

September 2015

I have written comments on this text version of an original draft report entitled "INDOOR AIR QUALITY/OFF-GASSING ISSUES, Citadel High School, Halifax, NS, January 2008" which was drafted after the opening of the new Citadel High School was reported to have caused health concerns for students and staff.

After Citadel opened, I had been asked by the Department of Education to help draft an assessment document about new school flush-outs. However, life issues caused me to be unavailable for several years. I don't know if this 2008 report is the planned document or if it is a separate document, and I don't know who the author(s) is. I am attempting to provide input that I would likely have contributed. If this has not already been accomplished, I hope it will ultimately lead to adjustments in procedures, such as adjustments to occupancy procedures, which ensure the health of students and staff in new schools and in major renovations.

Please note that this 2008 document was in draft form and someone else had already made comments on the draft. Those comments are those in italics and brackets. My comments are highlighted in grey.

Also, the copy that I received had names blackened out.

Even though there are sometimes setbacks, for two or more decades we in Nova Scotia have been doing great things regarding building and operating healthier schools. The list of the things we routinely do right is a long one - from the practice of no longer building schools on swamps, dumps, or other questionable locations right through to using less toxic cleaning materials in the finished building.

Thank you for the opportunity to contribute to the ongoing effort to make schools the best they can be for our province's school children. It is not always easy to be leaders, but we are, and I look forward to the day when schools, school children and staffs, across Canada benefit from what we have been doing and learning here in Nova Scotia.

- *Karen Robinson, Environmental Health Consultant and President of CASLE (Canadians for A Safe Learning Environment)*

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**INDOOR AIR QUALITY/
OFF-GASSING ISSUES**

Citadel High School

Halifax, NS

January 2008

Executive Summary

Without a doubt, Citadel High School is one of the best, if not the absolute best, school ever constructed in Nova Scotia. We fully expect it to achieve LEED certification.

It is concerning to me that Citadel achieved the LEED IAQ point despite the illness reported by students and staff during the first weeks and months. However, I have learned that the fact that people became ill was possibly not conveyed to the LEED adjudicators. When the NS Human Rights Commission called a December 2013 meeting of those of us involved in Citadel's planning and construction, we learned that few in TIR (others?) were aware of the number and severity of reported health concerns. I have attached Appendix A, a summary list of those who approached me in 2007 seeking my help in my capacity as Healthy Schools Consultant on the project and as Treatment Chair of the Environmental Health Association of NS. Appendix B is a separate list gathered by a teacher without either of us knowing about the other's list.

There is always more that can be done, and processes can be improved. However, it has to be recognized that the standard of school construction in Nova Scotia is acknowledged *[by whom?]* as being among the highest in Canada. There are costs and benefits to this, and we believe we have achieved an acceptable balance.

CASLE (Canadians for A Safe Learning Environment) informs all listeners of Nova Scotia's high standard for Healthy School construction and operation. Nova Scotia has been leading the way for nearly two decades. Many attendees (architects, engineers, researchers, agencies and government officials from other provinces and the Federal Government, building-related organizations and more) who have heard CASLE's presentations at international conferences on practices in NS have been excited by what we are doing here. We are told "We do research and work on theories, but in Nova Scotia you are putting these things into practice." We do continue to learn, but the builders of new schools as well as the operators of existing schools should be commended for their work to create Healthy Schools.

This does not mean that mistakes can't happen or that there is nothing further to learn or change. This is a process.

IAQ specialist and retired Public Works Canada IAQ researcher Tedd Nathanson drew conclusions about cost effectiveness and steps taken to provide healthy indoor air: <http://casle.ca/the-economics-of-good-indoor-air-quality-iaq/> In a personal communication he said that any effort to improve IAQ, even a Cadillac version, will pay back in avoidance of spin-off costs to productivity, health system, insurance, sick leave, family stability, and more.

In terms of healthy school design and construction, Nova Scotia is leading edge. Not perfect, by any stretch, but certainly very progressive as compared to other jurisdictions across Canada.

While problems at Citadel have manifested themselves as "inadequate off-gassing time", this is an unrealistic simplification of a very complex process.

While both parts of this statement are true, it is understandable that the media and possibly others often need to simplify the message and thereby focused mainly on the off-gassing issue, which had been in the plan and had suffered challenges.

Flush-out procedures are made up of several components, much more than just time to off-gas materials. (See <http://casle.ca/flush-out-guidelines/> from Healthy Schools Design and Construction (HSDC), the guidelines developed by the joint committee of TIR, DofED and CASLE, called Healthy Schools Construction Committee (HSCC).

In fact, off-gassing time is really a surrogate to conducting air quality testing to prove the air quality meets current standards. [This needs to be reconciled with _____'s statement that "Human bodies are more sensitive than those machines."]

And this is what is now done in Nova Scotia on a routine basis now.

The name was blackened out in the copy that was forwarded to me, but I believe the name is possibly mine. In my twenty five years of experience in the field of environmental health, air quality testing has not been a reliable indicator of air health and does not guarantee that occupants will remain well while in the building. As with mould testing, testing for contaminants is of limited value and any test results need to be used with care. People can become ill if IAQ tests are given too much merit in making decisions. HSDC developed a protocol to guide the safe opening of new schools and it can be found as item 5.0 in the 2003 Appendix of HSDC <http://casle.ca/wp-content/uploads/2015/05/Healthy-School-Design-and-Construction-Appendix-Robinson-7-2008.pdf>.

Relying mainly on air quality testing to "prove" that a school is ready for occupancy is a serious mistake. Using IAQ tests can sometimes be useful, and can help prevent litigation, but in practice they can fail people.

See the Flush-out protocol just mentioned,

see section 2.7 of the HSDC Appendix just mentioned,

and also Chemical Exposures: Low Levels and High Stakes, by Miller and Ashford.

Also <http://drclaudiamiller.com/about-tilt/> can help one's understanding of the health issues.

All of the air testing—every single test— was below the thresholds established by LEED, Health Canada, and US Environmental Protection Agency. By all accounts, and contrary to media reports, the school was absolutely safe for students and staff on opening day. Indeed, the school had the LOWEST rate of absentee staff during the September- December 2007 period.

I disagree. The school was not safe by all accounts. I pointed out that it was likely to make people ill and people did complain of becoming ill to varying degrees.

See the National Research Council/IRC IAQest project: <http://archive.nrc-cnrc.gc.ca/eng/ibp/irc/ci/volume-11-n1-1.html>

“Even though it is known that VOCs can adversely affect health, much more research is needed to determine safe exposure levels for each type of chemical, taking into account the variations in people’s sensitivities...”

From the NRC’s Institute for Research in Construction presentation to national IAQ conference c. 2010:

“Does TVOC correlate with IAQ?”

TVOC indicator is and has been widely misused; TVOC’s usefulness for health prediction is undocumented; there is no true standardized measure for TVOC ; TVOC cannot be used for normal regulatory risk assessment” Molhave (2003)

...Acute vs. Chronic exposures?

VOC Decay rates vary enormously (thus impact on chronic exposure)

Small surface area materials can release strong long-term emissions

Odour and irritation:

Are important aspects of IAQ and thus for assessment of product emissions

But: odour & Irritancy analysis thresholds are often above health effect levels, thus detailed chemical analysis coupled with toxicological assessment is needed”

(The underlines and bolded text were in the original NRC document)

Students and staff reported feeling ill enough to seek medical help, and some became ill enough to have to transfer to other schools. Some of these wrote letters to TIR, to MLAs, and the DofEd. I have copies of some of the letters and replies that indicate little or no acceptance that the building could be a factor, let alone be the primary factor in their symptoms. I hope that my comments in this document will help clarify the situation.

Absenteeism is not always a good measurement. Teachers expressed that they expected the first few months in the new school to be challenging. They were prepared for that and eager to get settled, but they did not expect to get sick. Also, despite complaints that do come in, in my experience people experiencing symptoms that they attribute to their home or workplace usually under-report their concerns for several reasons, including that IAQ related health issues are still often portrayed as controversial. Once some are complaining, then others may as well, however many do not.

Having said this, the school was completed later than expected, and there were odors in the building that would negatively affect sensitive people.

As just indicated by the NRC document, odours do not hurt people but they can serve as indicators. Chemicals that are indicated by odours and also chemicals that are odour-free can both harm people. These chemicals and their synergistic combinations can trigger symptoms and increase illness in some and can cause illness in previously well people. For example, the 175 international researchers in The Halifax Project are rethinking low level chemical exposures and cancer:

<http://www.preventcancer.ca/rethinking-cancer-symposium-watch-webcast-august-25th>

While we do not want to see even a single person affected negatively, it is acknowledged that we cannot build structures that are guaranteed not to affect very sensitive people. The number of people who complained of symptoms was small relative to the 1500+ people in the building, and it behooves anyone to justify putting these 1500 people back into their old schools while Citadel was left for months to “off-gas”.

[The thing to be careful of here is that nobody is suggesting this. The real issue is of ensuring that effective procedures are in place with respect to the new school project so that we can avoid having to be faced with this kind of scenario.]

Exactly. We can prevent harm. In the opening weeks and months of Halifax West and Sir John A MacDonald, for example, the schools had no health complaints to my knowledge. The issue is not just to protect the most sensitive students and staff, but also to prevent previously healthy people from becoming ill.

It is so common that the unexpected can cause school openings to be behind schedule. Unlike other types of buildings schools must start on time. We might be wise to routinely put contingency plans in place as back-up for each new school.

But also, even when lowest emission products are chosen and other controls are used to reduce the amount of offgassing in a new building, there is still some offgassing that remains. When chemicals are not flushed from the building, people’s bodies will do the “filtering”. Every molecule of foreign material that is breathed in must be dealt with by the body. Some molecules are cleared by the detoxification processes (Some are just breathed back out, others enter the bloodstream and have to be processed). Some do damage as they go through, some are stored where they can do damage there or if they shift to other places. Some are transformed into more dangerous chemicals by the body processes. (e.g. d’limonene and aldehydes)

Certain minerals and vitamins are used to deal with the molecules. If a body is depleted of necessary ones, or if the cleansing/detoxification organs are not functioning normally for any reason, then detoxification can be less effective. While some people may already know they are sensitive to their environments, we have no way of knowing who is on the verge of overload and of becoming ill when their body is given more to handle.

Students have developing bodies that use the building blocks the environment provides. We cannot control their family choices or personal choices but we can provide them with healthy schools.

