

August 31, 2017

Eric Taylor
Air Quality Meteorologist
BC Ministry of Environment
PO Box 9341, STN PROV GOVT, Victoria, BC V8W 9M1

Dear Mr. Taylor;

Re: Air Quality Health Index concerns

I am writing to outline some of our concerns with BC's Air Quality Health Index (AQHI) and how it is ineffective at best, and harmful at worst, for smoke-impacted communities in the province.

I understand that there have been a number of concerns raised recently about how the AQHI has applied to wildfire situations in BC and how it has not effectively or adequately identified and communicated the likely health risks, particularly in communities like Kamloops.

A number of these concerns apply every winter in many BC communities. It is the application of the AQHI to communities impacted by winter wood smoke—and how it fails these communities—that this letter focuses on.

AQHI IS MISLEADING IN NON-URBAN, PM2.5-POLLUTED AREAS

“Applicability of the AQHI outside of the Canadian urban centers from which the concentration-response co-efficients were derived can legitimately be questioned in that there are potential differences in exposure mix, population susceptibility, and time activity patterns.”

Quote from study that was used to develop Canada's AQHI system: “A New Multipollutant, No-Threshold Air Quality Health Index Based on Short-Term Associations Observed in Daily Time- Series Analyses.” Emphasis added.

In the Comox Valley, we have found that the AQHI frequently fails to reflect communicate health risks when fine particulate (PM2.5) levels are high in winters in our area; ***in fact we counsel people to ignore the AQHI as it can be misleading and people may be at higher risk than the AQHI indicates.***

As we understand it, the AQHI is based on a formula involving three pollutants: Ozone, Nitrogen Dioxide and PM2.5, and is derived from three hours of readings. This formula was based on an analysis of 12 major Canadian cities that included a statistical analysis of how daily death rates in major urban centres increased when air pollutant concentrations increased.

However, pollution sources and concentrations in urban areas are completely different than in many non-urban areas. Unlike most cities, the primary source of pollution in smaller communities in BC is PM2.5 from wood smoke. As a result, this urban-derived formula simply does not work.

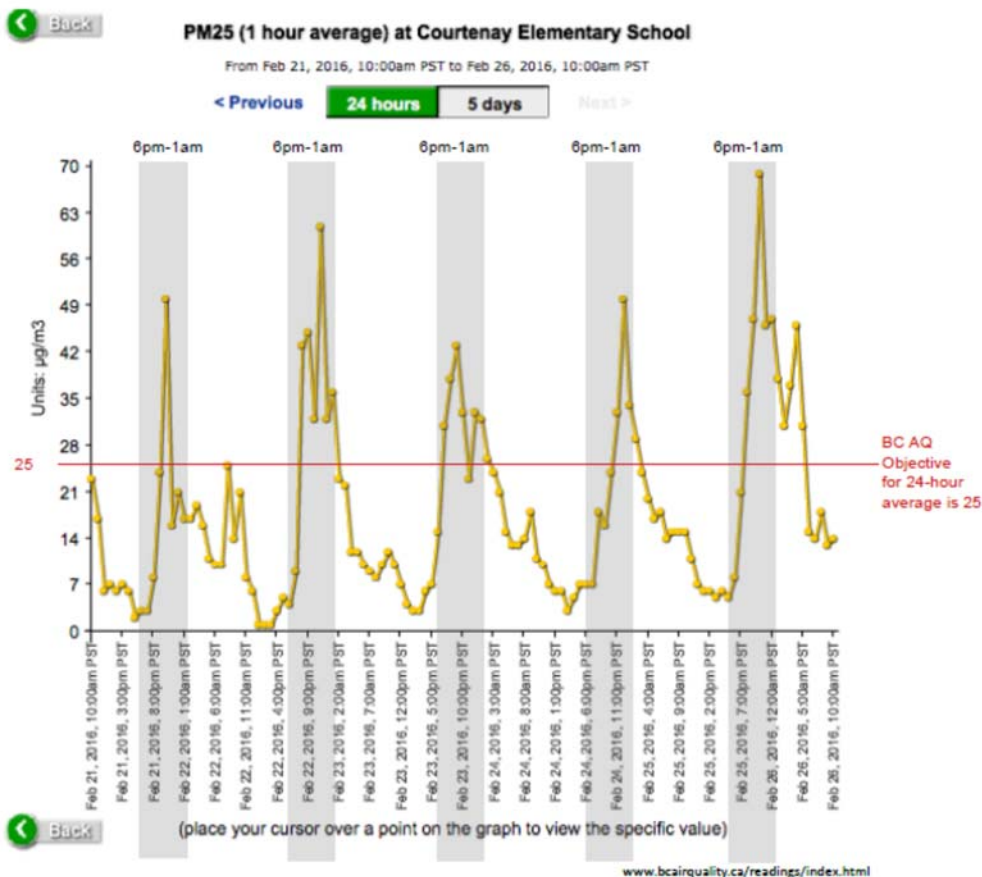
Under the standard AQHI formula, even though a community may have very high PM2.5 levels, if the Ozone and NO2 levels are very low, the AQHI often indicates there is a low, or occasionally moderate, health risk.

