausting air from the gymnasium building until the students return to classes the next day.

3.0 LIMITATIONS

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Air sampling results (if any) will apply only to the time and conditions of the testing and may not be used to reliably predict conditions on other days.

PINCHIN LEBLANC ENVIRONMENTAL LIMITED

Per…Julia King
Project Manager
IAQ Microbial Contamination
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Reviewed by: David Muise, OHST
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APPENDIX II

PREVIOUS REPORT ISSUED DECEMBER 9, 2013

FOLLOW-UP TOTAL VOLATILE ORGANIC COMPOUND SAMPLING
SIR WILFRED GRENFELL COLLEGE
CORNER BROOK, NL

Prepared for:

SIR WILFRED GRENFELL COLLEGE
1 UNIVERSITY DRIVE
CORNER BROOK, NL
A2H 6P9

ATTENTION: MR. DAVID STURGE

Prepared by:
Pinchin LeBlanc Environmental Limited
74 Broadway, Suite 201
Corner Brook, NL, A2H 4C8

Telephone: (709) 639-1984

December 9, 2013

Pinchin LeBlanc Environmental Project: 07-03-00068

EXECUTIVE SUMMARY

Pinchin LeBlanc Environmental Limited (Pinchin) was retained by Mr. Steve Hynes of Sir Wilfred Grenfell College (SWGC) to conduct Total Volatile Organic Compounds (TVOC) sampling. The follow up assessment was conducted throughout the Arts & Science building of SWGC in Corner Brook, NL. Ms. Karla Coles and Ms. Julia King performed the assessment from November 20 - 28, 2013.

The follow-up assessment was conducted as a result of air quality concerns following the application of floor sealant in the gymnasium, which occurred approximately three weeks ago. The initial report titled "Total Volatile Organic Compound Sampling, Sir Wilfred Grenfell College, Corner Brook, NL" was issued November 14, 2013.

The HVAC unit has been turned off since the floor sealant application and three exhaust fans have been placed in the gymnasium exhausting to the exterior. The HVAC unit was turned on for a brief time on November 27, 2013 but turned back off on the same day due to odour complaints by the occupants in the area.

The TVOC readings collected throughout the Arts & Science Building during November 20-28, 2013 were all below the Health Canada suggested comfort level of 0.4 ppm.

TABLE OF CONTENTS

1.0 INTRODUCTION AND SCOPE

1.1 Statement of Understanding

Pinchin LeBlanc Environmental Limited (Pinchin) was retained by Mr. Steve Hynes of Sir Wilfred Grenfell College (SWGC) to conduct Total Volatile Organic Compounds (TVOC) sampling. The follow up assessment was conducted throughout the Arts & Science building of SWGC in Corner Brook, NL. Ms. Karla Coles and Ms. Julia King performed the assessment from November 20 - 28, 2013.

The follow-up assessment was conducted as a result of air quality concerns following the application of floor sealant in the gymnasium, which occurred approximately three weeks ago. The initial report titled "Total Volatile Organic Compound Sampling, Sir Wilfred Grenfell College, Corner Brook, NL" was issued November 14, 2013.

1.2 Scope of Work

This follow up assessment was conducted throughout the Arts & Science building of SWGC and involved the following activities:

- Development of a sampling strategy;
- Measurement of the following indoor air quality (IAQ) factors:
  - Concentration of total volatile organic compounds (TVOC); and,
- Preparation of this report.

1.3 Assessment Methodology

The investigator interviewed the SWGC representative to discuss the sampling strategy. It was reported that since the sealant was applied to the gymnasium floor, there are still concerns with the smell migrating to other areas of the building. It was decided that the sampling would begin in the area of the gymnasium and expand to the surrounding areas and second floor adjacent to the gymnasium.

1.4 Test Methods

Spot-check sampling for total volatile organic compounds (TVOCs) was conducted with a miniRAE. The instrument is a portable gas detector that uses Photo-ionization technology to detect a large range of Volatile Organic Compounds (VOCs). Outdoor ambient air measurements were made in addition to samples collected in the building.

All sampling was performed in compliance with current professional practice[1].

2.0 ASSESSMENT AND FINDINGS

2.1 Facility Description

The Arts & Science building is a three storey structure with basement. The gymnasium is located in the southwest corner of the building.

