

Executive Summary

G2S Environmental Consulting Inc. (G2S) was retained by the Calgary Board of Education (CBE) to complete electromagnetic radiation (EMR) testing of twenty-five school buildings within the CBE.

Wi-Fi access points were installed at ceiling level at various locations throughout the schools. The objective of the testing was to assess the levels of radiofrequency (RF) emissions associated with the Wi-Fi equipment and compare the collected data to the exposure limits specified in Health Canada's Safety Code 6. During the testing, the staff and students continued to use the network in a normal matter to provide realistic RF exposure levels during a typical school day.

A total of 375 different locations were measured at the twenty-five school buildings. All measurements were well below the Safety Code 6 limit of 10 W/m^2 (for frequency ranges between 1500 to 15000 MHz). On average, the RF measurements were higher when the Wi-Fi equipment was turned on compared to when it was turned off, which is expected.

Both the background RF levels (Wi-Fi network "off") and the total RF levels (Wi-Fi network "on") showed values typical for residential areas of relatively low population density. Note that higher population density usually relates to higher RF activity, especially when cell towers are present.

Based on the findings of this survey, the RF measurements in the areas tested are well within the limits set by Health Canada Safety Code 6 (2009). The need for further investigations has not been identified at this time.

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1.0 Introduction

G2S Environmental Consulting Inc. (G2S) was retained by the Calgary Board of Education (CBE) to complete electromagnetic radiation (EMR) surveys at the following twenty-five school buildings.

Arbour Lake School 27 Arbour Crest Drive NW	Crescent Heights High School 1019 - 1 Street NW	Grant Macewan School 180 Falshire Drive NE	Olympic Heights School 875 Strathcona Drive SW	Twelve Mile Coulee School 65 Tuscany Hills Road NW
Acadia School 9603 - 5 Street SE	Douglasdale School 400 Douglas Park Blvd. SE	James Fowler High School 4004 - 4 Street NW	Robert Thirsk High School 8777 Nose Hill Drive NW	Tom Baines School 250 Edgepark Blvd. NW
Bridlewood School 207 Bridleridge Way SW	Dr. Gladys M. Egbert 6033 Madigan Drive NE	John Ware School 10020 - 19 Street SW	Sam Livingston School 12011 Bonaventure Dr. SE	Valley Creek School 10951 Hidden Valley Drive NW
Centennial High School 55 Sun Valley Boulevard SE	Dr. E. P. Scarlett H.S. 220 Canterbury Drive SW	Lester B. Pearson High School 3020 - 52 Street NE	Sherwood School 2011 - 66 Ave. SE	Wildwood School 120 - 45 Street SW
Colonel J. Fred Scott School 171 Whitehorn Road NE	Fairview School 7840 Fairmount Drive SE	Marlborough School 4711 Maryvale Drive NE	Stanley Jones School 950 - 6 Street NE	Willow Park School 343 Willow Park Drive SE

Wi-Fi access points were installed at ceiling level at various locations throughout the schools. The objective of the EMR testing was to assess the levels of radiofrequency (RF) emissions associated with the Wi-Fi equipment and compare the collected data to the exposure limits specified in Health Canada's Safety Code 6.

2.0 Background

2.1 Radio Frequency and Wi-Fi Background

Radio frequency is defined as any electromagnetic wave frequencies that range from 3 kHz to 300 GHz. RF power is often emitted from devices such as cell phones, medical devices, radar, and from radio and television broadcasting (Health Canada, 2009).

Wi-Fi is a trademark of the Wi-Fi Alliance and defines Wi-Fi as any wireless local area network (WLAN) product that is based on the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards (Industry Canada, 2012). Wi-Fi networks use radio technologies called 802.11 to provide secure, reliable, and fast wireless connectivity. A Wi-Fi network can be used to connect electronic devices to each other, to the Internet, and to wired networks which use ethernet technology. Wi-Fi networks operate in the 2.4 GHz frequency band (from 2.400 GHz to

2.484 GHz) and in the 5 GHz band (from 5.725 GHz to 5.825 GHz), with some products that can operate in both bands (dual band).

A device that can use Wi-Fi (such as a personal computer, video-game console, smartphone, digital camera, tablet, or digital audio player) can connect to a network resource such as the Internet via a wireless network access point. Such an access point (or hotspot) has a range of about 20 meters (65 feet) indoors and typically consists of one or more low power transmitters installed at the ceiling level.