Schools house a cross section of society and its health challenges. Asthma and other respiratory illnesses, migraines, fatigue, brain fog, and much more are triggered by airborne chemicals.

When CASLE guided the creation of an ECO-classroom at the new Lockview High, the original plan was to create an “oasis” classroom in all new schools so as to serve sensitive individuals. Making that room was successful enough to cause the DoEd to choose to make all new schools healthy places for all. That is, they recognized the benefits (to health and performance, and its cost effectiveness) of a healthy indoor

environment for all students and staff. This has proved to be very doable. HSDC was drafted to guide the process, and several schools have been healthy schools from day one.

Jennifer Boyle, a teacher in the opening months of both Halifax West and Citadel schools gave me permission to include this: October, 2007: "I have a history of severe allergies and environmental illness. At Citadel: sore throat, headache, burning eyes and I feel completely drained. Symptoms disappear at home, come back on Monday on return to school." Nov 23/07: "Within 20 minutes I lose my voice, have breathing problems. Dr. advised I stay off work until date "unknown". I was a teacher at Halifax West when it opened in 2002 and was perfectly healthy there from January until June. (School opened in January.) No issues whatsoever like I am having now."

There were lessons learned from Citadel and one recommendation resulting from this report.

I understand that recommendation was not followed. If any work has been done or is to be done on this, I would like to be a part of it. I work collaboratively to identify challenges to the healthy school goals and sort out action plans with the various professionals. I bring my 25 years of knowledge, training and experience to the table along with access to many experts across Canada and beyond, including those who developed HSDC with us who have expertise in many aspects of healthy building design and construction.

We would be remiss if we did not acknowledge the extraordinary care and due diligence exhibited by the building designers, constructors, project management staff, inspectors, school board staff, and those that selected and installed the Furnishings and Technology. Their efforts have gone unsung for the most part.

Yes, we must praise and continue what they/we are doing well. At the same time I know these professionals would want to prevent sickness and I know that they continuously strive to make improvements.

What is Off-Gassing (Flush Out)?

Much has been made in the media and other correspondence upon the opening of Citadel High School about the building causing staff/students to be sick. This has been blamed, for the most part, on inadequate off-gassing (Flush Out) prior to occupancy.

See my previous comment about the media. People who are suffering will sometimes turn to the media when their concerns seem not to be heard.

This report is intended to be a factual account of what actually transpired at Citadel High and what the expectations were.

I believe that the expectation was not to make people ill and that this building process would not make people ill, however, the author was apparently not made aware of the health complaints or possibly of my communications to the authorities in the weeks leading up to and following the school's opening.

Simply stated, there is no accepted definition of what off-gassing entails or the time required. Off-Gassing is intended to mean the airing out of a building or building components (e.g. furnishings) to reduce the amount of harmful gasses given off by the time the building is occupied. There is no set procedure or time frame that the writer could find for this process, although LEED came the closest.

We were well on the way toward setting an “accepted definition” here in NS schools. Yes, there is still no one accepted definition that I am aware of nationally or internationally, although many are working in that direction, as can be seen by some examples in this paper.

At the time, and it is still largely true today, most of the practical experience in opening buildings that do not make people ill existed in the field of Environmental Health (or Environmental Illness). No one to my knowledge has come closer than they/we have to finding a protocol that will work, although it would be good to take another look at what is being done in Denmark and Sweden now. CMHC researchers had done some work on this, including constructing a model home of less toxic building materials and beginning to look at how flush-outs work in tandem with source control. (See their publications, including *Building Materials for the Environmentally Hypersensitive*. Order # 61089)

CMHC's Dr. Salares, now retired, sent me the following email 29/07/2007 12:32 PM

“Hello Karen,

... We do not have a protocol for flushing out houses. Years ago, there used to be suggestions of building bake-outs. These are not recommended because raising the temperature cannot get rid of emissions from the core of materials. There is also potential damage. What is more important is increased ventilation, just like what you are advocating. As for the length of time, the longer it is, the more effective the flush out. Tests to monitor the effectiveness would tell something, but this process involves cost. Every building will be different. The loading (amount of emitting substances), the ventilation rate, the air distribution, the temperature and RH will all affect the effectiveness of the flush out. A two-week period is better than none, but four weeks would even be better. You can suggest four weeks or longer. The length of time required for airing out a home after construction depends on the extent the sources were controlled and the sensitivity of the occupant. Even solid wood, if extensive, takes time to air out.”

Learning how to build and renovate homes for highly sensitive people made physicians and researchers and support staff (such as myself) of Environmental Health medical facilities quite knowledgeable about what to do and how to do it. The sick people we deal with need that in a very immediate and practical way. In new schools it begins with site selection and carries on through all phases, including materials selection and a flush-out phase. At Halifax West we brought in professionals in materials selection for health to teach architects and designers. That process has improved over the years as TIR ran with those skills and as manufacturers have taken up the challenge to protect the natural environment and human health.

This information has also translated well to create healthy homes for healthy people, something I have practiced for the past twenty or more years, in addition to my work for sensitive or ill people.

I worked closely with TIR and Dof Ed on Halifax West and Sir John A as we sought to translate those procedures used successfully in homes into the creation of schools. (I have also worked with the Department of Health to create healthy offices and senior citizen complexes.)

Again, see the HSDC occupancy guidelines and the protocol item 5.0 in the Appendix of HSDC. The committee drafted the HSDC and Appendix with extensive input from professionals with expertise in environmental health as it relates to buildings.

You will not find this depth of information in the US Environmental Protection Agency or LEED and so on. We were creating this right here in Nova Scotia and we were succeeding.

At Citadel High, for the first time, and as a result of what we had done right at the previous schools, we developed written flush-out specifications for the "Specs" to guide this school's occupancy. Then, somehow, without my input, the specifications were changed to reflect the LEED air quality recommendations, including the option to just test air quality. I objected, but was told to "prove" that I was right. Somehow, some had apparently lost sight of what we had been doing to achieve just that.

US Environmental Protection Agency

The US Environmental Protection Agency in its IAQ Design Tools for Schools simply states: "Consider a building flush-out at the end of the construction process and before occupancy." It goes on to say that "through careful materials selection and material minimization, the designer can greatly reduce or even eliminate the need for air out and flush out."

This is true in my experience. Some flush outs can be one week end, depending on the products, the size of the project, source control, and other factors.

This same section discusses "Flush-out" as follows:

"Flush out is when large amounts of outdoor air are forced through a recently completed building for a period of 3 to 90 days (Note this is a 3-month period) so that the majority of pollutant emissions from building materials, finishes, and furnishings can be removed from the building before occupancy. The recommended minimum volume of outdoor air needed for flush out is the amount needed to ventilate the full school at least once each hour (1 ACH or air change per hour), 24 hours a day, 7 days a week. [For how long at this rate?] It depends on what is there and how much of it is there, and also on humidity. Controls such as source control and a flush out of 6 to 8 weeks have worked in homes and larger buildings and we were doing our best to find the optimum combination of factors for new schools. Summer, with its heat and humidity, is a good time to flush out. At Halifax West the builders finished the school in quadrants in order to leave as much flush-out time as possible in the more occupied parts of the building. The gym floor was finished early, window and door trim were painted off site and aged before installation...and much more. All combined to make the air clean on day one. At a minimum, all mechanical ventilation systems should be set to provide the largest amount of outdoor air as practical from the final construction stages when floor products and paints are applied through the first few days of occupancy. Based on a 90-day flush out of two different office buildings, the state of

Washington now requires a minimum 30-day flush out period for all its new public buildings. California's building standards also require a 1 hour daily flush out prior to normal building occupancy [*Again, how long is this to happen? Does it extend to after occupancy?*] to reduce contaminants that may build up when the ventilation is off overnight”

In my experience, if we have done a good job of source control and initial flush-out, California’s practice may be sufficient, including the daily flush-outs after occupancy. Consider, however, that we are dealing with the developing bodies of children and 6 to 8 weeks may be a wiser choice given that and other factors outlined in <http://casle.ca/understanding-new-building-flush-outs/>

HSDC, says extra ventilation may be necessary up to a year for 24 hours a day, depending on pollution levels. The Appendix of HSDC, 5.0 , recommends that decisions such as this be made by a committee. Since we are dealing with the developing bodies of children it makes sense to choose more rather than less. We were finding a cost effective process that worked.

In addition to Tedd Nathanson’s article, also see information on cost effectiveness at <http://casle.ca/cost-effectiveness-of-healthy-buildings/>

EPA’s top 10 recommendations include the following:

“In order to flush polluted air out of the school, bring adequate outdoor air into the building using the school ventilation system. Maintain minimum outdoor air ventilation rates consistent with ASHRAE 62.1, which for classrooms, is about 15 cubic feet per minute (cfm) of outdoor air per person. ”

Upon asking the specific question "What period of time do you recommend to "flush out" a building upon completion" of the US Environmental Protection Agency, I was referred to the following article from the US Department of Energy on Building Commissioning:

“Consider a building flush-out period to reduce possible indoor air quality contamination after construction completion and prior to occupancy. This involves running the mechanical system with tempered 100% outside air for an extended period of time (two weeks). Flushing out the building may be particularly important when high VOC and particle-emitting construction materials, furnishings, interior finishes and cleaning agents have been applied. Care should be taken with regard to humidity levels and microbial growth depending on the seasonal weather conditions. All ventilation air filters should be changed as a final step of building flush-out.”

As can be seen, if a flush-out is considered, a two-week period is recommended. (...by The US Department of Energy on Building Commissioning. The US EPA suggests up to 90 days. Each appears to be in the process of determining what works best, and this is a good process in which to be engaged.)

National Best Practices Manual [*Is this a US document or Canadian?*]

The National Best Practices Manual for building High Performance Schools states:

“Allow adequate time for the installed materials and furnishing to “off-gas” before the school is occupied. Run the HVAC system continuously at the highest possible outdoor air supply setting for at least 72 hours after all the materials and furnishes have been installed.”

This is a US document. It gives general encouragement which is good, but provides few details. I wonder what caused them to choose a number like 72 hours, but the words “at least” indicate they are aware that more would be wise.

Health Canada

Health Canada weighs in on the issue in its Tools for Schools Action Kit for Canadian Schools.

