814 Broad St.
Weymouth, MA 02189

T 781.337.0016
TRCcompanies.com

October 18, 2021

VIA EMAIL: ernest.sandland@whrsd.org

Mr. Ernest Sandland
Facilities Department
Whitman Hanson Regional School District
600 Franklin Street
Whitman, MA 02382

TRC Project No. 455410

Subject: **Final Report**
Indoor Air Quality Evaluation
Louise A. Conley School
100 Forest Street
Whitman, Massachusetts

Dear Mr. Sandland:

TRC Environmental, Inc. (TRC) is pleased to present its final report entitled *"Indoor Air Quality Evaluation"* performed at the Louise A. Conley School located at 100 Forest Street in Whitman, Massachusetts.

TRC appreciates the opportunity to be of service. If you have any questions or concerns, please contact me at (781) 337-0016.

Very Truly Yours,
TRC ENVIRONMENTAL, INC.

Olivia Smaracko
BSI - Sr. Industrial Hygienist

Gregory Hatch
BSI - Office Practice Leader

814 Broad St.
Weymouth, MA 02189

T 781.337.0016
TRCcompanies.com

Indoor Air Quality
at

Louise A. Conley School
100 Forest Street
Whitman, Massachusetts

TRC Project No. 455410
October 18, 2021

Prepared for:

Whitman Hanson Regional School District
Facilities Department
600 Franklin Street
Whitman, MA 02382

Prepared by:

TRC Environmental, Inc.
814 Broad Street
Weymouth, Massachusetts
781.337.0016

CONTENTS

1.0 INTRODUCTION

Mr. Ernest Sandland of the Whitman Hanson Regional School District (WHRSD) authorized TRC Environmental, Inc. (TRC) to perform an indoor air quality evaluation at the Louise A. Conley School located at 100 Forest Street in Whitman, Massachusetts.

WHRSD requested this evaluation to be conducted in a proactive manner to address potential occupant concerns. TRC Industrial Hygienist, Gregory Hatch visited the school to perform the evaluation on August 26, 2021. During the evaluation, building access and information was provided by Mr. Ernest Sandland of the WHRSD Facilities Department.

Appendix A presents the results of instantaneous direct-reading environmental measurements. Appendix B presents the IAQ monitor calibration report.

2.0 OBSERVATIONS AND DISCUSSION

TRC's evaluation included evaluating representative occupied spaces at the school building. TRC's observations and discussions were based on the following:

- Inspecting for possible microbiological reservoirs or amplifiers and sources of odor, chemical air contaminants, and combustion products within the survey areas and associated with the heating, ventilating and air conditioning (HVAC) system serving those areas.

- Collecting indoor instantaneous, direct-reading measurements for dry bulb temperature, relative humidity, carbon dioxide and carbon monoxide concentrations in representative areas and in outdoor areas for comparison.

2.1 OCCUPIED SPACE

The building is typical school building with office space, common areas such as hallways, Cafeteria/Auditorium, Library, Gymnasium and classroom space. The following was noted:

- School was not in session yet, but a few teachers were present preparing classrooms for opening day. Most of the unit ventilators and individual air conditioners in classrooms were not in operation.

- The outdoor temperatures were measured and ranged from 83.7-89 °F during the survey.

- No substantial water leaks or intrusion areas were observed.

2.2 DIRECT-READING ENVIRONMENTAL MEASUREMENTS

TRC performed direct-reading environmental measurements within select classrooms, offices, the gymnasium, the library, the cafeteria, and outdoors, on August 26, 2021. TRC measured for dry bulb temperature, relative humidity, carbon dioxide and carbon monoxide concentrations using a TSI Q-Trak Indoor Air Quality Monitor. This is a direct-reading instrument.

Appendix A presents direct-reading environmental measurements and Appendix B provides the updated instrument calibration report.

