PRINCE EDWARD ISLAND

2014 Air Quality Report
For the Years 2011-2013

September, 2016

Prince Edward Island
CANADA

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For the Years 2011-2013
September 2016

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1.0 INTRODUCTION

The Air Quality Management System (AQMS) was endorsed by the Canadian Council of Ministers of the Environment in October 2012 to improve air quality across Canada, using a consistent approach. The AQMS was developed by federal, provincial and territorial governments, in conjunction with a variety of stakeholders, over a number of years. The system consists of several interrelated parts.

Canadian Ambient Air Quality Standards

The driver for this system is the Canadian Ambient Air Quality Standards (CAAQS). Standards have been developed for fine particulate matter ($PM_{2.5}$ – particles that have a mean diameter of 2.5 microns or less) and ground-level ozone, and work has begun to develop standards for nitrogen dioxide (NO_2) and sulphur dioxide (SO_2).

Air Zones

Provinces and territories have established and manage air zones within their boundaries with the goal of bringing about improvements in air quality and preventing the CAAQS from being exceeded. An air zone is a geographic area, within a particular province or territory that generally exhibits similar air quality issues and trends throughout. An Air Zone Management Framework has been developed to ensure proactive measures are taken to protect air quality using the principles of continuous improvement and keeping clean areas clean.

Airsheds

Regional airsheds are large geographic areas that encompass many air zones. Six airsheds covering all of Canada have been established (Figure 1) to coordinate efforts to reduce transboundary air pollution flows and report on regional air quality.

Transboundary air pollution flows are those that enter one province or territory from other provinces or territories, or flows that enter Canada from the United States.

Base-level Industrial Emissions Requirements (BLIERs)

BLIERs are industrial emission requirements which are intended to ensure that all significant industrial sources in Canada, regardless of where they are located, meet a good base-level of performance. BLIERs are emissions requirements proposed for new and existing major industrial sectors and some equipment types. These requirements are based on what leading jurisdictions inside or outside Canada are requiring of industry, adjusted for Canadian circumstances. BLIERs are focused on nitrogen oxides (NO_X), sulphur dioxide (SO_2), volatile organic compounds (VOCs), and particulate matter (PM).