2.1.1 Results of Interview

The following information was reported to the consultant by the SWGC representative:

- The HVAC unit has been turned off since the floor sealant application and three exhaust fans have been placed in the gymnasium exhausting to the exterior. The HVAC unit was turned on for a brief time on November 27, 2013 but turned back off, the same day, due to odour complaints by the occupants in the area.

2.2 Results of Indoor Air Quality Monitoring

2.2.1 Background

The term "volatile organic compounds" (VOCs) refers to organic compounds with a boiling point of greater than 50°C and less than 260°C. Offices or other non-industrial workplaces can contain many VOC sources such as paints, furniture, cleaners, personal care products and office equipment. Where VOCs are present at higher concentrations, there is a risk of adverse health effects such as unacceptable odours, eye, nose or throat irritation, or headache. Indoor air in office environments is usually a mixture of many VOCs present in varying concentrations, measured in micrograms per cubic metre ($\mu g/m^3$) or parts per million in air (ppm). The sum of the VOCs in an environment is termed the Total Volatile Organic Compound concentration (TVOC), frequently measured by direct reading instrumentation or laboratory methods. IAQ investigators use the TVOC concentration to estimate the risk of adverse health effects.

There is no legislated TVOC standard or even a consensus standard set to prevent all IAQ complaints from VOCs in office buildings. In the past, Health Canada published guidance based on work by the Danish researcher Lars Molhave, recommending a threshold of 200 $\mu g/m^3$ for no adverse health effects, and noting that discomfort could be expected above 3,000 $\mu g/m^3$. However, Molhave has recently withdrawn support for these thresholds and Pinchin no longer recommends use of the Health Canada TVOC guidelines.

[1] American Industrial Hygiene Association: Field Guide for the Determination of Biological Contaminants in Environmental Samples. H.K. Dillon, P.A. Heinsohn, and J.D. Miller, Eds. AIHA, Fairfax, VA (1996).

The literature does include some guidance on typical and maximum acceptable concentrations. The US Environmental Protection Agency (US EPA) has conducted one of the largest IAQ investigations of IAQ in office buildings, including VOC concentrations. In the period of 1994-1998, the US EPA Building Assessment Survey and Evaluation (BASE) study surveyed 100 randomly selected office buildings across 37 cities and 25 states. These were not known to be "problem" buildings. The study found 25 VOC compounds to be present in every building tested. This study found TVOC levels in the 100 randomly selected office buildings to be about 400 µg/m^3, while some buildings ranged as high as 1,200 µg/m^3. Under the Canada Green Building Council Leadership in Energy and Environmental Design (LEED) program, newly built buildings receive IAQ credits for having TVOC concentrations under 500 µg/m^3 (0.2 ppm). Pinchin would consider an office environment with TVOC concentrations up to 1,000 µg/m^3 (0.4 ppm) to be at little risk of IAQ complaints. Complaints might be expected if concentrations were much above that level.

2.2.2 Summary of Data

The spot check measurements throughout the Arts & Science building are provided in table 2.2.2 presented below. It should be noted that all sampling results were instantaneous and recommendations provided to SWGC in real time while data was being collected.

Spot Check Monitoring of TVOCs
Arts & Science Building, SWGC, Corner Brook, NL
November 20-28, 2013

Location	TVOC (ppm)
November 20, 2013	
Outdoors	0.0
Pool Viewing Area	0.0
Help Desk	0.0
Stage Craft	0.0
C & C	0.0
Props	0.0
Gym Hallway	0.0
Gym	0.0
November 21, 2013	
Outdoors	0.0
Pool Viewing Area	0.0
Help Desk	0.0
Stage Craft	0.0
Wardrobe	0.0
Props	0.0

Location	TVOC (ppm)
Gym Hallway	0.0
Stairwell	0.0
Gym	0.0
November 22, 2013	
Outdoors	0.0
Pool Viewing Area	0.0
Help Desk	0.0
Stage Craft	0.0
C & C	0.0
Resource Centre	0.0
Props	0.0
Wardrobe	0.0
Gym Hallway	0.0
Gym	0.0
Cage	0.0
Gym Offices	0.0
November 23, 2013	
Outdoors	0.0
Pool Viewing Area	0.0
Help Desk	0.0
Stage Craft	0.0
C & C	0.0
Resource Centre	0.0
Party Room	0.0
Props	0.0
Wardrobe	0.0
Gym Hallway	0.0
Gym	0.0
November 25, 2013	
Outdoors	0.0
Pool Viewing Area	0.0
Help Desk	0.0
Stage Craft	0.0
C & C	0.0
Resource Centre	0.0
Party Room	0.0
Props	0.0
Wardrobe	0.0
Gym Hallway	0.0
Gym	0.0

