

Air-quality monitoring recommendations for child-care centers and schools

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This document is meant to serve as a recommendation for child-care centers and schools in Alberta to assess the risk of outdoor play during poor air-quality events. As a guideline, it suggests what staff and parents should consider in assessing both indoor and outdoor air quality to promote child health. The suggested use of LittleLungs.ca, an air-quality monitoring dashboard developed to support implementation of these recommendations, is described.

We provide information about the risks of air pollution and the Canadian Air Quality Health Index (AQHI), including general and wildfire-specific information on the health effects of inhaling particulate matter small enough to enter the small airways of the lungs (PM_{2.5}).

The following recommendations are based on the most recent, high quality scientific information available; as new information becomes available they will be updated. This document includes recommendations from the [Vancouver Coastal Health Community Care Facilities Licensing Program](#). This document has been developed with input from the [Alberta Capital Airshed](#).

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1. Particulate matter (PM_{2.5}) and associated risks:

Alberta's air quality has been impacted by increasing number of days with poor air quality yearly, in part due to the increased frequency of wildfires. PM_{2.5} is one of the major components of wildfire smoke, however year-round sources include traffic-related air pollution, fossil fuel burning power plants, industrial facilities, residential heating (especially using gas and heavy oil) and wood stoves. In the winter, [temperature inversion](#) can trap pollution, resulting in poor air-quality. Wildfire smoke may also contain [more hazardous material](#) than only PM_{2.5}.

PM_{2.5} poses the [greatest health risk](#) because the particles are small enough to enter the lungs, affecting the lungs and heart, and even smaller particles that can directly enter the bloodstream (PM_{0.1}) that have systemic inflammatory effects.

Symptoms from wildfire smoke and PM_{2.5} exposure may include sore throat, eye irritation, runny nose, mild cough, increased mucus production, wheezy breathing and headaches. Higher levels of PM_{2.5} in the air are associated with increased frequency and severity of respiratory infections like bronchiolitis and pneumonia, and asthma attacks, in children; adults are also more likely to experience cardiac and neurologic events like heart attacks and stroke.

Poor air quality due to PM_{2.5} has also been linked to poor health outcomes in pregnant people, such as preterm birth and small for gestational age newborns, and adverse neurodevelopmental outcomes in children, including an increase in autistic spectrum disorder diagnoses in areas with longstanding poor air quality.

It is important to recognize that **there is no safe level of PM_{2.5}**. Many organisations, including the World Health Organization, Health Canada and the American Thoracic Society recommend maximum short-term exposures for poor air quality events, such as wildfire smoke days, and maximum long-term exposure levels for everyday life, based on trying to limit poor health outcomes for the majority of people. While people with underlying health problems have the highest risk with poor air quality exposure, every person is affected.

[All infants and children, regardless of pre-existing or chronic conditions, are highly vulnerable to air pollution and wildfire smoke.](#) Children are more vulnerable than adults for 3 reasons:

1. With exploratory behaviours and limited control over their activities they have higher exposure levels;

2. Their higher breathing rate and small body size means more exposure per body weight than an adult;
3. Exposures affect growth and [development](#), whereas adults do not face that risk.

The rate of emergency department visits and hospital admissions [dramatically increases](#) for all children following wildfire events. For the general population, morbidity and mortality on smoke impacted days approximately [doubles the risk](#) on days without smoke impact. **Not just high-risk days are concerning; [prolonged \(many-days\) exposure to moderate air quality can damage developing lungs.](#)**

2. The Air Quality Health Index (AQHI)

The [Canadian Air Quality Health Index \(AQHI\)](#) reports outdoor air quality based on risks from three main pollutants: ground-level ozone (O₃), fine particulate matter (PM_{2.5}), and nitrogen dioxide (NO₂). AQHI values are calculated using a 3-hour rolling average from [local continuous air quality monitoring stations](#); a number from 1-10+ indicates the level of health risk for the local air quality. An AQHI value of 7 and above is considered to be high risk.

It is important to note that a 7 corresponds to a level considered high risk for the *general population*. **At-risk groups, consisting of infants and children, the elderly, pregnant people and those with pre-existing conditions, are at greater risk at lower levels.** According to the Canadian AQHI recommendations, infants and children should “consider reducing or rescheduling strenuous outdoor activities” at a moderate health risk AQHI value of 4-6. For young children, this includes typical outdoor play.