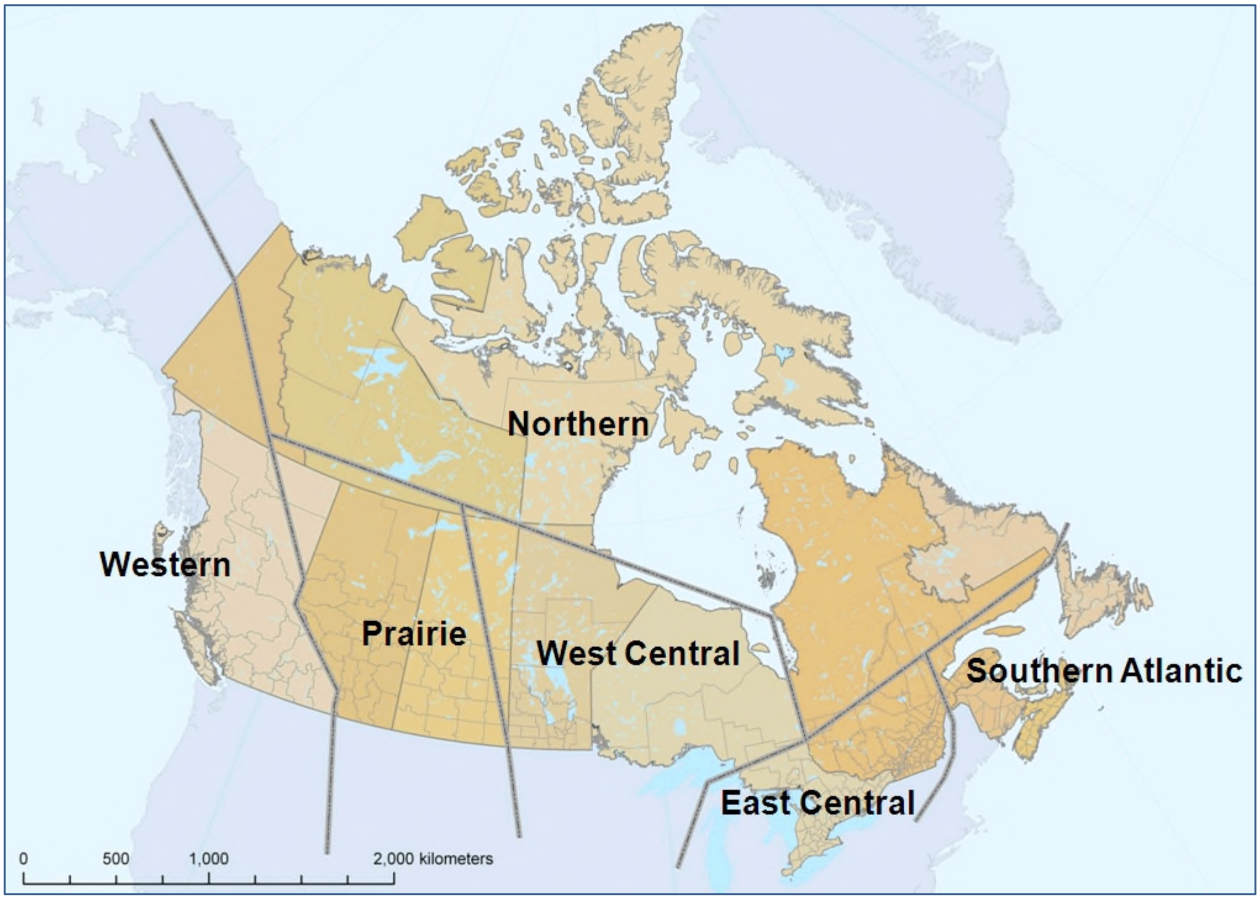


Figure 1 - Regional Airsheds

Mobile Sources

The AQMS includes work to address emissions from mobile sources that builds on existing federal, provincial and territorial initiatives aimed at reducing emissions from the transportation sector. Priorities are to reduce emissions through advanced transportation technologies, proper vehicle maintenance, initiatives targeting in-use diesel vehicles and engines, and by greening fleets.

Monitoring and Reporting

Provinces and territories, with assistance from the federal government, are responsible for monitoring in their air zones and reporting to the general public on air quality and the measures taken to implement the AQMS. Provinces and territories will produce annual air zone reports that include information on achievement of the CAAQS, and air quality issues and trends.

A national State of the Air Report will be produced every five years by Environment and Climate Change Canada, beginning in 2016. These reports will provide information on an airshed basis about air quality across the country and actions taken to address air quality issues.

Stakeholder Engagement

Stakeholders are currently engaged in the process through a national Stakeholder Advisory Group that provides advice to governments on the ongoing implementation, improvement, and operation of the AQMS. They will also be engaged in the development of CAAQS for NO_2 and SO_2, BLIERs, and mobile sources actions.

2.0 HOW PEI IS PERFORMING

This is Prince Edward Island's first Air Zone Report and it presents the compliance status of the province with the Canadian Ambient Air Quality Standards for the $PM_{2.5}$ 24-hour standard, the $PM_{2.5}$ annual standard, and the ground-level ozone standard, based on ambient concentrations measured in the years 2011, 2012 and 2013.

In PEI, there are three air monitoring stations, one in each county. They are located in Wellington, Charlottetown and Southampton as shown in Figure 2.