2.2 CBE Wi-Fi Equipment System

The Wi-Fi equipment (access points) installed at the twenty-five schools consisted of Aruba AP-60 (DAS) and Aruba AP-125 devices. The access points were wired into the DAS systems to extend the wireless coverage to a larger area of the school. Bridlewood School, Robert Thirsk High School and Twelve Mile Coulee School which were built after 2010 have the Aruba AP-125 devices. The remaining twenty-two schools built prior to 2010 include a mixture of Aruba AP-60 and Aruba AP-125 devices.

The locations of the access points for each school are shown on the corresponding drawings provided in Attachments B1 to B25. The installed Wi-Fi equipment operate in the frequency range between 2.4 GHz and 5.825 GHz.

3.0 Objective and Scope of Work

The objective of the investigation was to evaluate the RF exposure levels from the Wi-Fi computer network at each school and compare the measurements to Health Canada's Safety Code 6 exposure limits. More information regarding the Safety Code 6 limits is provided in Section 4 and a methodology of our survey is provided in Section 5.

In general, the scope of work for the survey included the following:

1. Review of all existing EMR sources within an approximate 150 m radius of each Site;
2. Conduct testing using a Narda Broadband Field Meter NBM-550 equipped with a NAR-EC5091 300 kHz - 50 GHz Shaped E-Field Probe, SC6 Canada, Isotropic;
3. Collection of RF readings from various locations throughout the schools with and without the wireless network equipment signals present;
4. Data evaluation with respect to Safety Code 6 exposure limits; and
5. Preparation of a report detailing the RF measurement results.

4.0 Health Canada's Safety Code 6 (2009)

Guidelines for acceptable levels of RF exposure for the protection of human health are outlined in the 2009 Health Canada document entitled "*Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz*" (Safety Code 6). The purpose of Safety Code 6 is to establish safety limits for human exposure to RF electromagnetic energy in the frequency range from 3 kHz to 300 GHz. Limits of exposure to RF energy in the code concerning the general public were set to a minimum of fifty times lower than the levels

where potential harmful effects (alterations in core-body temperature of about 1° C) could take place.

Safety Code 6 has specified two types of exposure limits: (i) exposure in a controlled environment and (ii) exposure in an uncontrolled environment. The first type of limit addresses the maximum permissible exposures (MPEs) for employees in the RF/communications industry, where exposure is a component of their job and is, therefore, predictable and carefully monitored. The second type of limit addresses the exposure of the general public, which can occur at any arbitrary location (public or private) and which, therefore, cannot be controlled or monitored on a regular basis. The applicable limit for this investigation is exposure in an uncontrolled environment.

The recommended exposure levels are regulated through: (a) the specific absorption rate (SAR) limits, and (b) the field strength or the power density limits, depending on the frequency range. SAR is a measurement of the rate at which electromagnetic energy is absorbed in the body and is measured in Watts per kilogram (W/kg). The SAR is typically determined for situations where exposures occur at a distance of 0.2 m or less from the source and is applicable for persons classified as RF and microwave workers. For conditions where SAR determination is impractical (this is usually the case of the uncontrolled environment), field strength and power density limits are applied. Section 2.2 of Safety Code 6 specifies exposure limits for persons NOT classified as RF and microwave workers (the general public) in terms of electric field strength and power density for frequencies greater than 100 MHz. Below 100 MHz, the limits are specified only in terms of electric and magnetic field strengths. The maximum allowed spatial average values in an uncontrolled environment are summarized in Table 1 in the relevant frequency bands. Note that the probe used in the current survey is specifically designed to report the RF emissions relative to Safety Code 6 in the frequency range from 300 kHz (or 0.3 MHz) to 50 GHz (or 50 000 MHz).