The [formula](#) used to estimate health risk in the national AQHI relates 3-hour pollutant concentrations with the daily mortality from a given pollutant. More details on recent amendments to the AQHI can be found in Appendix A.

When using the AQHI for information it is important to remember that 3-hour rolling averages may not reflect rapid changes in air quality, which can happen during wildfire smoke events. The AQHI is reported from local monitoring stations, so may not accurately report air quality at a distance from a monitoring station location. Air quality can also fluctuate based on meteorological factors like winds and humidity.

Assessments of the limitations of the Canadian AQHI highlight two issues:

1. Limitations owing to the lag of 3-hour rolling average measurements.
2. Limitations due to the location of monitoring stations and ground-level heterogeneity.

Low-cost microsensor technologies, such as [Purple Air](#) and [AQ Egg](#) monitors, have been adopted nation-wide to provide real-time PM_{2.5} data to fill monitoring gaps in rural areas, and cities. While these microsensors are low-cost sensors and have [limitations](#), they also hold [tremendous potential](#) in risk mitigation during poor air-quality events, particularly during Wildfire Season. There are numerous Microsensors installed across the province.

Based on particulate matter microsensors, the [University of Northern British Columbia \(UNBC\) and Environment and Climate Change Canada \(ECCC\)](#) have created an [air quality map](#) that provides real-time data on the amount of fine particulate matter in the air at hundreds of locations across the country. This map reports hourly PM_{2.5} concentrations with comparison to the AQHI+ colour scale. The [Alberta Capital Airshed Live Air Data Map](#) provides near-real time readings from continuous monitoring stations and microsensors within their boundaries.

To support risk-assessment around children’s outdoor play, we suggest supplementing AQHI readings with data from particulate microsensors. More details are provided in the Recommended Policy, below. In addition to outdoor air-quality, indoor air quality and heat are crucial, especially during wildfire season (see “Additional Consideration”, below).

3. Recommended policy for adoption by child-care facilities and schools

We recommend that child-care facilities and schools expand their emergency plan to include a response to wildfire smoke and associated extreme heat events. This may include evacuation plans to community centers or other public spaces with access to air cleaning and central air conditioning for facilities that are not able to provide cool, clean air environments under extreme circumstances.

Staff should be prepared to recognize the symptoms of distress due to PM_{2.5} and heat exposure and know when medical care is required. Staff should ensure that children with chronic health conditions, such as asthma, have prescribed “reliever” medications immediately available at all times, in the same way children with anaphylactic allergies always need to have injectable epinephrine on hand.

Symptoms from wildfire and PM_{2.5} exposure may include sore throat, eye irritation, runny nose, mild cough, mucus production (runny nose, wet cough), wheezy breathing and headaches. More severe symptoms, requiring medical attention, include shortness of breath, severe cough, dizziness, chest pain and heart palpitations. Many young children will report “tummy ache” for respiratory symptoms. Clues might be wheeze (noisy breath out), stridor (noisy breath in), fast breathing, gulping or holding in air at the end of a breath, muscles pulling between the ribs, at the neck or belly, or head bobbing in infants.

For assessing the risk of outdoor-play, we recommend obtaining air quality measurements immediately before outdoor play and/or throughout the day (morning, lunch-time and afternoon) from **both** federal continuous air quality monitoring stations and nearby microsensors.

LittleLungsAB.ca is an accessible platform providing air quality data from continuous air quality monitoring stations and microsensors across Alberta. It is built to support child-care centers and schools in performing risk assessment, as outlined in these recommendations.

3.1 Using LittleLungsAB.ca:

1. Determine your location using one of the following options:

- Hit “Use My Location” to auto-detect your location. Double check that the dropped pin has correctly identified your location
- Input your address manually
- Hit “Drag & Drop Location” to place the pin at your desired location. After dragging, hit “Confirm Location” to finalize.