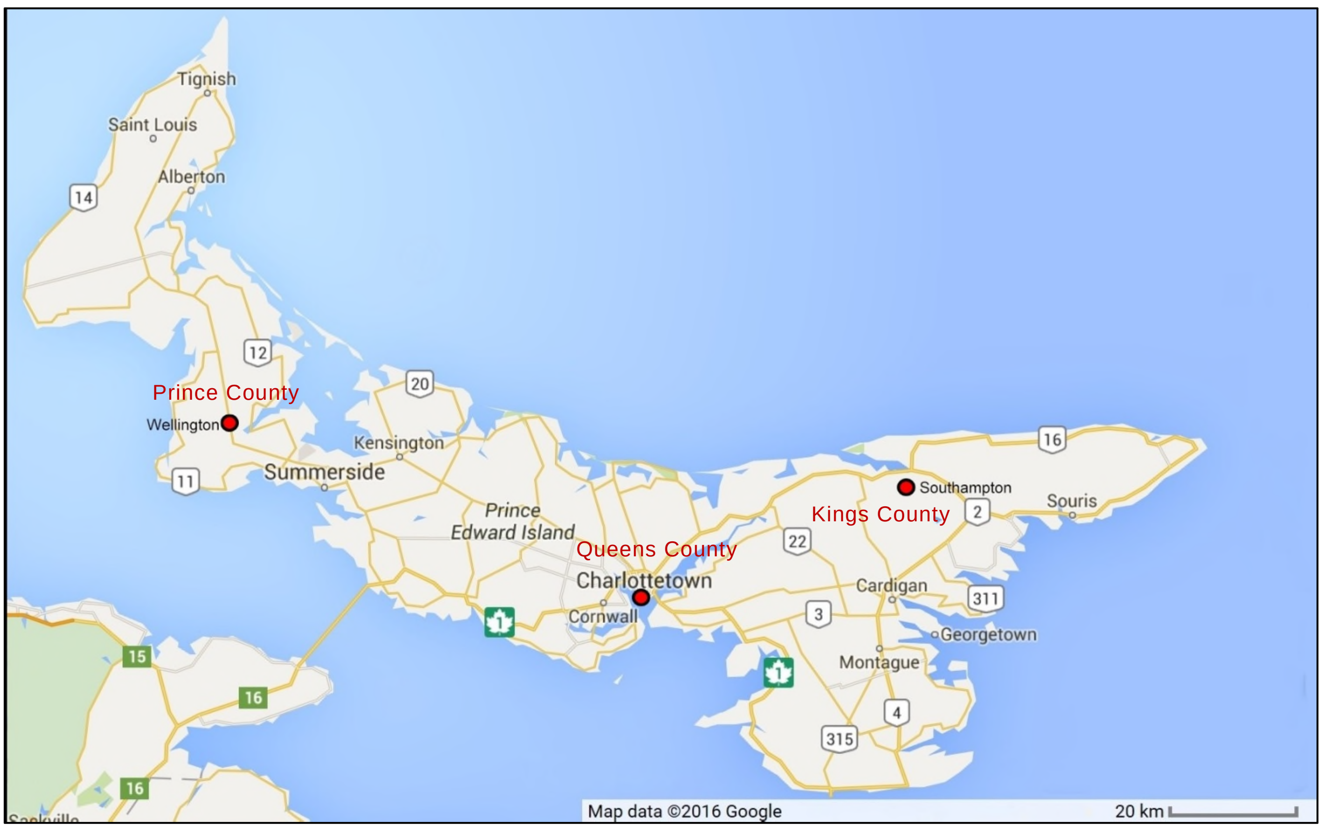


Figure 2 - PEI Air Monitoring Stations

Although the Island is small geographically, weather patterns can be markedly different in each of its three counties. In the Appendix are two tables showing average monthly precipitation amounts, and monthly maximum wind speeds/directions from meteorological monitoring stations closest to the air monitoring stations. The data covers the period 1981-2010. Figures 3a and 3b clearly show the variability from site to site.

	January	July	Yearly
Summerside (Wellington)	96.2	74.1	1,072.9
Charlottetown	101.0	79.9	1,158.2
Bangor (Southampton)	119.9	81.9	1,282.4

Figure 3a – Average Precipitation (rain and snow in millimetres) 1981-2010

	January	July
Summerside (Wellington)	121 N	64 S
Charlottetown	105 SE	64 SW
Bangor (Southampton)	63 S	48 SE

Figure 3b – Maximum Hourly Wind Speed (km/hour) & Direction 1981-2010

Due to this variability, concentrations of air contaminants at the three sites are often different. However, as the collected data is processed statistically before it is compared to the standards (CAAQS), this tends to smooth it out over the three year period and give the appearance that air quality is the same throughout the entire province. Even though this isn't the case, it is reasonable to treat PEI as a single air zone in the context of the Air Quality Management System.