2.2.1 Dry Bulb Temperature and Relative Humidity

On the day of the survey, TRC measured indoor dry bulb temperatures ranging from 73.5 to 81.3°F. The outdoor dry bulb temperature ranged from 82.2 to 88.0 °F. TRC measured indoor relative humidity in the occupied spaces ranging from 49.6 to 81.6%. The outdoor relative humidity ranged from 61.5 to 70.5%.

Occupant thermal comfort is based on a combination of temperature and relative humidity. The American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE) Standard 55-1992, *Thermal Environmental Conditions for Human Occupancy*, and Standard 55a-1995 Amendment, recommends a range and combination of temperature and relative humidity considered as acceptable for general occupant comfort.

The temperatures and relative humidity levels recommended in ASHRAE Standard 55-1992 and Standard 55a-1995 provide for conditions for which 90 percent of occupants will not express discomfort. The range of temperatures and relative humidity prescribed change from summer to winter and assume that occupants dress appropriately for the season. Ranges of temperature include adjustment factors based on occupant activity (metabolic rate) and clothing factor.

For occupants of office spaces with a metabolic range of 0.8 to 1.2, the recommended comfort ranges for temperature and relative humidity are:

- **<u>Winter</u>**

  Temperature - Dry Bulb: 67 to 76 ºF at 64 ºF Wet Bulb
  (85 to 54 Percent Relative Humidity)
  and
  69 to 76 ºF at 36 ºF Dew Point
  (30 to 23 Percent Relative Humidity)

- **Summer**

Temperature - Dry Bulb: 73 to 79 ºF at 68 ºF Wet Bulb
(78 to 58 Percent Relative Humidity)
and
74 to 87 ºF at 36 ºF Dew Point
(28 to 20 Percent Relative Humidity)

If space utilization or clothing factors change, then the temperature range will also change in accordance with:

T active = T sedentary – 5.4 (1 + Clo) (Met - 1.2)
Regardless of the metabolic rate calculation from above;
the minimum temperature permitted is 59 ºF

ASHRAE Standard 62:2001, *Ventilation for Acceptable Indoor Air Quality*, recommends that, to avoid fungal amplification in building fabrics, relative humidity in occupied spaces should be maintained below 60 percent.

The measured indoor temperatures were found to be within the acceptable range, with the exception of Room 32 (81.3 ºF) and the Music room (81.1 ºF). Several of the relative humidity readings were above the recommended 78% maximum level. The temperatures and the humidity readings measured outside of the recommended levels are due to the summer like conditions outside in conjunction with the unit ventilators and air conditioners not operating yet as the school was not in session. It is noted that all the readings were very close to the recommended levels.

2.2.2 Carbon Dioxide

On the day of the survey, TRC measured outdoor carbon dioxide concentrations between 429 to 439 parts per million (ppm). Indoor carbon dioxide concentrations ranged from between 397 to 698 ppm.

ASHRAE Standard 62:2001, *Ventilation for Acceptable Indoor Air Quality*, identifies indoor carbon dioxide 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 carbon dioxide 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 62:2001, when the peak indoor carbon dioxide concentration exceeds the outdoor concentration by more than 700 ppm, the ventilation rate for that space is inadequate for the occupant loading.

An indoor carbon dioxide 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.

Of the indoor measurements collected on August 26, 2021, none of the readings exceeded the recommended maximum 1,097 ppm (700+397), the calculated ASHRAE recommended indoor carbon dioxide concentration at the start of the survey.

2.2.3 Carbon Monoxide

Carbon monoxide is an odorless, colorless toxic gas produced by the incomplete combustion of solid, liquid and gaseous fuels. Elevated indoor carbon monoxide concentrations may be a result of combustion sources indoors or the introduction of combustion products from outdoors into the indoor air. In the absence of indoor sources, indoor carbon monoxide concentrations are usually less than, or equal to outdoor concentrations. ASHRAE Standard 62-2001 recommends an upper limit for carbon monoxide of 9 ppm as a 24-hour average, and 35 ppm as a 1-hour average.