2. Assess risk based on nearby stations

- Based on your location, a pop-up window will appear, providing:
 - AQHI from the three nearest Continuous Monitoring Stations,
 - Community AQHI
 - PM_{2.5} concentration on the AQHI scale from the three nearest microsensors
- It is important to consider more than one microsensor as an individual sensor may give anomalous readings based on local influences (such as nearby campfires), or could be malfunctioning or offline.

3. Follow the guidelines associated with the highest AQHI/PM_{2.5} concentration value

- E.g. If the Continuous Monitoring Stations station reports 6, and the microsensors report 4, follow the guidelines for a 6; if the continuous air quality monitoring station is a 3, and the microsensor is a 5, follow guidelines for a 5.
- It is crucial to consider both scales to capture pollution from all measured sources.

4. We recommend a modification of activities when the air quality is at or above an AQHI/PM_{2.5} concentration of 4-6

- This suggestion is based on the increased vulnerability of infants and children to poor air quality.
- Each daycare should choose a value in this range based on their own risk assessment, considering the risks described above.
- Note that the threshold for infants is lower than for older children and toddlers.

- Children with underlying diseases, such as asthma, should not play outdoors [at or above a value of 5](#).
- Offer vigorous indoor play as an alternative to outdoor play programming.

5. If it is deemed safe to play outdoors, monitor the children’s symptoms during outdoor play.

- Note that air quality can change rapidly during wildfire events - check the dashboard often (e.g. every hour while outdoors).
- Ensure that “reliever” medications are on-hand for high-risk children, such as those with asthma.
- Remember that air-quality risk is cumulative; symptoms can worsen over time.
- Reduce outdoor activity during poor air quality and during the hottest time of the day. The harder a person breathes, the more smoke they inhale.
- Ensure that children drink plenty of water to reduce inflammation.

Additional ways to access air-quality measurements and follow the recommended assessment without [LittleLungsAB.ca](#) is provided in Appendix B.