2.1 $PM_{2.5}$ 24-hour Standard

To determine compliance with this standard, the following steps were taken:

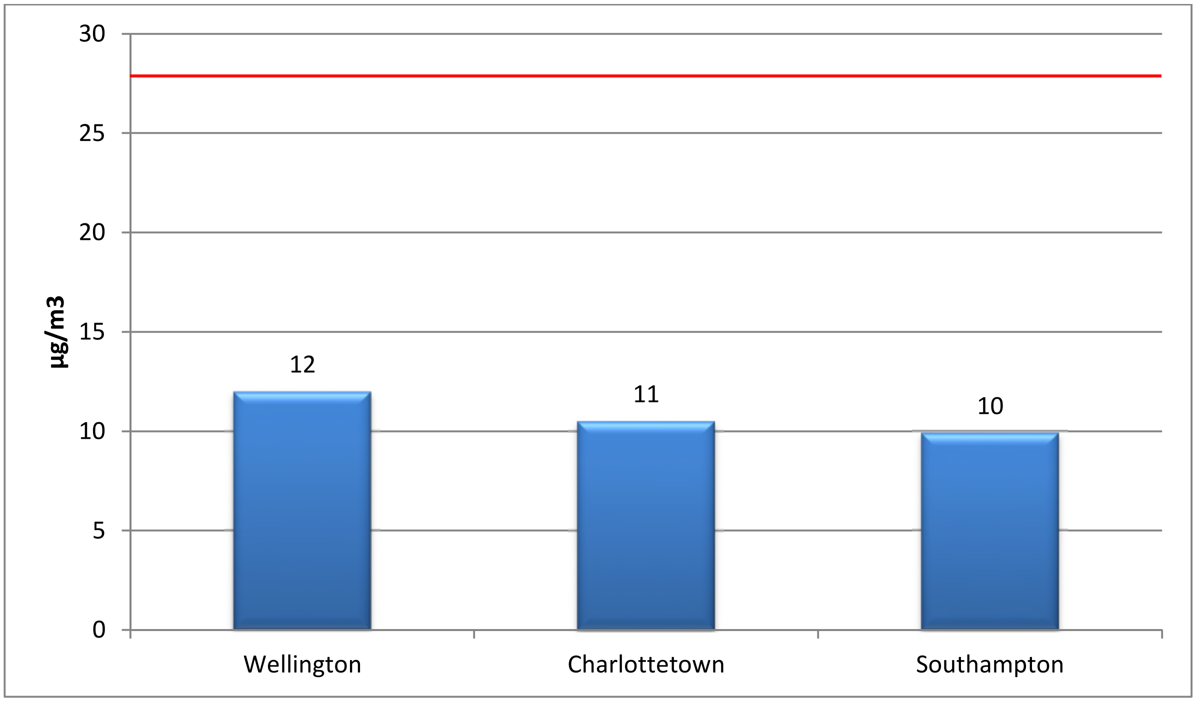
> The $PM_{2.5}$ 24-hour standard is
> **28 μg/m^3**
> (28 micrograms per cubic metre)
>
> The standard is calculated as the *3-year average* of the annual 98th percentile of the daily 24-hour average concentrations for each of three consecutive years.

1. The daily 24-hour average $PM_{2.5}$ concentrations, over the years 2011, 2012, and 2013, were determined for each of the three monitoring stations.

2. The 98th percentile[1] was calculated for each of the 24-hour averages, and the three year average of these numbers determined for each monitoring station.

3. The highest of the averages from the three stations was used as the value for the Air Zone and to determine achievement. Figure 4 shows the results.

[1] Percentile is a measure used in statistics indicating the value below which a given percentage of observations in a group of observations fall. So, the 98th percentile is the value below which 98 percent of the observations may be found. Here, it is used to adjust for differences in the amount of data collected at each site (equipment is occasionally down for maintenance or repairs). It also ensures that unusual events, for example, very high numbers caused by a motor vehicle idling near an air monitoring station, don't abnormally influence the overall numbers.



Legend: The red line is at the value of the $PM_{2.5}$ 24-hour standard, 28 µg/m^3. The numbers above the vertical blue bars are the measured $PM_{2.5}$ concentrations.