TABLE 1:
 EXPOSURE LIMITS FOR UNCONTROLLED ENVIRONMENTS ACCORDING TO SAFETY CODE 6

Frequency <i>f</i> (MHz)	<i>E</i> -field strength, rms (V/m)	<i>H</i> -field strength, rms (A/m)	Power Density (W/m ²)	Averaging Time (min)
0.003 to 1	280	2.19	NA	6
1 to 10	280/ <i>f</i>	2.19/ <i>f</i>	NA	6
10 to 30	28	2.19/ <i>f</i>	NA	6
30 to 300	28	0.073	2 (above 100 MHz)	6
300 to 1 500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> / 150	6
1 500 to 15 000	61.4	0.163	10	6
15 000 to 150 000	61.4	0.163	10	616 000/ <i>f</i> ^{1.2}

5.0 Methodology

The RF survey was conducted by G2S staff between November 17 and December 11, 2014. RF measurements were taken with a Narda Broadband Field Meter NBM-550 equipped with a NAR-EC5091 300 kHz - 50 GHz Shaped E-Field Probe, SC6 Canada, Isotropic. This probe ensures that RF exposure is evaluated in the entire frequency band from 300 kHz to 50 GHz, which includes all possible emissions from radio and TV, mobile handhelds (police, emergency services, etc.), cell phone towers and handsets, Bluetooth and Wi-Fi hot spots and devices, etc.

5.1 Additional Electromagnetic Sources

Prior to conducting the EMR survey, G2S identified existing EMR sources within an approximate 150 m radius of each school property line.

The majority of the schools are situated within a residential setting and have similar potential EMR sources including radio, TV broadcast, wireless networks, hydro corridor, cordless phones and mobile devices. Additional EMR sources that were identified during the preliminary site visits are labelled on the site location plans and summarized below.

TABLE 2:
 ADDITIONAL (NOT WI-FI) ELECTROMAGNETIC SOURCES

School	EMR Source	Approximate Distance from School Property (m)
Arbour Lake School	Communication Tower	30 m South
Centennial High School	Communication Tower	125 m Northwest
	Three roof top Cellular Antennas	75 m West
Colonel J. Fred Scott	Weather Station	On Site
Dr. E. P. Scarlett School	Communication Tower	150 m East
James Fowler School	Roof top Cellular Antenna	50 m North
Olympic Heights School	Weather Station	100 m North
Robert Thirsk High School	Roof top Cellular Antenna	130 m West
Stanley Jones School	Roof top Cellular Antenna	120 m Southwest
Valley Creek School	Weather Station	On Site

The additional (not Wi-Fi) Electromagnetic Sources that were identified above are shown on the site location plans provided in Attachments B1, B4, B5, B9, B12, B16, B17, B20 and B23.

The rooftop T.V antennas observed at Colonel J. Fred Scott School, Dr. E.P. Scarlett School, James Fowler School, Olympic Heights School, Sam Livingston School and Valley Creek School are not transmitting antennas and therefore do not contribute to the background electromagnetic radiation at the respective location.

The weather stations observed at Colonel J. Fred Scott School, Olympic Heights School and Valley Creek School do transmit electromagnetic signals and therefore would contribute to

background electromagnetic radiation, but it is important to note that they operate at a frequency approximately 1,000 times lower than the operating Wifi networks.

5.2 Measurement Equipment

The instrument measures values as percentage of the overall Safety Code 6 MPE limits for which the probe is designed. In this case, the instrument reports the overall detected RF power from 300 kHz to 50 GHz as a percentage of the limits specified by Health Canada Safety Code 6 for controlled environments. Note that this frequency range includes the 2.4 GHz and 5 GHz bands utilized by the CBE Wi-Fi networks. As a result, a conversion of the measured values is required to assess the measurements against the RF exposure limits set out in Health Canada Safety Code 6 for uncontrolled environments.

A comparison between the MPE limits for controlled environments versus uncontrolled environments in the frequency band of the probe (300 kHz to 50 GHz) is given in Table 3. The exposure value reported by the instrument, which is relative to the limits for a controlled environment, must be multiplied by a conversion coefficient of 5 in order to obtain the exposure value relative to the limits for an uncontrolled environment. For example, a recorded exposure value of 0.3017% relative to the limits for a controlled environment corresponds to an exposure value of 1.509% relative to the limits for an uncontrolled environment. Note (from Table 3) that the conversion coefficient is 4.6 below 100 MHz frequency, which means that applying a coefficient of 5 results in a slight overestimation of the exposure value relative to the limits for the uncontrolled environment (if radiation below 100 MHz frequency is indeed present). A slight overestimation of the emissions is in fact preferable as it provides an additional, albeit small, safety margin.