While it acknowledges that off-gassing can continue for long periods of time (months or years), they do not specify an off-gassing period of time. They state:

“whenever new products with the potential for off-gassing are installed, allow adequate time for off gassing before re-occupying the area, and increase ventilation with outdoor air until off gassing odours and any irritation symptoms no longer occur”

[The interesting thing to note is that this uses the existence of symptoms as a gauge for when to stop the “flush-out” period. _____ (name blacked out in document I received) makes reference to “environmental illness” as a condition where “...people... become more sensitive to indoor air pollution...” If this is true that people become “more sensitive” because of the exposure from a new building, then the process recommended by Health Canada would have to be considered imprudent]

I agree it was not the intent of the document to use sick people as a test or gauge. This Health Canada document does not detail flush out instructions because it was not part of the mandate of this Tools for Schools Kit project. The study’s purpose was to study Kit implementation procedures. However, what the Health Canada led document is indicating is that, once a building has been flushed out or aged using a protocol, if occupants still experience symptoms the flush out should continue and occupants need to be protected from potential harm. CASLE served on the Health Canada research project’s Project Team for this Canadian Tools for Schools Kit study and on a second similar study. CASLE was also an invited reviewer in the development of the US EPA Tools for Schools Kit.

This, of course, is a reasonable approach, provided it is not taken to mean a period of time until the most hyper-sensitive person no longer experiences symptoms.

The most hypersensitive people are not usually in the work force. The most hyper-sensitive cannot go to the grocery store or do many things the rest of us take for granted. Some can return to work after extensive detoxification and healing allow them to function again outside their protected living environments. For some this never happens. However, many teachers who would be classified as “the working ill” have been transferred into Halifax West. They feel well and are highly productive there. The principal of that school told me he has a staff full of sick people who are not sick in his school. It is completely possible to enable these people to function normally, and also to prevent illness onset in healthy people when we open new schools. To learn more about Environmental Illness, read the report

by Dr. Meg Sears on the Canadian Human Rights website: http://www.chrc-ccdp.gc.ca/sites/default/files/envsensitivity_en.pdf

The CHRC policy was confirmed in January 2014, and is available here: http://www.chrc-ccdp.gc.ca/sites/default/files/policy_sensitivity_0.pdf

The CHRC Legal Perspective:

http://www.chrc-ccdp.gc.ca/sites/default/files/legal_sensitivity_en_1.pdf

Generally, one would consider the ASHRAE approach where they apply the 20/80 rule. That is, things are probably OK if 80% of the occupants are OK.

The 20/80 rule in ASHRAE needs to be reconsidered. Having one out of five people in a building suffering health problems from the building would surely reduce staff productivity to an unacceptable level and would also mean the incidence of onset of permanent illness would rise comparably. See the HSDC Appendix for more on ASHRAE's 20/60 rule. Or, a copy of it is available at <http://casle.ca/about-ventilation-standards/>.

Health Canada, in its Environmental and Workplace Health document, takes the approach that the best way to eliminate harmful **gases** in the building is through source control, which was fundamental in the design and construction of Citadel. They also suggest to

"increase the flow of outside air during both occupied and unoccupied hours (eg. run ventilation system continuously until levels are within an acceptable range)" [A common comment from those who complain of the air quality issues at Citadel High School is that we cannot use the low VOC materials issue as the main defence against air quality issues. They maintain that the flush-out period is the key approach and that the longer the better.]

I do wonder who claims this, but more importantly, BOTH are important. Source control is important to reduce or prevent the presence of as many chemicals as possible and to eliminate if possible the most toxic ones. Some materials continue to emit chemicals for a long time, so we hope to avoid such materials. A flush out optimizes the most active shorter term off-gassing period of many new materials.

That the flush out was largely missing at Citadel and partial shut downs during late commissioning likely caused it to be focused upon in complaints.

School Planning and Management Journal

In an article by Ken Leach in the School Management and Planning publication, he espouses the importance of reducing off-gassing, again, by source selection. He advocates higher ventilation and better filters, but does not suggest that an off-gassing period at the end of construction is necessary.

Michel Joffres Study

In a very extensive study entitled "Indoor Air Quality in Canadian Schools", Dr. Michel Joffres references off-gassing of materials several times, but did not include any specified time frame for off-gassing the building. Once again, the emphasis is on source control to reduce emissions.

This document is one of the two Health Canada led Tools for Schools Kit research studies I referred to earlier. Dr. Joffres was the lead researcher. The study was to identify the best implementation methods for the Kit and was not expected to research or comment on precise methods for either source control or flush outs. Again, I served on this Project Team, as did a staff member from the Facilities Planning Division of the DofEd.

CASLE

There are a number of articles written by CASLE (Karen Robinson, et al) that discuss off-gassing. Among a great deal of such articles, the following are pertinent to off-gassing:

In the article Steps Towards Healthier New Schools, Ms. Robinson writes:

"offgassing {for gymnasium} for 8 weeks before occupant made a difference too.. {in air quality}"
Emphases added. There are other references to the benefits of off-gassing but no specific times.

Also see <http://casle.ca/flush-out-guidelines/>

And <http://casle.ca/understanding-new-building-flush-outs/>

CASLE had been recommending flush-out periods since before 1998 in talks and presentations to government departments, school boards, and industry, and including more recent recommendations on several schools including Halifax West, Barrington High, Sir John A and Citadel. In the earlier years we had followed CMHC and other's "bake-out" recommendations, but we removed the heat option when it was found, as Dr Salares also noted, it could cause damage to new building materials.

I believe that in this evolution of source control and flush out combinations we need to look at what happened at Citadel as an example of the pendulum swinging too far back. I hope we will learn (from reports such as this one and from other experience) and settle the practices in a healthy spot in the middle.

Nature Natural

The website Nature Natural talks about off-gassing in general and the health effects of poor indoor air quality. It states that these gases are known collectively as VOCs (volatile organic compounds) and the need to reduce them. It does not refer to a specific off-gassing period.

Healthy Schools Construction Guidelines for New School Buildings (Nova Scotia)

In the "Building Readiness Guidelines for New School Buildings" prepared by the Healthy Schools Construction Committee here in Halifax, there is no mention of off-gassing. It emphasized source control of materials (as do all of the other sources) as the primary method of improving IAQ, but suggested testing and a final inspection as the means of knowing when the building is ready for occupancy.

The inspection is an important point. In the HSDC paper being quoted here, the committee's overseeing and inspection are very important parts of the method to decide if the building is ready for occupancy.

The full document is found at: <http://casle.ca/wp-content/uploads/2015/05/Healthy-School-Design-and-Construction-Appendix-Robinson-7-2008.pdf>

In the Healthy Schools Design and Construction document, September 2002, the following are references to off-gassing time frames:

The July 2003 draft was formally submitted and is the version most commonly referred to, however the items below are essentially the same as mentioned there.

- a) Under the section on flooring, it states
"allow adequate (possibly several months) off-gassing."
- b) Under the Contract Task List it states:
"Allow for sufficient off-gassing time after completion of school before it is occupied."
- c) Under Program Task List, it states;
"Off-gas new computers and plastic/PVC encased equipment (turn on and heat up, for several weeks if needed). "This section also refers to the need to off-gas gym equipment and some furnishings, but no specific time frame is mentioned
- d) Under Source Control section, it is stated that the chairs be off-gassed by the supplier
"in a well-ventilated location several months before they are shipped " This same section indicates that
"In some finished products formaldehyde will continue to off-gas indefinitely..."
- e) In the section on Flush out Procedure, item 4 reads as follows:
"Maintain the flush out for as long as possible or necessary-usually a minimum of 24 hours, but sometimes as long as several months, depending on the materials being off-gassed and amount being off-gassed. Some experts recommend that after completing the aggressive flush out, a high ventilation rate should be maintained for at least a year"

In addition, see Page 18, Item #115 of the Architectural Task list: "Upon completion and thorough cleaning, allow for 6 to 8 weeks of offgassing of building and contents, with ventilation on high, all cupboards open, computers on, blinds, fabrics, room dividers, furniture and equipment, etc., exposed to ventilation."

Page 30: "designate a smaller room as a centre for materials, furniture and gym equipment offgassing, with ventilation on high six to eight weeks."

Page 11 of Source Control, Item 12. "Refer to HSCC's Preoccupancy Guidelines (in draft form presently), and:

- a) Keep building's main ventilation system off until after final cleanup or use delivery side only but with filters, and pressurized at all times to avoid ingestion.
- b) Provide local adequate ventilation to control construction emissions.
- c) Cleanup must be thorough after construction.
- d) After final cleanup, prior to occupancy, allow several weeks of flush out with main ventilation system on full.
- e) Open all doors, drawers, cabinets during flush out period.

Note: Off-gassing and exposure are influenced by amount of surface area. For example, the effects of

small amounts of caulk would be potentially less than the effects of the bulk of plastic furniture, even though the caulk may contain more toxic ingredients. The more the surface area, the higher the emission and/or potential for adsorption and re-emission of VOCs from other porous sources. For more information on source control and companies that specialize in least toxic materials selection, see the appendix.”

Under The Elements of Occupancy Review heading:

“The legally recognized provincial standards for Indoor Air Quality (IAQ) for workers are the ACGIH standards, however these industrial standards may not be adequate for protection of the developing bodies of children. To achieve more appropriate guideline we are using a combination of controls and standards, including: (1) Source control in several forms (*including elimination, substitution and dilution*) {emphasis added} (2) traditional commissioning processes (including performance testing and with some adjustments), (3) observations and recommendations of an evaluation team and (4) testing according to Health Canada’s Exposure Guidelines for Residential Indoor Air Quality and ALARA (As Low As Reasonably Achievable) principles.

The broad approach to preoccupancy guidelines also includes warranty period follow-up and a user's manual, management and occupant training and a general preventive maintenance plan, including maintenance logs, frequent filter replacement, equipment maintenance and more. (1) Source Control as covered in the Healthy School Design and Construction task lists is central to achieving a healthy building on opening day as well as for years to come. *Also require a Flush Out Procedure with building heat on for a minimum of (six to eight) weeks, but possibly longer if the Guideline levels are not reached, and continued flushing at 100% fresh air at a high rate for at least one year after opening.* {emphasis added}.