In reality, the AQHI could be harming people outside of urban areas as a result of inaccurate communications about the very real health risks associated with PM2.5.

PROFILE OF PM2.5 LEVELS WOOD-SMOKE IMPACTED COMMUNITIES

To understand the failings of the AQHI, and the new ‘plus’ system, it is important to understand how pollution levels change in communities in the Comox Valley (and many others throughout the province) where residential wood heat is a significant contributor to PM2.5.

Feb. 21 to Feb. 26, 2016



A result of residential wood heating is that PM2.5 levels typically rise in the evening, starting at about 5:00pm when people return from work (see Figure 1).

The readings stay high in the evening, often spiking as people stoke their wood stoves before going to bed. PM2.5 levels then go down in the early morning hours.

In some cases there is a smaller spike that corresponds with people lighting morning fires before leaving home. Unless there is a notable inversion, PM2.5 levels typically go down throughout the day, until the cycle begins again at 5:00.

Figure 1: This 5-day graph of readings in February 2016 is a common profile of winter PM2.5 readings in wood smoke impacted communities. Shaded areas highlight 6:00 pm to 1:00 a.m. when PM2.5 levels are typically the highest.

NEW AQHI+ SYSTEM STILL NOT EFFECTIVE

Clearly, BC Environment and your colleagues in other provinces have recognized the failure of the standard AQHI formula to reflect health risks in areas that may have high PM2.5 levels but low Ozone and NO2 levels. In BC, we understand that the new AQHI+ system was designed and implemented last year as an attempt to address the shortcomings of the standard AQHI formula's ability to reflect risk of high PM2.5 levels.

As you know, this new AQHI+ system uses higher PM2.5 levels to trigger higher a health risk level (a '7') on the AQHI scale. While this is a step in the right direction, this new AQHI+ system is still inadequate.

Concerns with 60ug/m3 trigger

For example, the new AQHI+ allows for the risk level to jump to a '7' (a "High Health Risk") when PM2.5 readings in an area reach 60 ug/m3. This risk level is then kept at a '7' for 6 hours following the last 60 ug/m3 reading.

One concern with this approach is that a community could have readings of 50-59 ug/m3 for hours on end, and the AQHI will often still read as "low". Then if the readings happen to cross over the magic 60 ug/m3 line, the AQHI will jump to a "high" (in numeric terms, from a '3' or '4' to a '7').

The use of 60ug/m3 as a trigger is clearly a based on the selection of a round figure. The health risk between 59 and 60 in the real world is obviously negligible; yet on the AQHI it is often represented as a sudden and large leap from "low" to "high" risk.

For example, the PM2.5 readings in Courtenay on Dec. 4, 2016, and the associated AQHI levels, indicate how much of a difference just 3 ug/m3 can make under the AQHI+:

- 57 ug/m3 at 7pm - AQHI = 3
- 53 ug/m3 at 8pm - AQHI = 3.5
- 57 ug/m3 at 9pm - AQHI = 4
- 72 ug/m3 at 10pm - AQHI = 7
- 102.2 ug/m3 at 11pm – AQHI = 7

The latter reading also raises the question about how higher PM2.5 levels impact the AQHI. At what point does a '7' become an '8' or even higher? An increase of 42 ug/m3 in this case was still not enough to trigger a higher warning.

There are also situations when there may be a few hours of 50-59 readings, with a "low" risk warning, and then a single 60Ug/m3 reading which triggers a '7' high health risk setting for 6 hours. Yet in those 6 hours, when the risk is still at "high", the readings could drop into the 30s or 40s. This highlights that the AQHI+ is often disconnected from the actual conditions and associated risks.

The image in Figure 2, captured during wildfire smoke alerts on Aug. 3, 2017 at 11:00 a.m., may also reflect the inappropriateness of this arbitrary use of '60' as a trigger. It shows most of the Lower Mainland at a '7' or 'high' health risk while one station is magically reflecting a '3' or 'low' health risk. Yet it is unlikely that the readings at this one station were that much lower than the others.