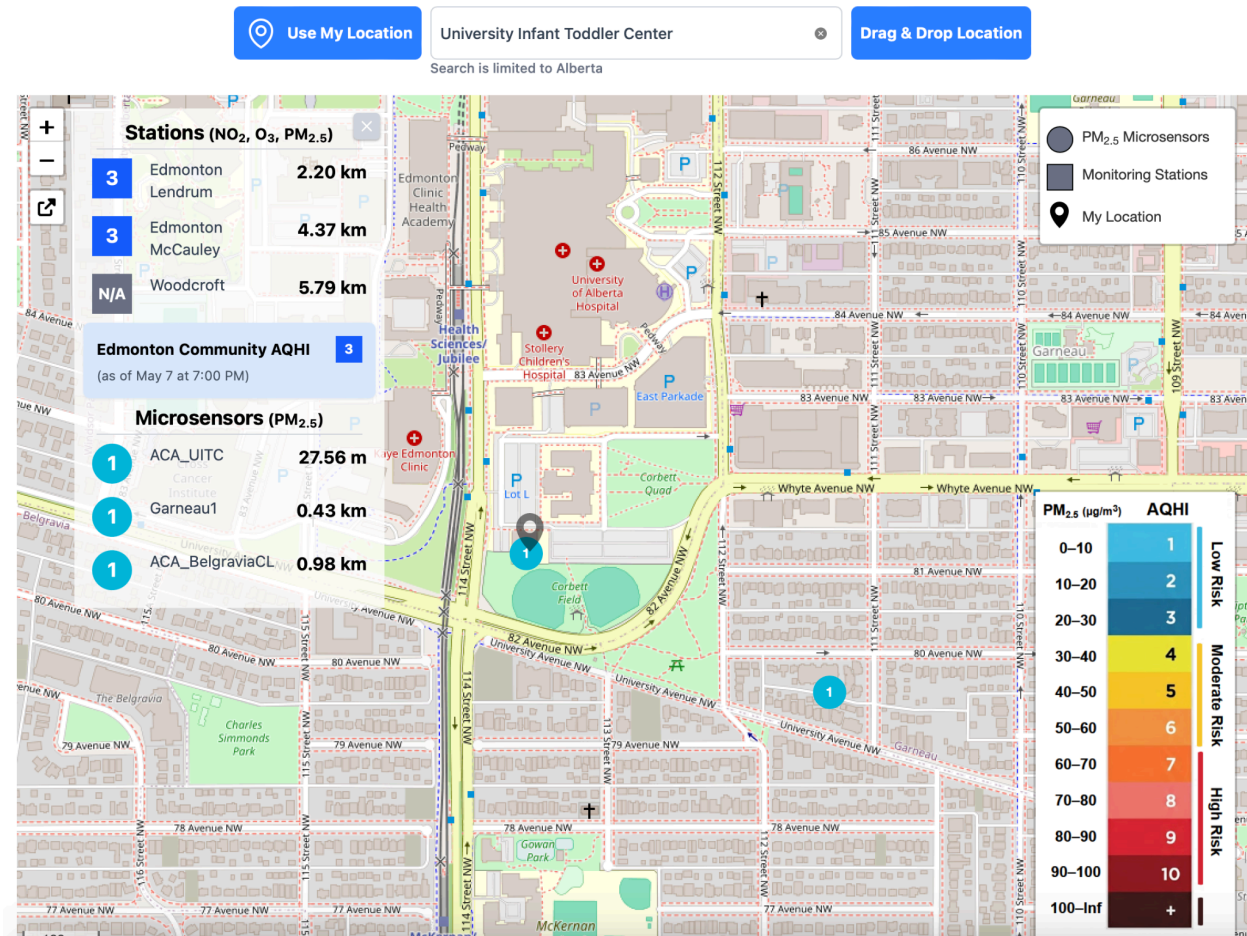


Figure 1: Screenshot from [LittleLungsAB.ca](#)

4. Additional considerations

4.1 Indoor air quality is paramount

Outdoor air quality precautions are important so long as the indoor air quality is better than outside. Indoor PM_{2.5} level of 12 µg/m³ or less, with infrequent or no spikes of 35 µg/m³ or higher, [is considered acceptable](#).

Children, particularly in North America, spend more than ¾ of their time indoors. In addition to suggesting maximum pollution exposure for outdoor play, we strongly recommend that childcare centres install indoor air quality monitors alongside portable air cleaners that can lower PM_{2.5}. Indoor air filtration and ventilation strategies, specifically High Efficiency Particulate Air (HEPA) air cleaners, can [significantly reduce](#) exposure to harmful fine particulate matter, as well as [reducing viral load](#) in the air, including COVID-19.

Child-care facilities should be ready to maintain clean air inside the facility.

- It is recommended to install an in-door air-quality sensor that covers PM_{2.5}, at least.
 - A [Purple Air indoor air quality monitors](#) covering PM₁₀ to PM_{0.3} can be purchased for ~\$300 CAD.
 - An [Air Things monitor](#) covering PM_{2.5}, CO₂ and airborne chemicals can also be purchased.
- We recommend updating ventilation systems to install MERV 13 or higher rated filters, and assessing the possibility of including HEPA filters in daycare rooms.
- During wild-fire events, we recommend portable air cleaners with HEPA filtration that are appropriately rated for the size of the space.
- Avoid air cleaners that produce ozone.
- The BC Center for Disease Control provides information on [choosing a portable air cleaner](#). [Homemade air cleaners](#) may also be considered as cost-effective alternatives.
- In areas with high outdoor pollution (above 35 µg/m³, AQHI+ of 4-5, in the outdoor air), windows to the building should be *closed* and outdoor air brought inside using HEPA filtration.

4.2 [Heat](#) - an additional environmental challenge

It is also important to note that heat may become an issue on wildfire days, and can be exacerbated by closing buildings during air pollution days. Heat can be especially dangerous for infants and young children. Indoor temperatures should be maintained below 26 degrees C to

prevent heat-related illnesses. Central air conditioning and air cleaning must be considered as part of wildfire response guidelines, as well as emergency response plans to evacuate to community centres or public places with clean and cool air.

It is important to note that heat may become an issue on hot wildfire days, and can be exacerbated by the need to close windows and doors for air cleaning. Heat can be especially dangerous for infants and young children.

- In enclosed spaces (e.g. cars), even moderately warm outdoor temperatures can lead to dangerously high indoor air temperatures.
- Indoor temperatures should be maintained below 26 degrees Celsius to prevent heat-related illnesses.
- Energy efficient active cooling systems are recommended to create a cool space with clean air.
- Times of decreased smoke can be taken advantage of to open windows and doors.