TABLE 3:
 COMPARISON OF THE MPE LIMITS FOR CONTROLLED ENVIRONMENT VERSUS UNCONTROLLED ENVIRONMENT IN HEALTH CANADA SAFETY CODE 6

Frequency range	SC6 limit (controlled)	SC6 limit (uncontrolled)	Limit type	Power Ratio
0.003 MHz to 1 MHz	600	280	Electric field strength in V/m	4.6
1 MHz to 10 MHz	600/ <i>f</i>	280/ <i>f</i>	Electric field strength in V/m	4.6
10 MHz to 30 MHz	60	28	Electric field strength in V/m	4.6
30 MHz to 100 MHz	60	28	Electric field strength in V/m	4.6
100 MHz to 300 MHz	10	2	Power density in W/m ²	5.0
300 MHz to 1.5 GHz	<i>f</i> /30	<i>f</i> /150	Power density in W/m ²	5.0
1.5 GHz to 3.0 GHz	50	10	Power density in W/m ²	5.0
3.0 GHz to 50.0 GHz	50	10	Power density in W/m ²	5.0

Note: *f* denotes frequency in MHz.

At each survey location, a maximum, a minimum and a spatial average measurement was recorded. Note that the time required to survey each location is at least 6 minutes as required by the time-averaging interval of Safety Code 6 (see Table 1). Thus, the spatial average measurement is an average of all values recorded over a 6 minute period and over a volume of space of roughly 0.35 m width, 0.35 m depth, and 1.25 m height, which is at a reasonable distance (for example, 0.5 m) from the floor. This volume represents roughly the volume of a human body and it is the value that must be used to evaluate the exposure relative to the

specified limits. The maximum/minimum measurements represent the highest/lowest values recorded over this 6 minute period and they serve the purpose of identifying where possible hot spots may reside. However, in an uncontrolled environment such as schools and public buildings, due to constant changes in the environment (mostly people moving around), such hot spots change constantly and are highly unpredictable. Here, the minimum and maximum values are reported to simply provide the client with an idea of how dynamic the RF environment is in the measured locations.

Two measurements were taken at each location, one with the Wi-Fi computer network “off” and one with the computer network turn “on”. In addition to Wi-Fi, the instrument has the capability of capturing other sources of EMR such as radio and TV broadcast, cellular towers (base-stations), mobile devices, etc. Thus, a measurement with the Wi-Fi network “off” provides a measure of the “background” radiation while the measurement with the Wi-Fi network “on” provides a measure of the “background” radiation plus the added RF power due to the Wi-Fi nodes. It is not uncommon in an uncontrolled environment to observe lower emission levels with the Wi-Fi network “off” as compared to when it is “on”. This is because: (i) the environment changes and (ii) effects of destructive and constructive RF wave interference influence the measurements locally.

During this survey, the staff and students continued to use the network in a normal matter to provide realistic background RF exposure levels during a typical school day. In addition, the Wi-Fi computer network “on” measurements were collected with two tablets uploading and downloading simultaneously. The two devices were uploading and downloading in the 2.4 GHz or the 5.0 GHz band. The tablets were in close proximity of the access point during the Wi-Fi computer network “on” measurements, actual distances are provided in Tables 1 to 25 in Attachments B1 to B25.

Data which included the location, time and frequency were recorded and the measurements were saved in the NBM-550 machine.

5.3 Measurement Locations

The survey locations for each school are shown on the site plans provided in Attachments B1 to B25. Readings were taken at various floors and rooms throughout the twenty-five school buildings to ensure proper representation of the school. The survey locations were chosen based on various factors including type of building construction, room size, room use, and potential exposure scenarios (proximity to access points).

Readings were taken at various height levels; in general, measurements were taken between approximately 0.3 m to 6.0 m from the access points.

6.0 Data Evaluation

The number of survey locations ranged from ten to fifteen in an elementary school and twenty-one to twenty-five in a secondary school.