Appendix, Healthy School Design and Construction, Page 53 (2) Evaluation Team: This committee would be formed by the Department of Education, but would be a non-technical team. That is, the architects, Dept. of Transportation and Public Works (TPW), air handling team etc. would be present to answer questions, but not serving on the committee itself. This committee would be formed early in the process to overview the healthy schools aspects of the project, oversee the elements of the Building Readiness Guidelines throughout and evaluate and advise the Department of Education on the success of the elements. At the end of the project their role would be to review the commissioning and performance tests, and the IAQ evaluation (according to this document), and walk through the building and grounds before recommending readiness to the Department of Education. As mentioned, this readiness recommendation would include the TPW readiness decisions, but would be a separate recommendation specifically on whether the building is ready in terms of occupant health risks. This evaluation team’s participation as an advisory committee needs to be included in contracts and agreements to ensure the committee has access to information as the project develops, although authority for decisions remains with the Department of Education.

In a document provided by **Nova Scotia School Board Occupational Health and Safety Program Administrators**, and included as an appendix in the Healthy School Design and Construction Manual, they requested that gymnasias be completed early due to off-gassing. They also suggested that

“all schools must have at least three week gas-off period and base line testing for formaldehyde, VOC, noise and lighting levels prior to occupancy. Gym floor coating is never to be applied or drying while the building is used by students. ”

Gymnasias require special precautions because of the area size, even if lower emission and lower toxicity products are used. Also, “at least three weeks” indicates more is better.

LEED

One of the most common references to flush out is that required by LEED. There are a number of LEED criteria, but the one most applicable appears to be from the Canada Green Building Council, LEED Green Building Rating System. This document refers to three options for testing for air quality before occupancy. These include:

Option 1 Building Flush Prior to Occupancy (About a three week process)

Option 2 Building Flush Overlapping with Occupancy

Option 3 IAQ Testing Prior to Occupancy.

Construction process have used a number of strategies for achieving this. Energy Design Resources suggests allowing for option 1 (two weeks in the schedule) and option 3 in case there is insufficient time at the end of the construction schedule. It also states that commissioning activities may occur during the flush out period. The Mechanical Contractors Association of America endorses this protocol.

Obviously, source selection of materials is a very high LEED priority and highly emphasized in this document.

The LEED recommendations are indeed commonly referenced. LEED is a high-profile, well promoted program that focuses primarily on sustainability and energy efficiency. It is not the most informed regarding environmental impacts on human health. It is a largely self-regulated, pick-list approach that awards certificates for buildings that achieve total points in categories. It is very valuable for raising the interest and efforts toward creating better green buildings, but a close look at individual projects can reveal significant deficiencies in the program. I am a member of the CaGBC and I have spoken at several international conferences on this. I had begun work with one of LEED Canada’s authors when personal circumstances for both of us caused us to postpone that effort. We met three times, planning to help correct the deficiencies that the author acknowledged were common. That is, that LEED buildings were too commonly achieving certification despite, I quote, “not coming in on time, not on budget, being energy pigs, and making people sick.”

LEED is well intentioned and has contributed to good advancements overall, however,

1) allowing options 2 and 3 pretty much eliminates the perceived need for a truly effective flush-out.

2) option 2 puts occupants at risk. And

3) when Citadel received the Air Quality point, LEED's stature and credibility regarding health and IAQ were damaged further.

LEED has significant deficiencies in a very practical sense.

I will add that LEED's strength in product selection is overall very good. However, it has been concerning to see some "green" products and methods given precedence over "healthy". A good example is the LEED point awarded for using modular, recycled carpet. Healthy schools are built without carpet for good reason. Recycled, modular carpet is no exception. (See the report on this prepared for the DoEd by Enviro-Health Consulting: <http://casle.ca/carpets-in-schools/>)

There are other examples. I hope that LEED will upgrade its healthy building priorities and I would be pleased to help with that.

CMHC

Canada Mortgage and Housing Corp. deal mainly with houses. However, they (Dr. _____ name blackened out) have been asked to comment on school off-gassing and advise they have no protocol for flushing out houses. They advise that the longer the flush out the more effective it will be. It will depend on the amount of emitting substance, ventilation rate, temperature and relative humidity. They suggest a two-week period is better than none, but four weeks would be even better.

I believe this is a summary of Dr. Salares email to me. I provided the actual text above. It encourages us to attempt to get longer flush-outs. CMHC has credibility because of the work they have done to make healthy homes for people with environmental sensitivity.

Because of the variables mentioned, it is not as easy to recommend a time for flush-out length as it is to work on source control. This does not mean that it is not also important to try to find a protocol for flush-outs that works well.

Cross Canada Survey on School Building Flush-out:

A survey was conducted coast to coast in Canada to determine what other Department of Education offices do with respect to off-gassing (flushing out) schools. They were also asked if there was any air quality testing regime carried out prior to school occupancy.

Generally, it was found that no such process existed. They neither flushed out the buildings nor tested for air quality prior to the move in.

This is not a surprise, given that, as stated in the opening paragraphs of this document, Nova Scotia is leading in building healthy schools.

It was found that Newfoundland is considering going with LEED (silver) as a building standard. That standard provides for three options, one of which provides for flushing out the building (generally two weeks is anticipated-depending on the building ventilation system capacity).

Some other provinces are either now going with LEED standard or anticipate going with a LEED standard in the future.

LEED is very assertively promoted. Some believe BOMA is a better program. I hope that LEED can repair its deficiencies, and begin to do great things regarding IAQ.

It should be noted that the remaining two options involve flush out with occupants in the building and thirdly, a baseline IAQ air testing using USEPA "Compendium of Methods for the Determination of Air Pollutants In Indoor Air."

Where Are We, in General, Regarding Off-Gassing?

It has been acknowledged by CASLE, and others, that Nova Scotia is a leader in healthy school construction. We go beyond what any known school jurisdiction in Canada is doing to provide environmentally sustainable and healthy schools.

Notwithstanding, we still get complaints about air quality. Some are well-founded while others are completely misguided. *[This comment has 2 problems. Firstly; it is quite aggressive. Secondly, it implies that someone is "guiding" incorrectly.]* *How was lack of credibility determined in each case, and which ones were determined not to be well founded? Building occupants can be a strong resource for identifying problem areas. I would like to know who wrote this document.*

The province will continue to take a proactive approach, and implement and monitor procedures and materials to ensure schools are designed and constructed to reasonably meet healthy standards. That is not to say our new schools will, or even can, accommodate every hyper-sensitive person. Such a building probably does not exist - we need to accommodate such students and staff on an individual basis. The expectation is that there will be very few such affected people. Besides their home, they will find schools the healthiest places they can go.

Yes. This is what I understood the Province is doing. I applaud this and will do my best to assist as always. These sensitivities include migraines, asthma, and many other environmentally induced or triggered conditions. There is much research now on how healthy buildings provide better educations for all. When people feel well they learn and teach better.

While much has been made about the length of the off-gassing period, it is really the end result that matters. It is well known that materials can off-gas for many months or even years. There is no agreed upon standard period of off-gassing but instead, variations exist, from one hour to several months and in at least one case, a whole year. Obviously, one has to weigh the period of off-gassing with the potential of keeping students in their old building for a longer period of time. Certainly parents would want documented proof that such a process is in the best interests of all. *[Again, we will be criticized if we are seen as recommending a lesser process because of these issues. We are going to be held to an appropriate standard for the new building, independent of anything else. If there are issues with, the buildings they are in now, that will need to be addressed as well]*

Yes. When Barrington High had to continue to be used while the new building was being built much effort went into making the old building as healthy as possible by adding filtration and increasing ventilation and more. When Halifax West student body had to be housed in other buildings, the Department of Education funded repairs and filtration and more to make the interim buildings as healthy as possible.

Because off-gassing has not been well defined, much confusion exists about how much off-gassing time has been provided at the opening of the school. For example, when does it actually begin -when the ventilation is turned on or after substantial completion? As soon as possible. Build in an early flush-out or flush-outs. Halifax West was conceived and built in two years. It is a matter of making it a priority and finding ways. Some can be general practices and some will need to be adjusted to fit specific factors in each school. How much work can be done after substantial completion (deficiencies) and still consider the period as off-gassing time? LEED has provided the best guidelines that we have seen to date. As indicated, I believe this statement is incorrect. Also, it is more important to do it right to protect occupants than to get a LEED point. It would certainly seem to meet recommendations from Health Canada and USEPA, as well as the basic intent of the Healthy Schools initiative in Nova Scotia. No. LEED misses the mark in that regard.

As evidenced by CMHC more off-gassing time will reduce the amount of gas given off while occupants are present, but there really is no standard They suggest four weeks or more. CASLE suggests eight weeks. Again, while more may be better, every building is different. The only real indicator of adequate offgassing is to test for the harmful gases prior to occupancy. [_____ blacked out, do not agree.]

Negative air quality tests are not a reliable judge for opening a building for occupancy. Controls work better than standards. HSDC recommends controls such as source control, including eliminating unnecessary harmful materials, and a priority to age and flush out materials and furnishings, plus firming up the draft protocol in HSDC Appendix 5.0 that includes a committee tasked with this for the particular school, and includes a final flush-out of 6 to 8 weeks, and longer if possible. Testing is included as part of this, but must never be a central deciding point. As an illustration: Some medical tests sometimes give “false negatives”. If testing shows the illness is present, then it is likely present and treatment is begun. If testing shows the illness is not present then alternative tests and assessments may be necessary, especially for tests that have a history of giving false negatives. Sometimes 20% or more can result in false negatives.

The NRC information above supports this.

From HSDC’s 5.0 Draft Building Readiness Guidelines: <http://casle.ca/wp-content/uploads/2015/05/Healthy-School-Design-and-Construction-Appendix-Robinson-7-2008.pdf>

“(4) IAQ testing. Testing has value despite inherent limitations. (1) It is applicable only to the exact location and time where testing was done, (2) It is only as accurate as the equipment and technician’s interpretation, (low levels that have produced symptoms are sometimes not picked up by testing equipment), (3) There is a risk that the numbers will be given attention not afforded other evidence that could provide obvious clues, and (4) It can be costly and time consuming.”

LEED provides for the option of off-gassing the building or air quality testing prior to occupancy. At Citadel, BOTH were carried out; albeit not entirely meeting LEED standard. The off-gassing time was compromised by other work going on, and in particular a glycol leak in the main foyer. The third LEED option of air quality testing was also carried out, as in previous schools, but that regime of testing did not meet LEED standards. *[I question the thought that, because we did not achieve the LEED standard for flush-out due to a small amount of work being done after Substantial Performance, the flushout period was rendered ineffective. Does work in one small section of a large building mean that the flushout period does not achieve what it is intended to?]*

A possible approach could be to use the standard for infection control in healthcare construction projects. This mandates that a barrier is constructed around the work area, with a negative air pressure maintained within and the air exhausted directly to the exterior. If the required work areas are small in size and number, this approach should satisfy even _____ (blacked out) that the flush-out period is not rendered ineffective. Achieving the LEED point should NOT be the gauge of effectiveness in these circumstances.]