Location	TVOC (ppm)
November 27, 2013	
Outdoors	0.0
Gym Hallway	0.0
Gym	0.0
Pool Viewing Area	0.0
Help Desk	0.0
November 28, 2013	
Outdoors	0.0
Gym Hallway	0.0
Gym	0.0
Pool Viewing Area	0.0
Help Desk	0.0

1. Total volatile organic compounds (TVOC) levels above 1.0 mg/m^3 (approximately 0.4 ppm), one may expect complaints.

* Numbers in **RED** are above the recommended value.

2.2.3.3 Conclusions

The TVOC readings collected throughout the Arts & Science Building during November 20-28, 2013 were all below the Health Canada suggested comfort level of 0.4 ppm.

3.0 LIMITATIONS

Work performed by Pinchin was conducted in accordance with generally accepted engineering or scientific practices current in this geographical area at the time the work was performed. No warranty is either expressed or implied, or intended by the agreement executed with the Client, or by furnishing oral or written reports or findings. The Client acknowledges that subsurface and concealed conditions may vary from those encountered or inspected. Pinchin could only comment on the conditions observed on the date(s) the assessment was performed.

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PINCHIN LEBLANC ENVIRONMENTAL LIMITED

Per…Julia King
Project Manager
IAQ Microbial Contamination
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Reviewed by: David Muise, OHST
Senior Occupational Hygienist
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dmuise@pinchinleblanc.com

APPENDIX III

VOC ANALYTICAL RESULTS

Your Project #: 07-03-00068
Site Location: GRENFELL,VOC MONITORING
Your C.O.C. #: N/A

Attention:Julia King

Pinchin Leblanc Environmental
74 Broadway
Suite 201
Corner Brook, NL
A2H 4C8

Report Date: 2013/12/16

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B3L4905
Received: 2013/12/12, 09:25

Sample Matrix: Filter
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Vol. Organic Comp. (VOC) in Air Badges	2	2013/12/13	2013/12/13	ATL SOP 00125	NIOSH 1500/1501

Remarks:

Reporting results to two significant figures at the RDL is to permit statistical evaluation and is not intended to be an indication of analytical precision.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Leonard Muise, Project Manager
Email: LMuise@maxxam.ca
Phone# (902)420-0203 Ext:236
==========
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Maxxam Job #: B3L4905
Report Date: 2013/12/16

Pinchin Leblanc Environmental
Client Project #: 07-03-00068
Site Location: GRENFELL,VOC MONITORING
Sampler Initials: KC

VOLATILE ORGANICS BY GC/MS (FILTER)

Maxxam ID		UG5411	UG5412		
Sampling Date		2013/12/09	2013/12/09		
COC Number		N/A	N/A		
	Units	GM 9353 COPIER ROOM	GM 9383 C AND C	RDL	QC Batch
Volatile Organics					
Benzene	mg/m3	ND	ND	0.014	3456920
Toluene	mg/m3	ND	ND	0.005	3456920
Ethylbenzene	mg/m3	ND	ND	0.013	3456920
Total Xylenes	mg/m3	ND	ND	0.014	3456920
Styrene	mg/m3	ND	ND	0.007	3456920
Isopropylbenzene	mg/m3	ND	ND	0.007	3456920
3-Ethyltoluene	mg/m3	ND	ND	0.012	3456920
1,3,5-Trimethylbenzene	mg/m3	ND	ND	0.012	3456920
1,2,4-Trimethylbenzene	mg/m3	ND	ND	0.007	3456920
Heptane	mg/m3	ND	ND	0.11	3456920
Octane	mg/m3	ND	ND	0.014	3456920
n-Nonane	mg/m3	ND	ND	0.011	3456920
Decane	mg/m3	ND	ND	0.023	3456920
n-Undecane	mg/m3	ND	ND	0.012	3456920
n-Dodecane	mg/m3	ND	ND	0.018	3456920
Methylcyclohexane	mg/m3	ND	ND	0.008	3456920
Chloroform	mg/m3	ND	ND	0.02	3456920
1,1,1-Trichloroethane	mg/m3	ND	ND	0.018	3456920
Trichloroethylene	mg/m3	ND	ND	0.013	3456920
1,1,2-Trichloroethane	mg/m3	ND	ND	0.009	3456920
Tetrachloroethylene	mg/m3	ND	ND	0.025	3456920
Chlorobenzene	mg/m3	ND	ND	0.013	3456920
1,4-Dichlorobenzene	mg/m3	ND	ND	0.01	3456920
1,2-Dichlorobenzene	mg/m3	ND	ND	0.014	3456920
Methyl Isobutyl Ketone	mg/m3	ND	ND	0.005	3456920
Methyl Butyl Ketone (2-Hexanone)	mg/m3	ND	ND	0.006	3456920
Naphthalene	mg/m3	ND	ND	0.006	3456920
d-Limonene	mg/m3	ND	ND	0.023	3456920
Total Volatile Organic Compounds	mg/m3	ND	ND		3456920
Surrogate Recovery (%)					
D10-Ethylbenzene	%	84	82		3456920
Fluorobenzene	%	90	90		3456920