The indoor and outdoor carbon monoxide concentrations were less than 1ppm.

3.0 CONCLUSIONS AND RECOMMENDATIONS

TRC's conclusions and recommendations are based on its observations, including visual surveys, sample results and inspections presented in this report.

3.1 CONCLUSIONS

A. Temperature and relative humidity readings were close to normal ranges, with several areas that were slightly above the recommended levels. This is due to the summer like outdoor conditions coupled with the unit ventilators and air conditioners not being in operation the day of the assessment.

B. The carbon dioxide (CO_2) readings and carbon monoxide (CO) readings were within the recommended limits. The direct reading measurements are attached in Appendix A.

C. No visible suspect mold or water staining was observed.

3.2 RECOMMENDATIONS

TRC presents the following recommendations to assist the WHRSD in improving indoor air quality:

- Make sure the unit ventilators and supplemental air conditioners are in operation to maintain the humidity and temperature levels within the recommended ranges when school is in session.

Should you have any questions or if things change within the building please give us a call.

This report prepared by:

Gregory Hatch
BSI - Office Practice Leader

This report reviewed by:

Olivia Smaracko
BSI – Senior Industrial Hygienist

Date: October 18, 2021

APPENDIX A

DIRECT-READING ENVIRONMENTAL MEASUREMENTS

School Name: Louise A. Conley School Date: 8/26/21
100 Forest Street, Whitman, MA

LOCATION	Time	Temp (^{0}F)	CO (ppm)	CO_2 (ppm)	RH (%)	Comments/ [Number of Occupants]
ACCEPTABLE LIMIT	a.m./ p.m.	73 – 79	9	1,097	<78	
Outdoor	9:10 am	82.2	0	439	70.5	Sunny
	9:59 am	85.3	0	435	69.9	Sunny
	1:25 pm	88.0	0	429	61.5	Sunny
Room 32	9:18 am	78.0	0	521	67.6	0 (occupants)/windows closed
	12:52 pm	81.3	0	464	63.6	0 (occupants)/windows closed
Room 36	9:19 am	77.2	0	482	74.0	0 (occupants)/windows closed
	12:56 pm	79.6	0	454	67.9	0 (occupants)/windows closed
Room 40	9:21 am	74.7	0	502	57.4	0 (occupants)/windows closed
	12:57 pm	76.6	0	466	57.9	0/1 window AC unit on
Gym	9:23 am	74.5	0	510	74.3	0/vent on/ windows closed
	12:58 pm	77.5	0	467	74.3	0/vent on/ windows closed
Room 109	9:26 am	76.4	0	480	79.7	0/UV on/ Windows closed
	1:00 pm	78.3	0	437	77.1	0/UV on/ Windows closed
Room 4	9:28 am	75.3	0	470	61.4	0/UV on/windows closed/AC unit on
	1:02 pm	74.4	0	444	54.3	0/UV on/windows closed/AC unit on
Room 1	9:30 am	75.4	0	457	78.4	0/windows closed/UV on
	1:01 pm	74.7	0	427	74.1	0/windows closed/UV on
Library	9:31 am	74.6	0	488	69.9	2/Central AC on/UV on
	1:07 pm	74.1	0	432	67.9	2/Central AC on/UV on
Room 11	9:34 am	75.9	0	499	80.6	0/UV on/window AC off
	1:08 pm	75.2	0	484	72.1	0/UV on/window AC off