On a positive note, it is good that hourly readings (as opposed to three hours of readings) are enough to change the AQHI. This gets us closer to reflecting real time health risks.

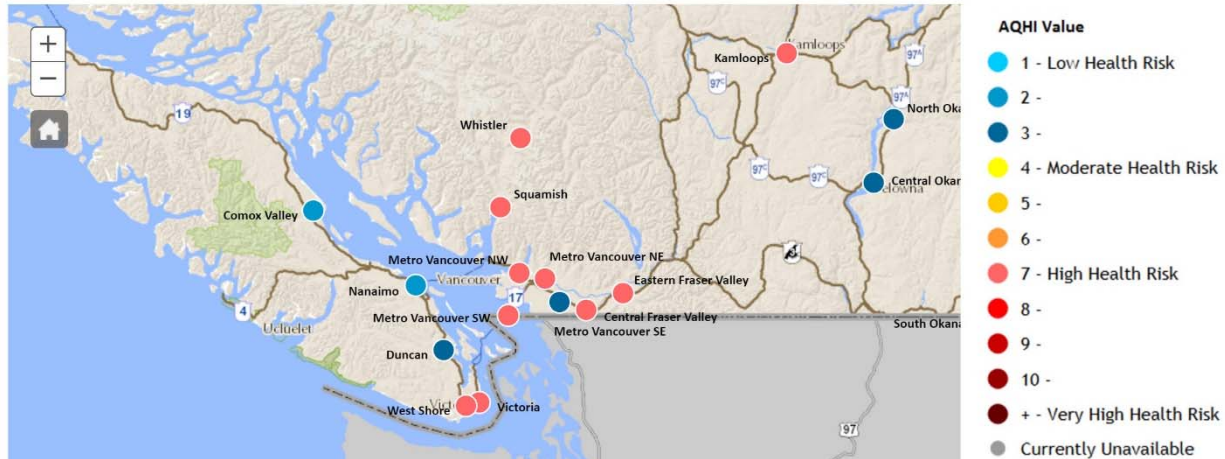


Figure 2: AQHI settings at 11am on Aug. 3, 2017 during wildfire smoke alerts in the Lower Mainland. One station is inexplicably at a '3' while all others are at a '7'.

Concerns with proposed 24-hour average of 25 ug/m3 trigger

Another proposed, but not yet implemented, trigger for the new AQHI+ system is a 24-hour average reading of 25 ug/m3. This trigger would be completely inappropriate in communities that display the PM2.5 profile noted above and we believe should not be used.

Often in wood smoke impacted communities PM2.5 readings exceed the 24-hour average of 25 ug/m3 after the highest readings in the evening and when PM2.5 levels are on the way down (see Figure 3).

If implemented, the 24-hour trigger would result in a '7' or 'High' health risk just as the air is improving (except when we have a prolonged, significant inversion and PM2.5 levels stay high for multiple days).

As a result, when it is smoky in the evenings, for example with PM2.5 readings of 40-59, the risk level might be a low '3'; and then late at night or early in the morning, when actual readings might be under 25 ug/m3 and dropping, the risk level would jump to a '7'.

Clearly, this approach would often fail to reflect actual risk and it would likely create a huge public credibility issue for the AQHI.