Yes, the potential health of occupants is more important, and if the enclosed area that was worked on needs to remain sealed off and with ongoing exhaust and ventilation in order to make it good for occupancy, then it could be effectively “removed” from the school’s occupied area when school begins.

Due to the late completion of the building; the formal commissioning still has not been completed. This is a very detailed process which is intended to resolve any outstanding issues (of which there are some, as in any new building). At this time; an effort is being made to complete this work as soon as possible. *[A common criticism of the Citadel situation is that air balancing was not done or various ventilation deficiencies exist]*

What was Done at Citadel with Respect to Off-Gassing?

The following gives an account of what transpired at Citadel with respect to off-gassing the school prior to occupancy in September 2007. The off-gassing issue was given high prominence as a result of past experience and trying to meet the Healthy School Design and Construction guidelines prepared by the Healthy Schools Construction Committee in 2002. *[I need more information about this committee and its recommendations.]*

The 2003 version was the one used for inclusion in the DC350:

<http://casle.ca/healthy-school-design-and-construction-2003/>

Because of frequent and long term success assisting the DofEd around the province regarding Healthy School issues, and because there was a goal to make all new schools Healthy Schools, I was asked to form a committee to pull together guidelines to advise the Departments in the creation of Halifax West High School as a “benchmark” healthy school. I asked for representation on this committee from Dof Ed, TIR (TPW), and CASLE. See the document for more details on the committee and procedures used.

The Appendix contained much relevant information as well: <http://casle.ca/wp-content/uploads/2015/05/Healthy-School-Design-and-Construction-Appendix-Robinson-7-2008.pdf>

This Healthy School Construction Committee (HSCC) set about creating task lists for relevant segments of school creation. We had no budget, but we asked professional advisors from across Canada and within NS who have special training on various aspects of healthy buildings to provide information, review and help revise the final document. The interest and excitement among them was gratifying. They saw the potential to lift research, practices, and theories up into reality in this document that had the potential to very positively change the way schools are designed and built. The result was Healthy Schools Design and Construction (HSDC) and its Appendices, 2003. (Further input led to a 2008 revision.)

Each item was reviewed for inclusion in the planning and construction of the new Halifax West.

We succeeded in creating a Healthy School, given that no one reported any ill health at all on opening day or in the weeks that followed, and over the years many environmentally sensitive teachers have been transferred into the school (confirmed by recently retired placement officer of HRSB and by the principal).

The school also had a mandate to be a “green” school. That was not part of the HSCC mandate and unfortunately some of the green technologies used caused challenges and continue to cause challenges to maintaining this as a Healthy School. For example, condensation on heat pumps in each room drip and cause mould growth. I understand some solution is being sought. So far that has meant ongoing mould prevention efforts. But the benchmark school has taught us a lot about creating Healthy Schools, and other successful schools have followed.

We (CASLE, TIR, DoEd) then spent two years examining each item for possible inclusion in the DC350 Design Requirements Manual for use in making all new public buildings Healthy Buildings.

It is important to keep departmental and board staff well versed in the healthy school items so that they understand the details and priorities when new schools are planned and built. I see this is one of the suggestions in the conclusion section of this report and I heartily support that.

The Team

At the beginning of the design process, the Halifax Regional School Board hired an environmental consultant to review specifications, attend meetings, and advise on matters related to delivering a healthy building. [_____] (blacked out)

I was that consultant. The Department of Education supported this plan and provided the funds. Terry Smith-Lamoth and Mr Cummings, the commissioning professional, and I wrote flush-out specifications that were to be included in the Specs, but I learned late Spring that they had been rewritten without my input. LEED options were to be given precedence. I voiced my concerns.

Also, I was not allowed to speak to the construction company’s decision-makers or to the trades to gain their interest and understanding of Healthy School goals. I was eventually allowed to produce a power-

point CD which I was told would be given to them. Personal communication would have had much more impact.

This school design followed the procedures required to obtain LEED (Leadership in Energy and Environmental Design) certification and as such, had considerable oversight [*“oversight” isn’t the best word to use here.*] on health and environmental matters. This was assured with a LEED consultant reviewing products and processes, the contractor providing LEED information to make decisions, and the designers specifying only products acceptable to meet LEED standards.

As mentioned, while it gets some of it right, LEED is not expert in environmental health. In some cases LEED requirements are counter to Healthy Building items. Examples: use of recycled carpet, chemical toilets, rubber floors. While materials selection is generally done well, it is important to eliminate chemicals in general and not focus on just toxic chemicals. Operable windows were once frowned upon in LEED, but became acceptable eventually. To create a healthy school, both LEED and Healthy Schools professionals have value, but it is important to make healthy choices a priority.

A very experienced project manager and full-time site inspector were also employed.

This has benefitted schools before and I believe it is important to continue. I agree these were skilled people among the best.

As the project drew to a close, training was provided to the board staff and a custodian hired several months before occupancy.

This has worked well before and should continue to be done. Avoid staff turnover or train new staff thoroughly each time.

Overall, this team would be considered as competent as any ever put together to deliver a school.

I agree. Note that these roles were part of HSDC recommendations.

However, I believe that my services as Healthy Schools Consultant were underutilized especially during the construction phase. Meetings were had and decisions were made without my being consulted. I had no way of knowing what was or was not being done other than at the monthly progress meetings where we were assured the school would be ready on time despite setbacks.

Material Source Selection

By far, the most important aspect of delivering a healthy school is to ensure selection of materials that have low VOC (volatile organic compounds), particularly low or no formaldehyde. This was specified at this school and achieved to the highest standard yet for any school constructed in the province. All adhesives, paint, coatings, sealants, and composite wood were strictly controlled by the contractor and verified by the LEED consultant. The following will provide some rationalization for this statement:

Source control is an essential aspect but so is a flush-out, and certain design elements, and good site selection as well.

1. Paints All paint was latex, low VOC, and applied as early in the construction process as possible to assure no off-gassing at occupancy. Due to construction delays, a small amount of painting was carried out until just before occupancy. Where and how much painting was carried out can be important.

2. Wood Products All millwork, wall paneling, plywoods, doors, and wood blocking was specified and supplied with no added formaldehyde. The laminates were all heat applied at the factory and all edges were factory finished. Cuts and holes were sealed on site. Some holes in the laminates required for technology cords were not sealed but the impact of this would be minor owing to the low VOC materials used. Due to the low VOC content, sealing cut edges considered "belt and braces".

Formaldehyde appears to be the main concern here. As noted, Formaldehyde is not the only chemical needing to be controlled.

Who is saying that sealing is "belt and braces"? The HSDC calls for sealing of drill holes and cuts. Less toxic chemicals and even natural wood terps can contribute to airborne contaminant overload. Pinene, like other wood terpenes, for example, is a common irritant and allergen that needs to be sealed in and the residues offgassed.

Wood Products used in the tech production lab for curriculum were not controlled by the contractor or LEED.

All of the wood doors are the Lambton EnviroDesign Series, containing no Urea Formaldehyde.

The Gymnasium Robbins wood floor adhesives and sealants contain no VOCs and the sub-floors (plywood) are formaldehyde-free.

What definition of "no-VOC" is being used? One definition specifies that VOCs are materials that affect the Ozone layer. Is this the definition used here? Many less toxic chemicals, including natural volatiles, are still "volatiles" in the air and are able to affect people. In a new building there are many sources and they can all add up.

3. Adhesives All floor adhesives were zero VOCs or very low VOCs. The highest VOC product was 1.7g/l with a LEED maximum of 50g/l.

Wall adhesives were low VOC with a rating of 45g/l and a LEED standard of 70g/l.

The rubber base adhesive was zero VOCs. (Rubber itself is a common incitant for reactions among those with environmental sensitivities.)

Plastic laminate counter tops were factory applied.

Minimizing chemicals is good. Low emission products are good, but materials still gas off something. When many things contribute a small amount, that accumulation needs to be flushed out of the building.

4. Acoustic Panels These are not regulated by LEED but were similar to those used in other schools. The panels have a core fibreglass material called SpinGlas which is Green Guard Certified for low emission. They were protected with plastic until the major construction was complete.

It should be noted that these panels were used extensively throughout this school, in quantities far exceeding any other school. Nevertheless their low emission qualities seemed to work. Some additional testing is anticipated to verify the low emissions of these panels.

5. Ceiling Tiles This building was designed with only a small fraction of ceiling tiles used in a school, due to the open ceiling concept. Those tiles installed in the offices, corridor and music room were formaldehyde free. They were installed as late in the construction period as possible so as to reduce possibility of their absorbing any construction odours.

Good

The Appendix of HSDC provides a procedure for determining whether a material gasses off chemicals, natural or man-made. MSDS and product information are useful but this sniff test is another good component to product evaluation procedures.

6. Blinds The blinds in this school were selected based on a study carried out by the HRSB and consultant Enviro-Health consulting Ltd.

That is my company. Dof Ed and my company did this study, not HRSB.

7. Communications Boards The standard communication boards used in all schools was specified for this school. They contain no urea-formaldehyde or other VOCs.

8. Gym Divider Curtains (_____) trying to get info.

This is a likely source of (one of?) gym chemicals. Do we know yet? The gymnasium smelled strongly of something. While it is good to list what we did well, it is good to be looking for what might not have gone so well, such as what was making students complain about sore throats and such in the gym.

9. Bleachers The bleachers consisted of refinished units from the former St Patrick's High School and new vinyl seat bleachers. These were refinished with low VOC finish. All units were placed in the gyms by June 4 and assembled by June 18.

Even low levels can contribute to the general "soup" and can combine with other low level emissions such as from a room divider and from remains of offgassing of a floor finish.

10. Vinyl tile The tiles used were low emission. The tile finish process (waxing) and adhesive would have the biggest impact on air quality (see other sections).

I understand that most schools do waxing on holidays to prevent lingering chemicals from being in the schools and affecting students and staff. Schools contain a cross section of society with all manner of health concerns and frailties. Low emission is still some emission. Glues, sealants and waxes can contribute.

11. Rubber Baseboard The product used is far superior to vinyl base in terms of offgassing. It was a styrene butanene rubber, non-WHMIS controlled.
12. Sealants A total of 30 different sealants were approved for use on the project for different applications. All but two meet LEED standards and the two that did not were used outside or underground.