4.3 Emotional support

Finally, like us, children experience emotional distress, anxiety and grief due to wildfires and extreme weather events. We recommend empowering educators to involve children in real-time air-quality monitoring, for example through building their own AQHI scale that can be updated daily, to enable the children to understand these indices and have some ownership over the response to poor air quality events.

Appendix A: Amendments to the national AQHI

Alberta has used an AQHI + model since 2011, augmenting AQHI reporting based on the hourly concentrations of PMPM_{2.5}, ozone, nitrogen dioxide, sulphur dioxide, hydrogen sulphide, total reduced sulphur and carbon monoxide in its AQHI reporting. Limitations in the Canadian AQHI to elevated PM_{2.5} have prompted amendments to the AQHI. In 2021, British Columbia implemented an [AQHI + amendment](#) that overrides the 3-pollutant standard AQHI value in response to elevated one-hour PM_{2.5} concentrations. Under this formula when PM_{2.5} reaches or exceeds 60 ug/m³, the AQHI becomes a 7 (high health risk). Once this threshold is reached, the AQHI is reported hourly. The PM_{2.5} override formula used to amend the AQHI is based on [studies](#) assessing asthma-related outcomes.

On April 2nd, 2024, Alberta adopted the BC PM_{2.5} override formula where a PM_{2.5} concentration of 60 ug/m³ corresponding to an AQHI+ of 7, lowering it from its previous threshold concentration at [80 ug/m³](#) (which corresponds to Alberta's 1-hour Ambient Air Quality

Guideline for PM_{2.5}). For context, as increased respiratory health outcomes [have been observed](#) within one hour of exposure to each 10 µg/m³ increase in exposure to PM_{2.5}.

Appendix B: Additional ways to access the AQHI and microsensor data

2. Go to <https://airquality.alberta.ca/map/> to get the current Alberta AQHI value

- a. Both the [Government of Alberta](#) and the [Federal website](#) can be used to see measurements from provincial continuous air quality monitoring stations. Edmonton, St. Albert, and Strathcona County can have different index ratings even though they are in proximity. You may also subscribe to push notifications on the [WeatherCan](#) app.
- b. Click on the community name (e.g. Edmonton).
- c. Note the station, time, and date, and Index calculation.
 - i. Updates usually occur hourly (by about mid-way through the hour).
 - ii. This AQHI value reflects nitrogen dioxide, ozone and fine particulate matter (PM_{2.5}).

3. Go to the UNBC AQ Map

(<https://aqmap.ca/aqmap/#13/53.5320/-113.5186/B31/L38/L40/L41>) to get hourly PM_{2.5} concentrations only, on the AQHI + colour scale.

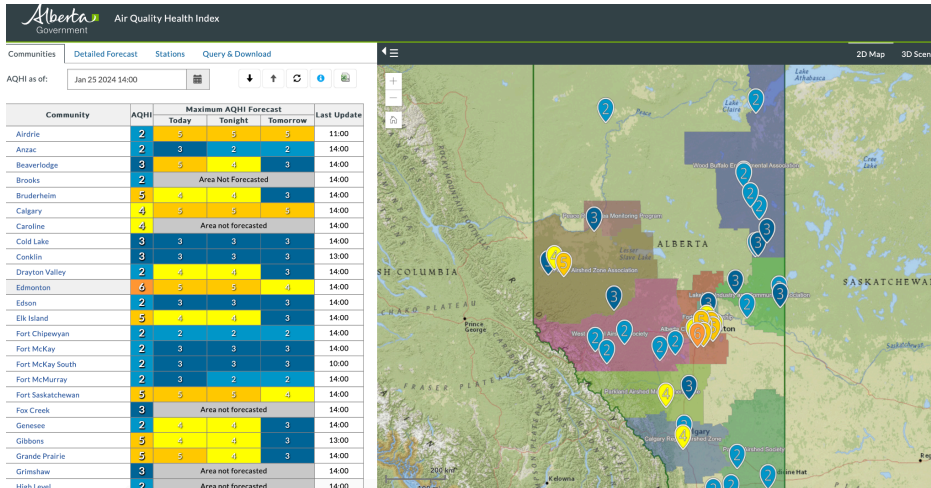
- a. Ensure using the layers icon in the top right that “Corrected Purple Air (PA) monitors” and “Corrected AQ Egg (EGG) monitors” are checked. (Note: The default includes both of these plus “Agency (FEM) monitors”, it is okay to leave the FEM monitors checked).
- b. Hover the cursor over the colour scale on the bottom right to map the PM_{2.5} concentration to the AQHI + risk assessment.
 - i. Red is high risk (7), yellow to red are moderate risk (4-6) for the general population and riskier for sensitive groups including infants and children.
- c. Use the +/- toggle in the top left and the mouse to zoom into the closest outdoor sensor to your location on the map.
- d. Click on the Monitor name (e.g. Garneau1).
- e. Note the station, time, and date, and 1-hour average value.
 - i. Note that it is important to consider more than one microsensor, in conjunction with the community AQHI, as an individual sensor may give anomalous readings based on local influences (such as nearby campfires), or could be malfunctioning or offline.
 - ii. Note the 10-min value; if this is significantly higher from the 1-hour average, this may indicate quickly worsening air quality.