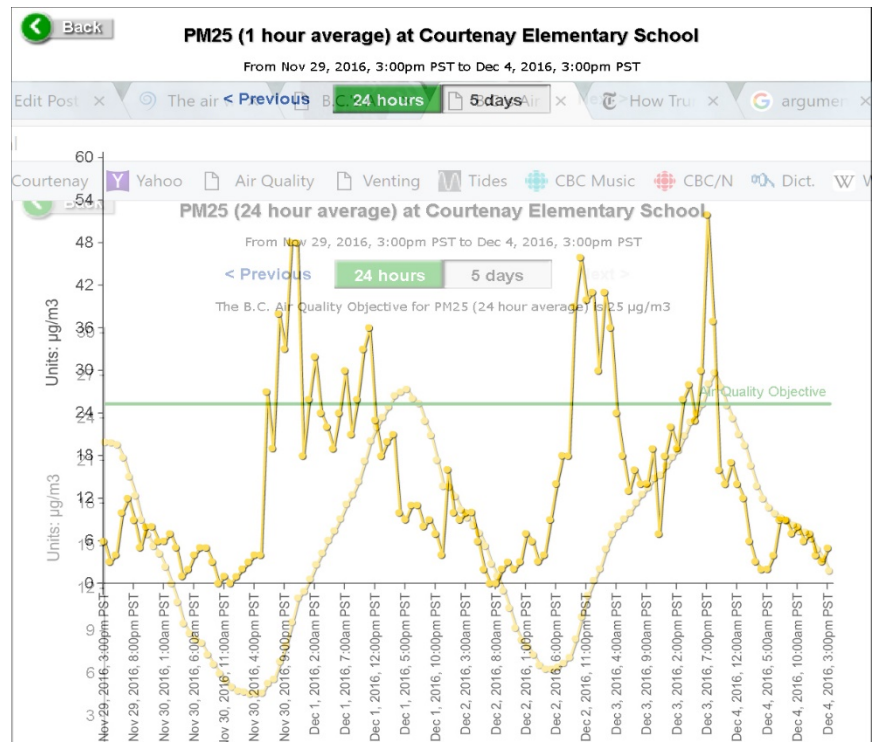


Figure 3: 24-hour average of 25 ug/m3 often occurs well after highest evening levels of PM2.5. Yet, with the AQHI+ system, the higher readings correspond with a "low" health risk on the AQHI (as long as they are under 60 ug/m3) and the much lower

AQHI FORECASTING UNTRUSTWORTHY

Additionally, the forecasted AQHI values typically fail to reflect the diurnal cycle of wood smoke and are misleading.

During the day, the forecast might be for a '7' if our 24-hour average is likely to stay high (when the hourly readings might in fact be dropping) (see Figure 4).

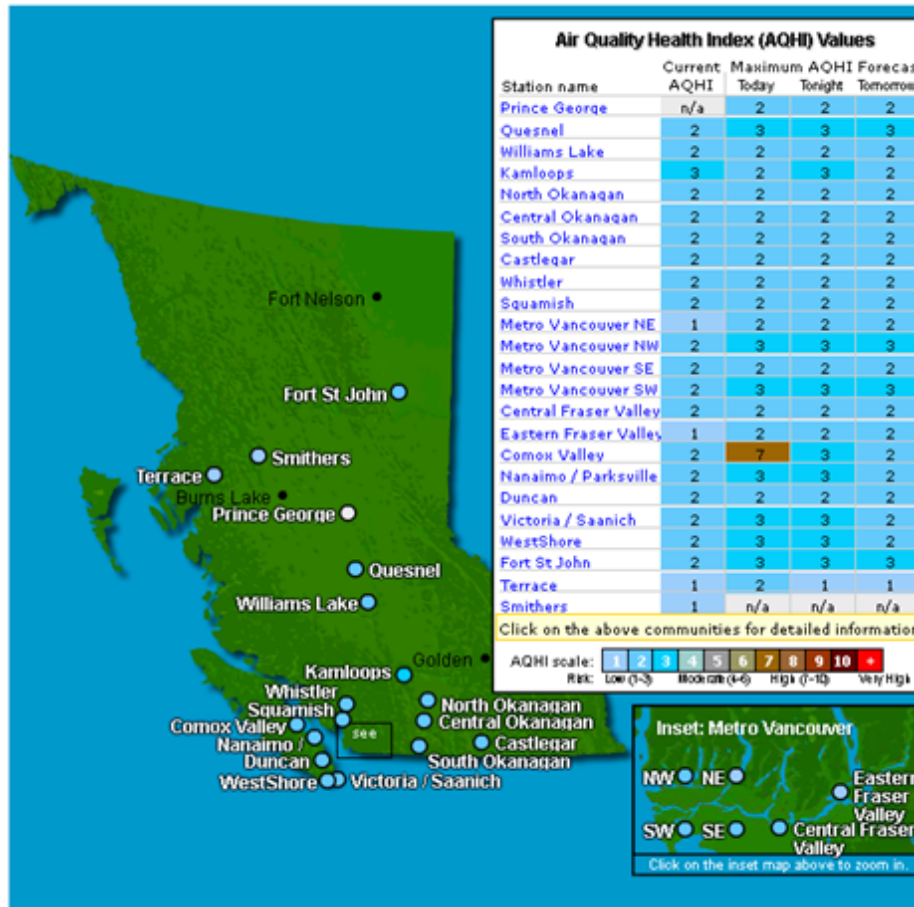


Figure 4: Although there was a forecast of '7' in this example from Nov. 17, 2016, the AQHI never exceeded a "2" during the day. This is a common occurrence which makes the forecast untrustworthy.

In addition, if a reading of 60ug/m3 is reached, a forecast of 3 will suddenly become a 7.