LEED standards are useful, but low levels and non-toxic chemicals can still contribute to health issues. Flush-outs help remove chemicals not controlled for.

13. Kitchen Epoxy Grout The material used was a food grade.
14. Fibreglass Insulation All fibreglass insulation used in the walls of the building was formaldehyde free.

All fibreglass pipe insulation (Alley-K) was covered and wrapped. In exposed areas, a PVC cover was used for protection.
15. Duct Work All metal duct work was specified and delivered oil-free to meet Healthy Schools Guidelines.

Off-Gassing Process

The original intent was to complete the building (substantial performance) by July 15, 2007. Following that time period, minor deficiencies would be completed, furnishings installed, etc.

As I recall, the original intent was to complete the school by March 2007. I recall the school principal saying he was pleased because that meant there would be lots of time for a full flush-out of the school.

This allowed at least 23 days to meet the requirements for option 1 for LEED flush out of the school

Due to the very compressed construction period, which was greatly exacerbated by a severe shortage of skilled tradesmen, the building could not be completed by the intended date. The projected date of completion was moved to end of July and then to mid August. The contractor was finally granted substantial performance on September 4, 2007.

By August 15, all of the ventilation fans were operating and the school was being ventilated 24/7, notwithstanding some work still going on, primarily in the central core area. Indeed, the entire classroom block had been well completed by this time, and was being partially ventilated since August 10. A total of 80,000 CFM of 100% outside air is provided, resulting in about four air changes per hour

for the classrooms. Other areas of the school would receive air changes varying from 10 per hour (washrooms) to less than one per hour (mechanical and electrical rooms).

It should be clearly understood that the ventilation system was operated 24/7 (and at the time of writing of this report, still is). Minor shut down of individual systems (there are five main systems) was carried out to allow adjustments and for air-balancing. Notwithstanding reports to the contrary, the ventilation system operated 24/7 from August 15, with short stoppages of individual units.

Where, how long, and when were the short stoppages?

Another issue raised by some was that the ventilation system was not being operated at full capacity. It is true that the gymnasium systems and one of the classroom systems was found to be operating at about 82% of designed capacity. This would indeed prolong the flush-out of the building. This situation was discovered when the air balancing was finally carried out (there were extraordinary problems with the sub-contractors who do this work), and was corrected on November 12.

In defense of this situation, the mechanical ventilation engineers indicate that the building is ventilated far beyond ASHRAE (American Society of Heating, Refrigerating, and Air Conditioning Engineers-the acknowledged industry standard) and even at 82% capacity, the school still exceeded ASHRAE standards.

From this report it is evident that while the building was occupied, the system was not operating at full capacity in all areas, and some systems were sometimes off. Those situations would cause people to report that in their area, and they might mistakenly think the whole school was off. However, the main concern is that this is during a time when the building materials emissions would be needing flush-out and therefore occupants would be more likely to experience symptoms.

The fact that the system was exceeding ASHRAE is irrelevant. ASHRAE minimum standards have not been acceptable in NS school construction for over 10 years. We are deliberately building them to well exceed ASHRAE minimum standards because we paid attention to what was happening to student and staff well-being when we only provided the minimum.

By August 15, then, the clock began on meeting the LEED flush out standards. Due to ongoing work in the building, the LEED consultant would not approve this period as meeting LEED requirements (strictly no painting, wet, smoky or dusty work to be done anywhere in the building is the criteria for starting LEED clock). Finally, a glycol leak that destroyed gypsum walls and ceilings in the lobby necessitated remedial work which extinguished all hope of meeting LEED flush out requirements.

A glycol leak could impact some occupants.

It concerns me that the school was eventually awarded the LEED IAQ point even though these things happened and even though people got sick.

This is not to say the building was not flushed out at all. It certainly was. It does mean, however, that it was not flushed out for the time period anticipated, and there were odours in the building upon opening of the school. Those odours were respirable chemicals. The testing conducted on August 20-28, and

subsequently on August 20-28, and subsequently on September 23, October 28, and December 8 indicated that there were no harmful VOCs or other air quality issues in the building. This means, in particular, that there were no harmful levels of benzene or formaldehyde, as some have suggested.

Benzene and formaldehyde are two harmful chemicals worth controlling, and that effort to do so is good. We must not lose sight of the capacity of other less harmful chemicals to impact health, and also we need to recognize the potential for synergistic affects as well. Chemical sensitivity, asthma, migraines and more are triggered by chemicals not considered to be as harmful as Benzene and Formaldehyde. Environmental health professionals and the NRC documents quoted and others such as *Spengler, Samet, McCarthy, Indoor Air Quality Handbook, McGraw-Hill, 2001* recognize that standard tests are not a reliable way to determine if a building is ready for occupancy.

The gymnasia were scheduled to be completed by the end of May 2007 as an added assurance that they would be off-gassed before school opened. They were indeed completed on time and clearance air testing indicated that the protocol used to control off-gassing was effective. This protocol was developed by DOE, in conjunction with the Healthy Schools Committee, a number of years ago because of the high VOC created in finishing gymnasium floors. The gym floor finishes do not meet LEED standards and consequently needed extra precautions.

The Healthy Schools Committee worked on the successful finishes plan for Halifax West's gym, and a protocol. The Committee did not work on any product substitutions or changes to that protocol that were used in subsequent schools.

School Cleaning

Cleaning of the building was carried out either by board staff or under their indirect supervision to ensure it met board standards. All materials used were approved and identical to those used by the board at all of their schools.

Having said this, the delay in completing the construction work put great pressure on the board in terms of having adequate time to clean and wax floors and ensure final dusting was complete. On-going construction during the cleaning added extra pressure. The board is certainly not a stranger to such conditions and put many of their best staff on the job.

Odors from the cleaning and waxing materials were evident in the building upon opening of the school. While none of this produced harmful levels of gases, as evidenced by the testing, it was nevertheless an irritant to building occupants. Having said that, cleaning is a process always done on a daily basis within hours of staff and students entering the building.

But is daily cleaning done to that degree and while other materials are also gassing off? Again, a compounding effect can produce symptoms and even cause illness onset.

See my comments above on waxing during vacations.

Filters on the air handling system were changed prior to building occupancy. The filters are of a very high standard, rated at 95% efficiency. Pre-filters are used to prolong the life of the finer filter system. A HEPA filter system is the only level higher than that provided at Citadel, and this has never been done in Nova Scotia nor is it planned.

The HSCC agreed with this, and was a part of this decision. The committee would be very pleased to see that this is still the practice.

School Furnishings and Technology

School furnishings have been blamed for significant off-gassing. It is not always possible to dictate what materials a supplier will use to manufacture the furniture, so time is the best option for off-gassing it.

Time is only one part of the off-gassing process. Unwrapping the objects, turning on electronic equipment (also equipment that has electric motors or otherwise generate heat while in operation, especially if the equipment has plastic parts that will heat up even mildly during use), and providing air flow over time. Time, heat and ventilation are all factors, in addition to the make-up of the materials.

Also, HCDC advises requiring suppliers/manufacturers to provide materials details on their products as part of the tender process.

Similarly, the plastics and components of computer equipment and other high technology equipment are prone to off-gassing issues. Turning them on for a period of time prior to school occupancy was a strong recommendation from the Healthy Schools Committee.

In the selection and installation of the furnishings and technology at the school, three principles were very important. These included environmental (trying to meet Healthy Schools Guidelines), security (keeping the equipment from disappearing), and operational requirements (having the stuff ready for the students). In some instances, not all three could be completely met, but those involved made every conceivable effort to achieve all three.

Technology

There has been criticism that technology was not off-gassed. The facts suggest that this is not the case.

Computers and printers began arriving at the school on August 14. This is one day later than had been scheduled from the very beginning.

The computers and printers were stored in two classrooms in the south/east side of the building. All computers were unwrapped and the packaging moved out of the building within one hour of their arrival at these classrooms. They were immediately turned on and the imaging process started. On August 16, the process of distributing the computers throughout the school was begun, starting on the third floor of the classroom wing. The computers were fully distributed throughout most of the school, by August 21. The labs and some classrooms on the first floor were not done until after August 21. All

computers and LCD monitors were turned on as soon as they were unpackaged and were left on continuously, even after they were delivered to their final classroom destination.

It should be noted that the ventilation was running 24/7 (with brief outages due to maintenance on the systems) on the east side of the building since August 10. This means the computers would have been offgassed by the main ventilation system as soon as they arrived. The elevated temperatures of these rooms, due to summer outside air conditions and building start-up conditions, also hastened any off-gassing. *[Is the concept of higher temperatures accelerating off-gassing actually accepted?]*

Yes. A combination of heat, moisture and ventilation. The nature of materials being offgassed is of course a factor as well.

It is also important to note that there were no CRT monitors. All monitors were LCD units which require virtually no off-gassing compared to the old CRT monitors. In comparison, Halifax West opened with only one week of computer installation/off-gassing time and all of the monitors were CRT's. Having successfully done that, and subsequently at Kingswood, Sir John A Macdonald, and Barrington, with no reported air quality issues, there was every confidence that the computer systems would contribute no harmful off-gassing.

During the installation of the computers, it was necessary to drill holes in the computer desks to accommodate the wires. It is unknown if this had a deleterious affect on the air quality (due to the small exposure). However, the material drilled through was particle board, urea- formaldehyde bonded. This material can liberate formaldehyde. This process, four holes in desk-tops about 3" diameter, in each classroom took about a week. The holes were covered with plastic grommets.

Plastic grommets are not designed to stop emissions from entering the air. The HSDC recommends all drilled holes be sealed with 3 coats of less toxic sealant.

By August 31, about 95% of all LCD projectors and CCTV units were installed (although these are thought to have minimum off-gassing characteristics-no data is available). These were also turned on to ensure any off-gassing that might occur happened before the majority of staff arrived on September 4.

The computers and printers for the administration were set up in a temporary area and turned on August 17, and run continuously after that.

It is very possible that the technology contributed nothing harmful. All the effort put into succeeding at technology offgassing, and indeed all work in this regard on this school, needs to be acknowledged and appreciated. Then, we need to look closely again in order to determine if there remains any possibility that there were parts of this process that may have broken down and contributed low levels of respirable chemicals, or temporary pockets of that when systems were down. This will help us prevent exposures and illness in the next schools.