4. Assess the risk based on the worst value reported from Steps 1-2.

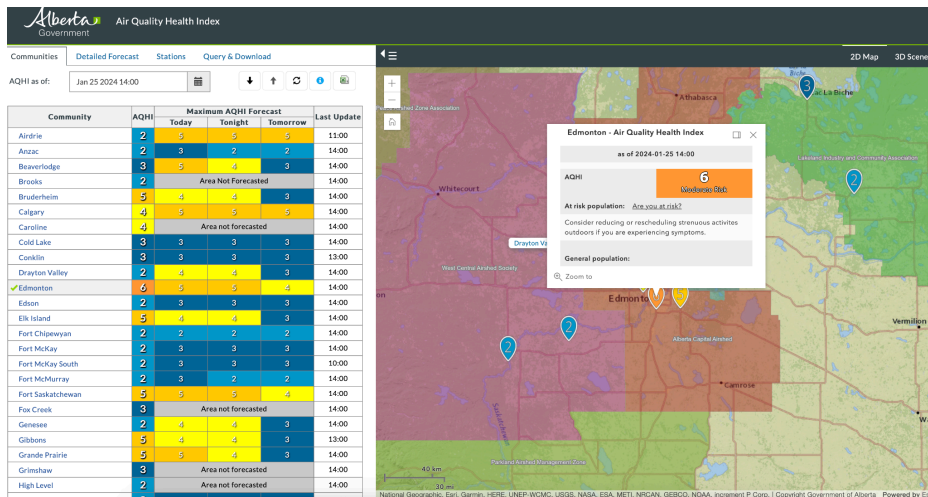
- a. Following the guidelines associated with the highest AQHI+ value (e.g. if the continuous air quality monitoring station reports 6, and the microsensors report 4, follow the guidelines for a 6; if the continuous air quality monitoring station is a 3, and the microsensor is a 5, following guidelines for a 5). *It is crucial to consider both scales to capture pollution from all measured sources.*
 - b. We recommend a modification of activities, for example providing vigorous indoor play alternative equivalent to outdoor play programming, when the air quality is at or above a 4-6 on the AQHI + and/or AQHI scale.
 - i. This suggestion is based on the increased vulnerability of infants and children to poor air quality.
 - ii. Each daycare should choose a value in this range based on their own risk assessment, considering the risks described above.
 - iii. Note that the threshold for infants is lower than for older children and toddlers.
 - iv. Children with underlying diseases, such as asthma, should not play outdoors [at or above a value of 5](#).
- 5. If it is deemed safe to play outdoors: monitor the children’s symptoms during outdoor play.**
- a. Note that air quality can change rapidly during wildfire events.
 - b. Ensure that “reliever” medications are on-hand for high-risk children, such as those with asthma.
 - c. Remember that air-quality risk is cumulative; symptoms can worsen over time.
 - d. Reduce outdoor activity during poor air quality and during the hottest time of the day. The harder a person breathes, the more smoke they inhale.
 - e. Ensure that children drink plenty of water to reduce inflammation.