The overall average of the spatial average readings when the Wi-Fi equipment was turned on compared to when it was turned off at each of the twenty-five schools is summarized in Table 4 below:

TABLE 4:
 OVERALL AVERAGE OF THE SPATIAL AVERAGE RESULTS WITH THE WI-FI COMPUTER NETWORK “OFF”
 AND “ON” BY LOCATION

School	Sample Type	Wi-Fi Computer Network				Measurement Difference
		Operating		Off		
		% of SC 6	W/m ²	% of SC 6	W/m ²	
Arbour Lake	Overall Spatial Average	0.448 %	0.0446	0.403 %	0.0402	0.045 %
Acadia	Overall Spatial Average	1.551 %	0.1544	1.170 %	0.1165	0.380 %
Bridlewood	Overall Spatial Average	0.715 %	0.0712	0.699 %	0.0696	0.016 %
Centennial High	Overall Spatial Average	1.303 %	0.1298	0.607 %	0.0604	0.696 %
Colonel J. Fred Scott	Overall Spatial Average	1.725 %	0.1718	0.765 %	0.0762	0.960 %
Crescent Heights High	Overall Spatial Average	0.445 %	0.0443	0.334 %	0.0333	0.111 %
Douglasdale	Overall Spatial Average	0.7004 %	0.0698	0.781 %	0.0778	-0.081 %
Dr. Gladys M. Egbert	Overall Spatial Average	1.184 %	0.1179	1.324 %	0.1319	-0.141%
Dr. E. P. Scarlett High	Overall Spatial Average	1.237 %	0.1232	0.477 %	0.0475	0.761 %
Fairview	Overall Spatial Average	1.174 %	0.1169	0.587 %	0.0585	0.587 %
Grant Macewan	Overall Spatial Average	1.726 %	0.1720	1.032 %	0.1028	0.694 %
James Fowler High	Overall Spatial Average	1.068 %	0.1063	0.818 %	0.0815	0.249 %
John Ware	Overall Spatial Average	1.115 %	0.1110	0.751 %	0.0748	0.363 %
Lester B. Pearson High	Overall Spatial Average	1.305 %	0.1300	0.399 %	0.0397	0.906 %
Marlborough	Overall Spatial Average	0.896 %	0.0892	0.400 %	0.0399	0.496 %
Olympic Heights	Overall Spatial Average	0.472 %	0.0470	0.598 %	0.0596	-0.127 %
Robert Thirsk High	Overall Spatial Average	0.870 %	0.0866	0.676 %	0.0674	0.194 %
Sam Livingston	Overall Spatial Average	1.303 %	0.1298	1.041 %	0.1037	0.262 %
Sherwood	Overall Spatial Average	0.932 %	0.0928	0.673 %	0.0671	0.258 %
Stanley Jones	Overall Spatial Average	1.904 %	0.1896	0.730 %	0.0727	1.174 %
Twelve Mile Coulee	Overall Spatial Average	0.578 %	0.0576	0.509 %	0.0506	0.069 %
Tom Baines	Overall Spatial Average	0.892 %	0.0888	0.978 %	0.0974	-0.086 %
Valley Creek	Overall Spatial Average	0.916 %	0.0912	0.954 %	0.0950	-0.038 %
Wildwood	Overall Spatial Average	0.454 %	0.0452	0.384 %	0.0383	0.070 %
Willow Park	Overall Spatial Average	0.449 %	0.0447	1.203 %	0.1198	-0.7542 %

Note: Measurements are % of Safety Code 6 limit in an uncontrolled environment
 Safety Code 6 Limit = 10 W/m² (uncontrolled)

A summary of the maximum spatial average, minimum spatial average and overall spatial average at each of the twenty-five schools is presented in a summary table included in Attachment A. The complete results for each school are presented in summary tables included in Attachments B1 to B25. Spatial average, maximum and minimum measurements are presented as a percentage of the allowable limits and in W/m².

The results relative to the Safety Code 6 in a controlled and uncontrolled environment are shown in the summary tables. A summary of the maximum spatial average measurements recorded at each of the twenty-five schools is summarized in Table 5 below.