Then the forecast will show a '3' or '4' for the evening, when there is a strong likelihood that smoke levels will be increasing significantly.

If the 60 ug/m3 line is crossed, as it often is on a cold winter evening, a forecast '3' will suddenly become a '7'.

Additionally, during the recent high levels of wildfire smoke in the Lower Mainland and elsewhere, the AQHI forecasting appeared to be completely disconnected with what was happening, often predicting a low or moderate health risk when weather reports, air quality advisories and actual air monitor readings were indicating ongoing high smoke/PM2.5 levels.

This again highlights that the three-pollutant formula is completely inappropriate when it comes to identifying health risks from high PM2.5 levels.

ARE AQHI WARNINGS APPROPRIATE?

As noted earlier, the AQHI was developed based a study of pollution and mortality rates in urban centres in Canada. The messages associated with the risk categories would also have been linked to the three main pollutants identified in the study.

As outlined above, the levels of these three pollutants are very different in smaller communities. PM2.5 is often the primary pollutant in most non-urban communities, and PM2.5 levels are also *significantly* higher than levels in urban areas (except perhaps during wildfire events).

Since the AQHI was first developed in the late 1990s or early 2000s, there have been many studies released regarding the health impacts of PM2.5. For example, a recent study of Prince George, Kamloops and the Comox Valley showed that even an increase of just 5ug/m3 in PM2.5 over a few days can result in a significant increase in heart attack risk for seniors (even more so if the PM2.5 comes from wood burning). This is just one study of many that have increased our collective awareness of the health risks of PM2.5. As the BC government's own Healthlink notes, PM2.5 is the number one air pollutant of concern in BC.

This increasing knowledge and awareness of health risks of PM2.5 has been acknowledged by our governments in the form of amendments to the Canadian Ambient Air Quality Standards (CAAQS) and BC's own Air Quality Objectives. Targets for PM2.5 have been lowered to reflect the improved understanding of the dangers of PM2.5, and are being lowered again in 2020. (Although one may debate the appropriateness of these lower numbers, and if they go far enough, the changes clearly indicate an agreement that PM2.5 is a greater health risk than previously thought).

But the AQHI formula, and the associated health risk warnings have, apparently, not been amended since they were developed. As such, they do not reflect the improved understanding of PM2.5 health risks and they also continue to be based on a combination of urban-related pollutants.

During the wildfires in particular, the inadequacy of these health messages and associated assurances that only vulnerable people should really be concerned became readily apparent. However, these messages are likely just as inappropriate in the winter in wood smoke impacted-communities.

Our organization has heard of many stories where healthy people have moved to wood smoke-communities and developed a range of different health issues associated with wood smoke. Yet, even when a higher health risk warning is triggered, we believe the associated text gives "non-vulnerable" people a false sense of security.

As our we have heard different medical health officers note in reference to PM2.5 "There is no such thing as a safe level of exposure". The AQHI messages must be updated to reflect our increased understanding of the short- and long-term impacts of PM2.5 exposure.

RECOMMENDATION:

- **In order to serve BC citizens living outside of Vancouver and the Lower Mainland, the AQHI formula should be significantly amended to ensure that high readings of any one pollutant, and associated health risks, are not modified by low readings of other pollutants.**

The approach of the US AQHI can perhaps be used as a model to ensure that health risks of PM2.5 are more appropriately reflected and communicated. Additionally, use of hourly readings are more appropriate than three hours of readings for the AQHI.

Additionally:

- **The AQHI should reflect a graduated increase in risk that corresponds with the increase in PM2.5 readings. As an example, if 60 ug/m3 is considered enough to trigger a "7", then**

perhaps 50-59 would be a "6", and 40-49 would be a "5". Additionally, when readings are much higher than 60, the AQHI should increase accordingly. A reading of 120 ug/m3 should be a much higher risk than a "7". A single number trigger as used currently in the AQHI+ is clearly not appropriate.

- **The use of the 24-hour average for PM2.5 as a possible trigger in the AQHI+ system should not be implemented as it inadequately reflects the diurnal cycle of risk in wood smoke impacted communities. It would further harm the credibility of the AQHI.**
- **AQHI Health risk warnings need to be amended to better reflect the risks of short- and long-term exposure for all populations.**

We appreciate the opportunity to provide comments on the AQHI and hope that you find this submission helpful in your review of the AQHI and the AQHI+.

We look forward to hearing about the outcome of your review and providing additional feedback if needed.

Sincerely,



Jennell Ellis
Breathe Clean Air Comox Valley

cc.

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