Using <https://airquality.alberta.ca/map/> to get the current Alberta AQHI value:

- a. Edmonton, St. Albert, and Strathcona County can have different index ratings even though they are in proximity. You may also subscribe to push notifications on the WeatherCan app.

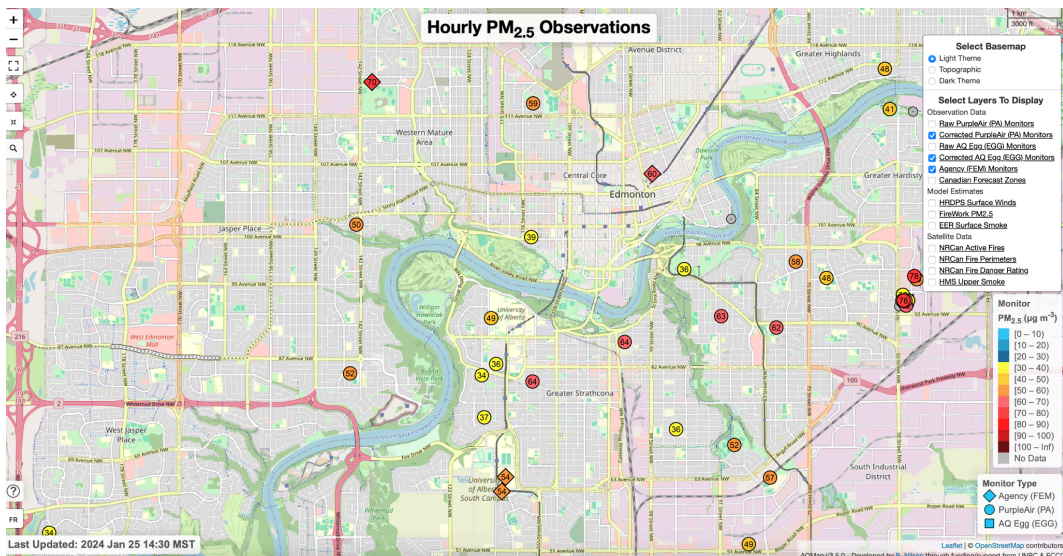
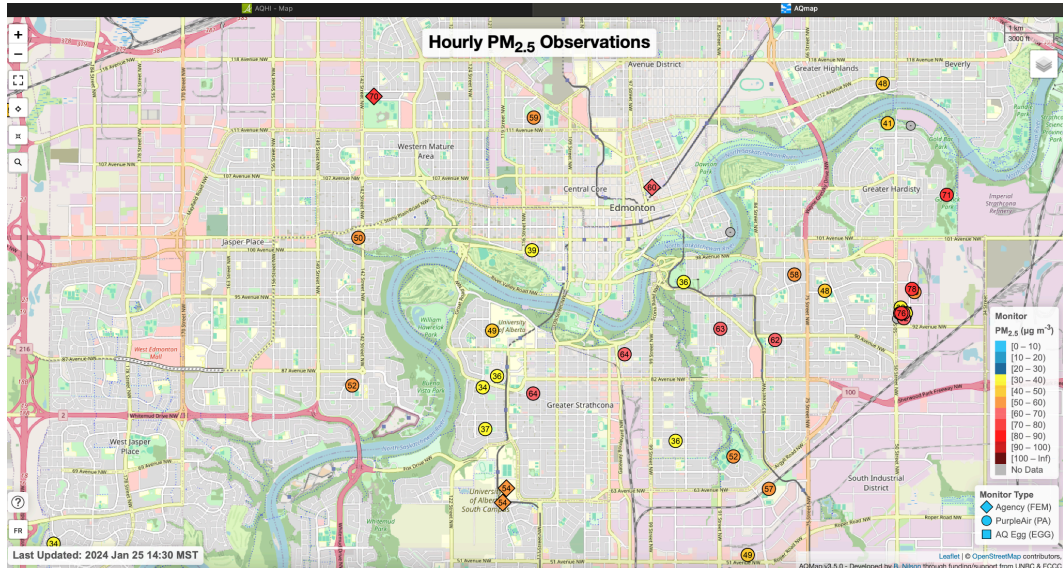


- b. Click on the AQHI community name (e.g. Edmonton).
 - i. Note the station, time, and date, and Index calculation.
 - ii. Updates usually occur hourly .