TABLE 5:
 MAXIMUM OF THE SPATIAL AVERAGE RESULTS BY LOCATION

School	Sample ID	Wi-Fi Computer Network	% of Safety Code 6 Limits (uncontrolled environment)	Power Density (W/m ²)
Arbour Lake	AL 4	ON	1.755 %	0.1747
Acadia	A 9	ON	2.533 %	0.2523
Bridlewood	BW 6	ON	2.127 %	0.2118
Centennial High	CH 7	ON	3.728 %	0.3713
Colonel J. Fred Scott	CJ 7	ON	4.684 %	0.4665
Crescent Heights High	CH 6	ON	1.198 %	0.1193
Douglasdale	D 5	ON	1.559 %	0.1552
Dr. Gladys M. Egbert	DG 8	OFF	2.578 %	0.2568
Dr. E. P. Scarlett High	DS 12	ON	2.697 %	0.2686
Fairview	F 11	ON	1.821 %	0.1814
Grant Macewan	GM 12	ON	2.570 %	0.2560
James Fowler High	JF 13	OFF	2.615 %	0.2605
John Ware	JW 8	ON	2.299 %	0.2290
Lester B. Pearson High	LP 6	ON	2.136 %	0.2127
Marlborough	M 9	ON	1.385 %	0.1379
Olympic Heights	OH 9	OFF	1.065 %	0.1061
Robert Thirsk High	RT 4	ON	2.080 %	0.2072
Sam Livingston	SL 6	ON	2.236 %	0.2227
Sherwood	S 6	OFF	1.873 %	0.1866
Stanley Jones	SJ 12	ON	3.623 %	0.3609
Twelve Mile Coulee	TM 10	OFF	1.361 %	0.1356
Tom Baines	TB 4	ON	2.350 %	0.2341
Valley Creek	VC 8	ON	2.055 %	0.2047
Wildwood	W 2	ON	1.184 %	0.1179
Willow Park	WD 12	OFF	1.958 %	0.1950

Note: Measurements are % of Safety Code 6 limit in an uncontrolled environment
 Safety Code 6 Limit = 10 W/m² (uncontrolled)

7.0 Conclusion and Recommendations

A total of 375 different locations were measured at the twenty-five school buildings. All measurements were well below the Safety Code 6 limit of 10 W/m^2 (for frequency ranges between 1500 to 15000 MHz). On average, the RF measurements were higher when the Wi-Fi equipment was turned on compared to when it was turned off, which is expected.

Both the background RF levels (Wi-Fi network “off”) and the total RF levels (Wi-Fi network “on”) show values typical for residential areas of relatively low population density. Note that higher population density usually relates to higher RF activity, especially cell towers.

Based on the findings of this survey, the RF measurements in the areas tested are well within the limits set by Health Canada Safety Code 6. The need for further investigations has not been identified at this time.

8.0 Qualifications of the Reviewer

Dr. Natalia K. Nikolova, P.Eng. (ON), is a Professor at McMaster University, Hamilton. She has been a faculty member of the Department of Electrical and Computer Engineering in McMaster University since 1999 where she teaches courses related to electromagnetic fields and waves, antennas, and radio-frequency (RF) and microwave engineering. She supervises a large research team working on projects in microwave and antenna engineering, electromagnetic field theory and computational methods. She has consulted for more than 11 years in the areas of microwave antennas, radar imaging and detection, and electromagnetic high-frequency computer-aided design. She has been working on collaborative projects between McMaster University and industrial partners related to the RF hazard evaluation of mobile devices and radiation sources for the last seven years. Prof. Nikolova is a registered Professional Engineer in the province of Ontario and a Fellow of the Institute of Electrical and Electronic Engineers (IEEE).

9.0 References

- a) Health Canada. *Environmental Workplace and Health: Radiofrequency Fields*. Updated 2009-11-12. <<http://www.hc-sc.gc.ca/ewh-semt/radiation/cons/radiofreq/index-eng.php>>.
- b) Health Canada. *Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz* (Safety Code 6). 2009.
- c) Industry Canada. *Case Study: Measurements of Radio Frequency Exposure from Wi-Fi Devices*. May 2012.
- d) Occupational Health and Safety Act - Ministry of Labour (MOL).

10.0 Limitations

This report has been prepared for the sole benefit of the Calgary Board of Education and is intended to provide a Radiofrequency Electromagnetic Field Survey of the twenty-five school properties. The report may not be used by any other person or entity without the expressed written consent of the Calgary Board of Education and G2S Environmental Consulting Inc. (G2S). Any use which a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties.

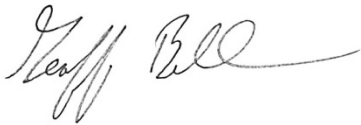
The findings in this report are limited to the conditions at the Site at the time of this investigation (November and December 2014) as well as information provided by the Site representatives as reported herein. Conclusions presented in this report should not be construed as legal advice.

If Site conditions or applicable standards change or if any additional information becomes available at a future date, changes to the findings, conclusions and recommendations in this report may be necessary.

11.0 Closing Remarks

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Yours truly,



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