Room 14	9:36 am	76.6	0	481	70.3	0/UV on/window AC off
	1:09 pm	76.4	0	445	60.0	0/UV on/window AC off
Room 17	9:38 am	77.4	0	505	81.6	0/UV on/window AC off
	1:11 pm	77.6	0	451	64.2	0/UV on/window AC on then shut off
Room 20	9:40 am	78.3	0	457	80.5	0/UV on/window AC off
	1:12 pm	78.0	0	431	70.7	0/UV on/window AC on
Room 21	9:42 am	79.0	0	459	77.8	0/UV on/window AC on
	1:13 pm	77.7	0	412	65.2	0/UV on/window AC on
Cafeteria	9:43 am	79.9	0	465	79.3	0/windows open/fan on/UV on (2)
	1:14 pm	79.7	0	397	79.2	0/windows open/fan on/UV on (2)
Music Room	9:47 am	79.2	0	698	81.4	0/windows open
	1:15 pm	81.1	0	417	81.2	0/windows open
Room 27	9:50 am	77.4	0	496	68.8	0/UV on/AC on
	1:17 pm	79.0	0	470	67.0	0/UV on/AC on
Room 28	9:52 am	75.5	0	485	49.6	0/UV on/window AC on
	1:18 pm	78.3	0	453	53.1	0/UV on/window AC on
Room 31	9:54 am	74.8	0	588	70.0	2/central AC on
	1:20 pm	77.0	0	437	72.4	0/central AC on
Conference Room	9:56 am	73.5	0	503	66.2	0/central AC on
	1:22 pm	75.1	0	436	66.4	0/central AC on

APPENDIX B

IAQ MONITOR CALIBRATION REPORT

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	71.52 (22.0)	°F (°C)
RELATIVE HUMIDITY	50.7	%RH
BAROMETRIC PRESSURE	29.10 (985.4)	inHg (hPa)

MODEL	7575-X
SERIAL NUMBER	7575X1421005

☒ AS LEFT ☒ IN TOLERANCE
☐ AS FOUND ☐ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

THERMO COUPLE — **SYSTEM PRESSURE01-02** — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	70.9 (21.6)	70.9 (21.6)	68.9~72.9 (20.5~22.7)				

BAROMETRIC PRESSURE — **SYSTEM PRESSURE01-02** — *Unit: inHg (hPa)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	29.11 (985.8)	29.11 (985.8)	28.53~29.69 (966.1~1005.4)				

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
Temperature	E004626	02-14-20	02-28-21	Pressure	E005254	10-10-19	10-31-20
Pressure	E003982	07-21-20	01-31-21	DC Voltage	E003493	06-17-20	06-30-21

ChaoVang
CALIBRATED

July 31, 2020
DATE

Doc. ID: CERT_GEN_WCC

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	71.55 (22.0)	°F (°C)
RELATIVE HUMIDITY	50.5	%RH
BAROMETRIC PRESSURE	29.11 (985.8)	inHg (hPa)

MODEL	7575-X
SERIAL NUMBER	7575X1421005

☐ AS LEFT ☒ IN TOLERANCE
☒ AS FOUND ☐ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

THERMO COUPLE — **SYSTEM PRESSURE01-02** — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	70.8 (21.6)	70.6 (21.4)	68.8~72.8 (20.4~22.7)				

BAROMETRIC PRESSURE — **SYSTEM PRESSURE01-02** — *Unit: inHg (hPa)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	29.12 (986.1)	29.08 (984.8)	28.54~29.70 (966.5~1005.8)				

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
Temperature	E004626	02-14-20	02-28-21	Pressure	E005254	10-10-19	10-31-20
Pressure	E003982	07-21-20	01-31-21	DC Voltage	E003493	06-17-20	06-30-21

ChaoVang
VERIFIED

July 31, 2020
DATE

Doc. ID: CERT_GEN_WCC

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	71.50 (21.9)	°F (°C)
RELATIVE HUMIDITY	47.4	%RH
BAROMETRIC PRESSURE	29.24 (990.2)	inHg (hPa)

MODEL	982
SERIAL NUMBER	P14180028

☒ AS LEFT ☒ IN TOLERANCE
☐ AS FOUND ☐ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