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

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Maxxam Job #: B3L4905
Report Date: 2013/12/16

Pinchin Leblanc Environmental
Client Project #: 07-03-00068
Site Location: GRENFELL,VOC MONITORING
Sampler Initials: KC

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.3°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
3456920	PDV	Method Blank	D10-Ethylbenzene	2013/12/13		101	%	70 - 130
			Fluorobenzene	2013/12/13		91	%	70 - 130
			Benzene	2013/12/13	ND, RDL=0.014		mg/m3	
			Toluene	2013/12/13	ND, RDL=0.005		mg/m3	
			Ethylbenzene	2013/12/13	ND, RDL=0.013		mg/m3	
			Total Xylenes	2013/12/13	ND, RDL=0.014		mg/m3	
			Styrene	2013/12/13	ND, RDL=0.007		mg/m3	
			Isopropylbenzene	2013/12/13	ND, RDL=0.007		mg/m3	
			3-Ethyltoluene	2013/12/13	ND, RDL=0.012		mg/m3	
			1,3,5-Trimethylbenzene	2013/12/13	ND, RDL=0.012		mg/m3	
			1,2,4-Trimethylbenzene	2013/12/13	ND, RDL=0.007		mg/m3	
			Heptane	2013/12/13	ND, RDL=0.11		mg/m3	
			Octane	2013/12/13	ND, RDL=0.014		mg/m3	
			n-Nonane	2013/12/13	ND, RDL=0.011		mg/m3	
			Decane	2013/12/13	ND, RDL=0.023		mg/m3	
			n-Undecane	2013/12/13	ND, RDL=0.012		mg/m3	
			n-Dodecane	2013/12/13	ND, RDL=0.018		mg/m3	
			Methylcyclohexane	2013/12/13	ND, RDL=0.008		mg/m3	
			Chloroform	2013/12/13	ND, RDL=0.02		mg/m3	
			1,1,1-Trichloroethane	2013/12/13	ND, RDL=0.018		mg/m3	
			Trichloroethylene	2013/12/13	ND, RDL=0.013		mg/m3	
			1,1,2-Trichloroethane	2013/12/13	ND, RDL=0.009		mg/m3	
			Tetrachloroethylene	2013/12/13	ND, RDL=0.025		mg/m3	
			Chlorobenzene	2013/12/13	ND, RDL=0.013		mg/m3	
			1,4-Dichlorobenzene	2013/12/13	ND, RDL=0.01		mg/m3	
			1,2-Dichlorobenzene	2013/12/13	ND, RDL=0.014		mg/m3	
			Methyl Isobutyl Ketone	2013/12/13	ND, RDL=0.005		mg/m3	
			Methyl Butyl Ketone (2-Hexanone)	2013/12/13	ND, RDL=0.006		mg/m3	
			Naphthalene	2013/12/13	ND, RDL=0.006		mg/m3	
			d-Limonene	2013/12/13	ND, RDL=0.023		mg/m3	
			Total Volatile Organic Compounds	2013/12/13	ND		mg/m3	

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

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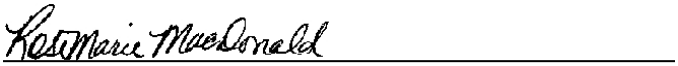
Maxxam Job #: B3L4905
Report Date: 2013/12/16

Pinchin Leblanc Environmental
Client Project #: 07-03-00068
Site Location: GRENFELL,VOC MONITORING
Sampler Initials: KC

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Rose MacDonald, Scientific Specialist (Organics)

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