Furnishings

A relatively large amount of furnishings was transferred from St Pats and Queen Elizabeth High to the new Citadel High School (estimated at roughly 25%). Most were not an issue, but the recently refinished desks in the administration were still significantly off-gassing when the school opened. The desks were refinished using Danspeed 80, the same material used on Ven Rez desks.

Yes, these furnishings were offgassing. See below, the comments about improving desk finish materials and the choice having been made to stay with the more toxic finishes. The finishes could contribute to total load and it may be wiser to seek other sources of furniture and finishes.

Most of the books, furnishings, equipment, etc. from the old schools were moved into Citadel beginning on about August 16. While this material would have long since been off-gassed, it may have contributed to odours in the new building from fireboxes and other packaging.

Odours don't make people sick. Yes, cardboard boxes and packaging can contribute significantly to respirable chemical load.

Also, I hope that musty or otherwise mould-contaminated books and materials were not put in the new school.

The newly purchased furnishings was constructed at Ven Rez beginning on July 3 and the first load was delivered to the school on August 7. Most of the furnishings were on site by August 10, including student desks and chairs, computer tables, and office furniture. The furnishings were put into classrooms as soon as the rooms were cleaned and ready (beginning on the third floor), and the remainder were put into the hallways prior to moving into the remaining classrooms. In addition the smaller equipment that arrived was stored in the music rooms as these were larger, with high ceilings with higher ventilation rates. The furnishings were retained in their original shipping containers (plastic and cardboard) until they were put into the classrooms. This would have a negative impact on any offgassing of them.

Yes. Again, see the HSDC document about options for low emission furnishings. Also, wrappings slow offgassing, but as indicated, plastic and cardboard wrappings themselves add to respirable chemicals.

Furnishing of various types continued to arrive at the school and indeed are still arriving as of the date of this report. This is typical for any school and is practically unavoidable. Many practices that were typical for schools have been improved and we continue to seek what needs further improvement.

The paint used on all student chairs and desks is a dry powder electrostatically applied and has no off-gassing. Good The table tops are MDF as manufactured by Uniboard Canada and contain urea-formaldehyde. This could contribute to airborne chemical total load. The chair seats are plastic (propylene ethylene copolymer) and are similar to chairs used in all schools in Nova Scotia. Off-gassing of these components would be significant but appears to be mitigated by the ventilation as evidenced by the VOC testing regime.

An area of concern expressed during the air quality controversy was the finishing of the edges on all of the student desk tops (all of the other furniture had plastic laminate edges). A request was made to

have these edges finished with a water-based finish (Aquatec Platinum by Chemcraft) to seal the composite wood and reduce off-gassing. This was tried at Halifax West on about 60% of the desk tops delivered and it was found that there was absolutely no difference in off-gassing using the water based product compared to the solvent based product normally provided by Ven Rez. In fact, the edge coating in all cases was completely off-gassed by the time it was delivered to the school and the 25% premium cost for the water based material had no discernable benefit. This was evidenced by this not being an issue at Barrington, Kingswood, Sir John A Macdonald or Oyster Pond schools. The premium cost arises not out of additional quality, but because the assembly line process has to be changed to accommodate this, resulting in delay costs. In the final analysis, the standard coating provided by Ven Rez was entirely satisfactory and resulted in no additional risk to air quality problems.

Why is formaldehyde MDF being used at all? Alternatives are possible to find now. IKEA began using the E-1 standard for health reasons.

Sir John A. MacDonald was a success in my experience, but there were factors there that were different from Citadel's situation and that contributed to IAQ success. I cannot comment on Kingswood or Oyster pond as I was not directly involved there. Barrington did have complaints about health concerns but I learned from the sufferers that they did not report their problems because they were so grateful to be out of the old school. That they had complained so much while trying to get a new school they just couldn't get themselves to admit to authorities that the new school was also making them feel ill. They chose to "tough it out", but at least one teacher was forced to retire early because of these health issues. People don't want to be sick. Sickness is terrible. People commonly hide their symptoms. If they had been asked they would have answered honestly.

When we humans have put so much work into trying to get it right, and then things go wrong, it is common to first experience denial, followed by defense and justification, and often there is a blaming of the complainants. This is human nature. When we can move past the discouragement that some things failed and start to look again at what needs to be shored up, then we approach success.

Useful clues and information can come from occupants who can report where, when, and how they experience building-related symptoms. The QUEESI test <http://familymed.uthscsa.edu/geesi.pdf> is a scientifically proven tool based on body symptoms that can help identify building IAQ deficiencies.

Conclusions

Extraordinary care was taken in the design, construction and supervision of the construction to meet Healthy School Standards. LEED certification is anticipated.

Some highly sensitive people may have been affected by the school environment upon opening. Some of the complaints were unfounded. The number of complaints were relatively few.

As mentioned above, we learned that many complaints were apparently not communicated to authorities. While it is statistically likely that a small percentage might be unfounded, how was it determined which, if any, were unfounded?

There were enough that were well founded, including with doctors' letters, to warrant action to protect the entire school community. But most importantly, this could all have been prevented.

Not only highly sensitive occupants can be affected. All occupants can be affected. While those with asthma and other respiratory illnesses, migraine sufferers, and other sensitive individuals can be obviously affected, 2007's Our Toxic Nation report and follow-up studies showed the importance of preventing our children's developing bodies from filtering chemicals that are inhaled, touched, or ingested.

The delay in completing construction was unfortunate but not uncommon. The alternative of sending 1,500 students and staff back to St Pats and Queen Elizabeth would be a much worse alternative. Keeping that many people out of school for several months was an equally bad alternative. *[As I noted earlier, this does not make up for inappropriate planning and processes.]*

Yes, prevention.

At Citadel's monthly "stakeholders" meetings the Board, myself, Department of Education, and Principal could voice concerns and get answers and a progress report from TPW. At every meeting the first question was "Is it on schedule?" That was the crucial question. Two schools were being closed and another opened and there comes a point where there is no way to go back. The answer was always "yes" yet the proposed handover of July 16 didn't happen. Time had run out. Even the LEED 4 week flush out option was not possible. LEED's testing option was chosen. I was not part of that decision and of other decisions – a fact that made my presence on the project arguably a waste of money and of my time and effort.

If it is likely that delays can ruin the efforts to create a healthy indoor environment for the first day of occupancy and forward, then we need to develop fall back plans as part of routine planning for new schools.

While the air quality testing regime concluded the school was safe to occupy, it was known that some of the staff had high environmental sensitivities. *[Is there corroboration for this?]* When it became obvious the school would be late in opening those highly environmentally sensitive people should have been provided with alternatives. Sick time (before entering to school), transfer to an older facility, or part-time duties may have been reasonable alternatives for staff. Transfer of students, with paid transportation costs, for at least one semester could have been considered.

Yes, there is corroboration for this. While I agree that these people could have been better protected in the ways mentioned, the potential for significant harm to others needs to be addressed. The Province decided to make healthy schools for all. It is impossible to predict who is on the verge of becoming sensitive to environmental factors. Children's bodies need more protection from chemical intake.

I believe that my presence on this project, faith in my role and my commitment, contributed to a lower level of personal protective action in some cases and to a general belief that all would be well. Unfortunately I learned too late that my input was lost somewhere in the list of priorities.

Better and timely communication among the various parties involved could have mitigated the complaints somewhat. Rather, could have led to better protection of occupants and problem solving. Many rumours, exaggerations, untruths, or misinterpretations prevailed at all levels from the construction workers all the way through to the general public. However, the essential truth remains that people were feeling ill – it is natural to seek explanations. While the board has a procedure for reporting IAQ problems in a school, the high profile of Citadel resulted in that protocol not being followed, with the obvious very public hype.

I agree the high profile of that school contributed to several problems including confusion over what should be priorities.

I also agree the media was filled with hype and incorrect information. Three weeks into it I received a phone call asking for my perspective. I refused at first, then decided facts needed to be made known. However, I was misrepresented and things did not get better.

Perhaps we need to discuss a new way of handling this. Could new school projects and future projects benefit from a transparent education process about healthy buildings and include a process for user feedback about the effectiveness of the healthy building efforts? Tell them the plan to build a healthy school and why it is important. Tell them there is a back-up plan if something goes wrong. Measure success and be prepared to act on the results. Could we make it so routine it is not an issue? It is due diligence.

This report reveals a need for more training about how the human body can be affected by low level chemical exposures, including synergistic exposures and exposures not just to the most highly toxic chemicals. (I am a participant in Health Canada and Environment Canada's Chemical Management Plan. Evaluating each chemical is a long and complicated process, and even highly dangerous chemicals remain on the waiting list while new ones keep being added. Triclosan, for example, is currently waiting for the election to be over before government can look at it. The chemical industry lobby is a strong one.)

Training is needed about how to prevent exposures; that individuals can have sensitivities to specific chemicals and to compounds in very low amounts; how healthy people can become ill from renovations and new construction; that low levels of chemicals from several sources add up; and that they can combine in the air to create new compounds; that problems with timing and with the air handling systems can contribute, that IAQ testing has limitations and should not be given too much authority.

Air quality test results can cause us to lose sight of other evidence that indicates there is indeed a problem. If people are reporting symptoms while in the building then the air quality tests that say otherwise are inadequate in some way. I believe Jennifer Boyles' comments (above) are a very strong clue for us.

Additional training of board maintenance staff at the school would have been an asset. A highly qualified person bridging the period from substantial performance of the construction contract (and take over by to board) and the point where to board is entirely comfortable in operating the school

would have helped mitigate many of the problems. The current situation is that an already extremely busy principal ends up handling many of the issues that this person would be responsible for. This person was ultimately put into Citadel when this condition was recognized.

Yes, new schools in general would benefit from this.

However, I also recall being very concerned that the Quebec firm hired to build the school, unlike our provincial companies that had learned by building healthy schools with us already, did not have the background in building healthy buildings. My request to meet with them, make a presentation to them, was denied.

Select companies that have training or are willing to be trained in healthy building construction. A questionnaire to identify truly experienced healthy building companies well versed in healthy building construction (not just green building construction) could be developed and made part of the selection process. If they are not, they would either be rejected or required to take a training session with myself or another approved specialist or to bring on qualified staff.

Have a back-up plan for if things go wrong.

Standards must be continuously reviewed for relevance and applicability. LEED should become a standard for new school construction with the goal of silver certification.

Healthy Building guidelines must take precedence over LEED certification. What educators need in order to do their job of educating must also take precedence. While building green, sustainable, schools is a worthy goal, it must be a lower priority than these.