TEMPERATURE VERIFICATION — SYSTEM T-101 — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	32.1 (0.0)	32.2 (0.1)	31.1~33.1 (−0.5~0.6)	2	140.0 (60.0)	140.0 (60.0)	139.0~141.0 (59.5~60.6)

HUMIDITY VERIFICATION — SYSTEM H-102 — *Unit: %RH*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	10.0	8.9	7.8~12.2	4	70.0	69.7	67.8~72.2
2	30.0	29.1	27.8~32.2	5	90.0	89.2	87.8~92.2
3	50.0	49.7	47.8~52.2				

CO_2 GAS VERIFICATION — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	0	0	0~50	4	3018	3030	2928~3109
2	501	502	451~551	5	5031	5035	4880~5182
3	1005	1019	955~1055				

CO GAS VERIFICATION — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	35	36	32~38	2	101	100	98~104

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
Temperature	E010657	02-14-20	02-28-21	Temperature	E010658	02-14-20	02-28-21
Temperture	E010655	01-21-20	01-31-21	Humidity	E003539	02-26-20	08-31-20
5000 CO2	14a044096	04-06-20	04-06-28	200 CO	149801	03-24-20	03-24-28
N2	13B110153	04-27-20	04-27-28	Air	A79204	05-20-20	05-20-28
Flow	E003341	09-03-19	09-30-20	Flow	E003980	04-22-20	04-30-21
Flow	E003525	01-06-20	01-31-21	Flow	E003342	09-03-19	09-30-20
2000 C4H8	EB0054467	08-13-19	08-12-22	100 C4H8	CC507339	03-24-20	03-24-28

Baoyang
CALIBRATED

August 3, 2020
DATE

Doc. ID: CERT_GEN_WCC

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	74.3 (23.5)	°F (°C)
RELATIVE HUMIDITY	48	%RH
BAROMETRIC PRESSURE	29.07 (984.4)	inHg (hPa)

MODEL	982
SERIAL NUMBER	P14180028

☐ AS LEFT ☐ IN TOLERANCE
☒ AS FOUND ☒ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

GAS CO_2 AS FOUND — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	0	0	0~50	4	3021	2975	2930~3111
2	504	484	454~554	5	5031	4900	4880~5182
3	1007	1002	957~1057				

GAS CO AS FOUND — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	35	34	32~38	2	100.7	* 94.8	97.7~103.7

TEMPERATURE AS FOUND — SYSTEM T-101 — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	32.1 (0.0)	32.2 (0.1)	31.1~33.1 (−0.5~0.6)	2	140.0 (60.0)	140.0 (60.0)	139.0~141.0 (59.5~60.6)

HUMIDITY AS FOUND — SYSTEM H-102 — *Unit: %RH*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	10.0	9.9	7.0~13.0	4	70.0	67.5	67.0~73.0
2	30.0	29.1	27.0~33.0	5	90.01	* 86.22	87.01~93.01
3	50.0	48.5	47.0~53.0				

**Indicates Out-of-Tolerance Condition*

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
5000 CO_2	14a044096	04-06-20	04-06-28	200 CO	149801	03-24-20	03-24-28
N_2	13B110153	04-27-20	04-27-28	Air	A79204	05-20-20	05-20-28
Flow	E003341	09-03-19	09-30-20	Flow	E003980	04-22-20	04-30-21
Flow	E003525	01-06-20	01-31-21	Flow	E003342	09-03-19	09-30-20
2000 C4H8	EB0054467	08-13-19	08-12-22	100 C4H8	CC507339	03-24-20	03-24-28
Temperature	E010657	02-14-20	02-28-21	Temperature	E010658	02-14-20	02-28-21
Temperture	E010655	01-21-20	01-31-21	Humidity	E003539	02-26-20	08-31-20

Chao Vang
VERIFIED

August 3, 2020
DATE

Doc. ID: CERT_GEN_WCC

TSI P/N 2300157