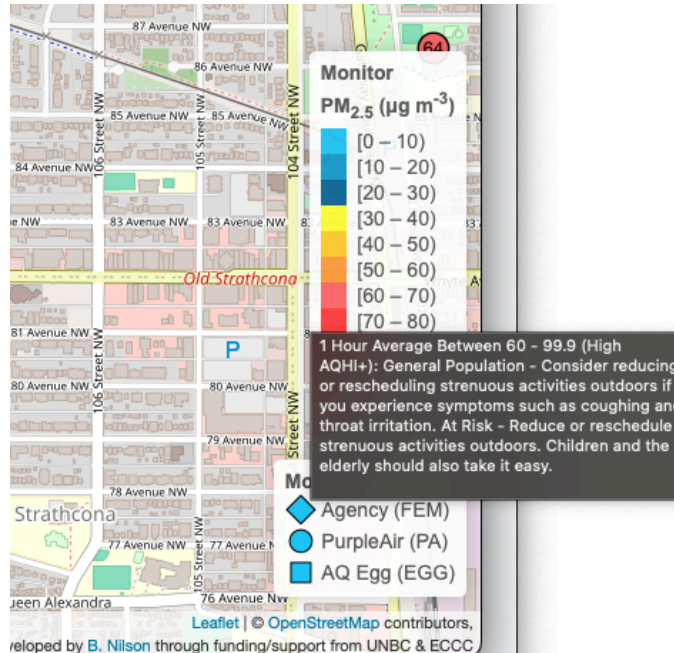


Using <https://aqmap.ca/aqmap/#13/53.5320/-113.5186/B31/L38/L40/L41> to get hourly PM_{2.5} concentrations with the BC AQHI + index

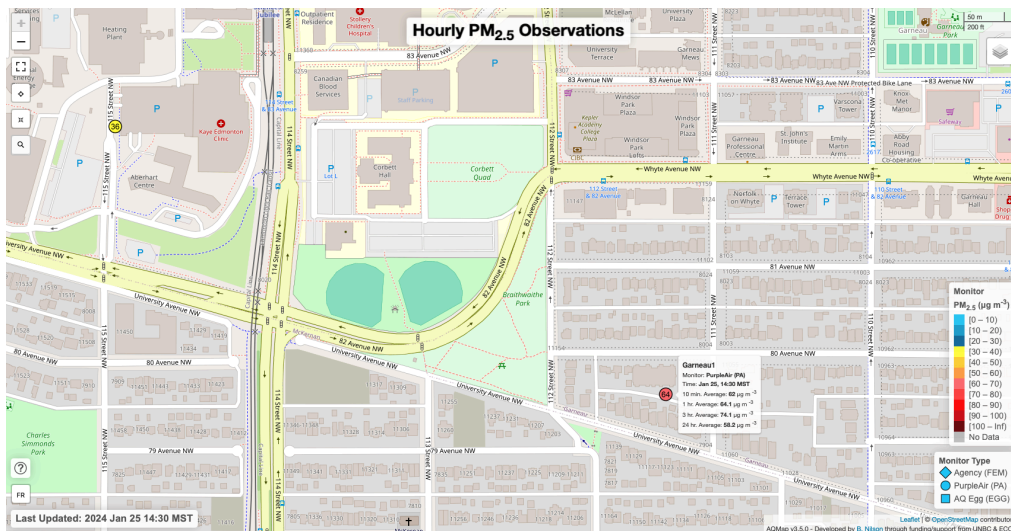
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- b. Hover the cursor over the color scale on the bottom right to map the PM_{2.5} concentration to the AQHI + risk assessment.
 - i. Red is high risk (7), yellow to red are moderate risk (4-6) for the general population and riskier for sensitive groups including infants and children.



c. Use the +/- toggle in the top left and the mouse to zoom into the closest outdoor sensor to your location on the map.



d. Click on the Monitor name (e.g. Garneau1).

e. Note the station, time, and date, and 1-hour average value.

- i. Note the 10-min value; if this is significantly higher from the 1-hour average, this may indicate quickly worsening air quality.