Furthermore, because LEED has such strong marketing and promotion it is hard to see its deficiencies. One of many illustrations of LEED's deficiencies is revealed in LEED's granting of the IAQ point to Citadel, a school that made people sick. If we use LEED as a guide for striving to make sustainable buildings, use its information and its deadlines for green building creation, but let's put priorities on education and on health in these buildings we are building for our children. I would like to see Cabinet declare a priority for creating schools that are healthy and serve education above all other priorities.

Staff of the Project Management and Design divisions of TIR, should receive on-going training in healthy schools construction materials and practices.

Yes, not only because of staff turnover, but because of new information and new factors may need problem solving.

Recommendations

At first blush, numerous recommendations appear obvious. However, rather than simply list even more recommendations, this report specifies only one:

Recommendation

The Nova Scotia Department of Transportation and Infrastructure Renewal needs to strike a high level standing committee to review the contents of this report, along with the Healthy Schools Guideline, and any other lessons learned and develop a specification to be following for all new schools to be constructed in the province. The committee should report to the Minister of TIR no later than the end of the year, 2008.

I support this recommendation and would be willing to contribute. This 2008 report has much to spark further learning and is a good place to start.

We have made great progress in creating healthy schools. Each one is an opportunity to learn. In the past it was routine to have people suffer symptoms and even illness upon the opening of a new school. For a long time such complaints were denied or even seen as collateral damage that would pass over the months. Once we realized these effects were real and significant we sought ways to prevent them. Halifax West High School was the pivotal attempt, although Horton High, Lockview High and many others formed part of the efforts. Citadel had its own challenges and I hope that it becomes a significant learning ground along this path toward routine Healthy School design and construction.

Building-related impacts on health can be prevented. No one wants to make others sick. Let's look closely and see what did not go as well as hoped. Therein likely lays the cause of occupants' symptoms and the life-changing level of illness of some. It can point us to what needs improvement in the next schools. We have done it in other schools. Let's look closely and see what needs to be done to make it work well every time.

I submit these comments with respect and in hopes that I can help positive progress. I am willing to discuss any of my points further. We are leading the way and are so close to getting it right for every new school.

Karen Robinson

President, Enviro-Health Consulting Ltd.

President and CEO, Canadians for A Safe Learning Environment

APPENDIX A

Karen Robinson: Summary of complaints from Citadel High School's opening, Fall 2007

I received unsolicited personal complaints and concerns from 19 people, including an Environmental Health physician, 3 MLAS, and 15 people who were directly affected.

The 15 included one SAC member, two of the school administrators, 7 teachers, plus the 3 teachers I overheard in the stairwell and later the office, and the mothers of two students: One student had been a top athlete and A-student who in Grade 12 became so ill that her parent told me she barely graduated. She was forced to attend university part time, but eventually did graduate well behind her entry class.

Complaint summaries

Sept '07 Teacher: One music room better than another. Elevator v bad. Can't go in there.

Sept '07 I overheard 3 teachers talking "so many are having trouble. Should we report it?" Minutes later, I came across them in office reporting. Secretary was waving Tylenol bottle saying its empty because so many had complained of headaches that morning. (It was 11am)

Sept '07 Teacher took me to another teacher who was afraid to complain. These symptoms were new to him.

Sept '07 Teacher Lambie: trying to work sitting down, air filters requested, strong smell from new cabinets.

Sept '07 VP: Headache, tired. Office furniture offgassing. No operable window to help.

Sept '07 Principal: Headache, 2 air filters in office.

Sept '07 Teacher: IAQ in her area very poor. No windows. Sore throats, tired,

Sept '07 Teacher: difficulty breathing. Puffers. Previously healthy.

Sept '07 Teacher: strong plastic smell in gym. Some students complain of breathing problems

Oct '07 Teacher Lambie: severe headache, cognitive problems, arms and then legs shake, too weak to stand, throat closes and lose voice, covered in hives, lost consciousness in the school 4 times in Sept and Oct 2007, symptoms go away when not in the school.

Oct '07 Parent: Son with EI not able to attend school

Oct '07 Teacher Boyle: October, 2007 history of severe allergies and environmental illness. At Citadel: sore throat, headache, burning eyes and feel completely drained. Symptoms disappear at home, come back on Monday return to school. Oct '07 MLAs MacDonald, Estabrooks called me with concerns, having heard from "several constituents".

Oct'07 MLA Peris called me because he had been lobbying to have a new school open in his region in 2010 even if it is unfinished. From the Citadel coverage he became aware that may not be a good idea and requested my input.

Nov '07 opening ceremonies day: Physician parent: experienced symptoms and could smell building materials when in school in first few weeks, expressed concern for occupants. "...thought we learned from the new IWK..."

Nov 23/07 Teacher Boyle: "Within 20 minutes lose my voice, breathing problems. Dr. advised stay off work until date "unknown". Was a teacher at Halifax West when it opened in 2002 and was perfectly healthy there from Jan until June. (School opened in January) "No issues whatsoever like I am having now. "

Dec '07 Dr E. Gold contacted me about several patients. She wrote general letter to use as needed.

June '08 Parent: Daughter previously healthy. top athlete, A student, now off school. (Graduated under her potential. Attended university part time due to health.)

APPENDIX B

Information on Air Quality Issues at Citadel High			
Date	Room	Person	Statements and Quotes
Sept 2007	CHS	J Swales, HRSB manager OH & S	"The board accepts that there is VOC off gassing in the building" wrote J Swales in email to M LeClair, HRSB nurse in Human Resources.
Sept 2007	Main office	T Fawcett, CHS principal	Always has a headache within 10 minutes of entering CHS. Is sick every day when she is in CHS.
Sept 2007	Main office	ALL staff in the admin office (7 people)	Headaches General malaise
2007	VP's office	Greg MacKinnon, CHS VP	Headaches and ill
2007	Registrar's office	Zeno MacDonald, CHS registrar	Headaches and ill
2007	Guidance office	3 guidance counselors and 1 admin assistant	Sore throats Headaches Very tired Feel sick
Nov 2007	Cafeteria	T Fawcett wrote re. CHS cafeteria staff:	"The cafeteria staff has complained en mass a range of issues from breathing problems to eye irritations.
Nov 2007	French classroom	DonnaMcInnis, Languages Dept Head	Extremely depressed. Cognitive difficulties. Reduced abilities. Physical pain and fatigue.
Nov 2007	Gym	"a teacher in the gym"	Complained of headaches in the gym and has a plastic smell.
Nov 2007	Art room on third floor	SD, Arts Dept Head	Very depressed. Illness, pain and fatigue.
Nov 2007	Staff room	"quite a few staff members"	"quite a few staff members complained" to JB re poor IAQ in staff room
2007	3 rd floor classroom	RW, teacher	Headaches, fatigue and illness
Dec 2007	Room 101	RL, CHS Lang Dept Head	Throat closing and difficulty breathing while inside CHS. Takes puffers when at CHS, but does <i>not</i> use puffers outside CHS. Very sore throat.
Dec 2007	Room 112	MM math teacher	Extremely red, watery eyes all the time. She appears to cry <i>all</i> the time.
Dec 2007	Room 109	CH, CHS Math Dept Head	Extremely itchy at work. Irritated skin. Red hives all over his body.
Dec 2007	Room 106	JB math teacher	Gone on sick leave
Dec 2007	Room 105	LL math teacher	Teacher reduced to 1 class/day due to illness
Dec	Gym	All staff in gyms (4	Complained to JB re IAQ in gym

2007		people)	
Dec 2007	Elevator	NS gvt employee (Gary?)	"There was a significant hydraulic oil odor in the elevator"
Dec 2007	Gym	NS gvt employee (name blacked out: Gary?)	"There was a very noticeable odor in the gym ...reading was 400 PPB."
Dec 2007	QEHS gym used as an off gassing site	200 new desks and chairs	This furniture was unwrapped to off gas them at QEHS for 2 months
2007-2008	Classroom in English Dept	KM, English teacher	Severe headaches. Sinus pain. Red, itchy, watery eyes.
2007-2008	CHS	Many students	Complained of severe daily headaches while at school. Many slept when they went home after school, instead of eating and being active. There was a lot of fatigue.
2007-2008	CHS	Crystal, grade 12 student	Sever fatigue, severe pain, reduced cognitive abilities. She lost TWO years of her life (2008-2010) because she was too sick to earn the grade 12 credits which she needed to graduate.
2007-2008	CHS in one specific classroom on the 3 rd floor	Warren, grade 12 student Before 2007-8 and after 2007-8, he was a very healthy, active, hard working student.	Warren fell asleep every day in one specific classroom. His course was held in this room at different periods during the day (period A, B, C, D). He never fell asleep in class before 2007-2008 and he never fell asleep in university classes after 2007-2008. He was extremely tired throughout 2007-2007.
Sept 2008	CHS	Meg Campbell, a very smart and athletic grade 10 student	Meg was happy, healthy, very active and smart her entire life outside of Fall 2008. In Fall 2008, she lost all her energy. She developed severe depression, her marks dropped, she could not learn. She transferred to another school and returned to being a high achieving active healthy student.
Sept 2008	Room 218 Room 219 Main office	Tam Fawcett: "There are people ... " who are in room 218 and room 219 and the main office	"There are people who are experiencing sore throats...eye, throat, hives, itching."
May 2009	3 rd floor classroom	K.R.	2 months of breathing difficulties which her dr. thinks are related to IAQ at CHS
June 2009	Room 313 Room 314 Room 315	J Swales, HRSB OHS	"Exhaust fan not working... AHU filters need to be changed."
July 2008	Gym	Mike Tanner, PE teacher for 34 years with ZERO sick days and ZERO absences	Had walking pneumonia Sept 2007 – June 2008. It went away after he left CHS in June 2007.
Sept 2008	Air filters taken from	T Fawcett, CHS principal	"I redistributed them to 4 other staff who requested the filters" to improve IAQ.

	Room 105		
Sept 2010	CHS air circulation problems	Linda Fewell, CHS principal	"The issue of air circulation persists... the chillers on roof never fully functioned." Teachers are complaining of the lack of fresh air in their 3 rd floor classrooms.
Sept 2007 – May 2008	Room 105	Laura Lambie, FI math teacher	Memory loss. Loss of ability to think clearly. Brain fog. When working in CHS: Dizziness. Nausea. Reduced cognitive and physical abilities. Constant physical pain (muscles and joints). Extreme fatigue. Extreme depression.