Figure 4 – Compliance with the 2015 $PM_{2.5}$ 24-hour Standard, 2011-2013

The highest $PM_{2.5}$ 24-hour concentration was at the Wellington station, so 12 µg/m^3 was taken as the air zone value.

2.2 PM $_{2.5}$ Annual Standard

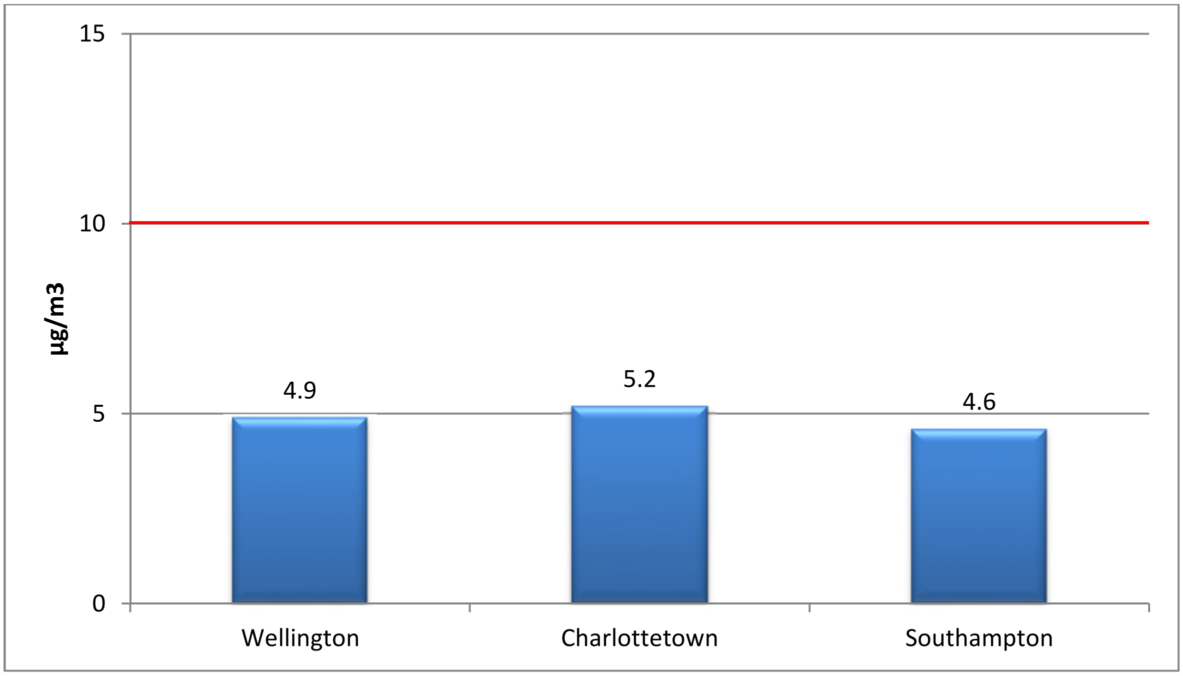
To determine compliance with this standard, the following steps were taken:

> The $PM_{2.5}$ annual standard is
> **10.0 µg/m^3**
> (10 micrograms per cubic metre)
>
> The standard is calculated as the *3-year-average* of the annual 1-year average concentrations for each of three consecutive years.

1. As previously, the daily 24-hour average $PM_{2.5}$ concentrations, over the years 2011, 2012, and 2013, were determined for each of the three monitoring stations.

2. The annual averages of the daily 24hr-$PM_{2.5}$ concentrations for each year were calculated for the three stations.

3. The 3-year average was determined for each station. The results are shown in Figure 5.



Legend: The red line is at the value of the $PM_{2.5}$ annual standard, 10 μg/m³. The numbers above the vertical blue bars are the measured $PM_{2.5}$ concentrations.

Figure 5 - Compliance with the 2015 $PM_{2.5}$ annual standard, 2011 to 2013

The highest of these values, 5.2 µg/m³ in Charlottetown, was taken as the value for the air zone.

2.3 Ozone Standard

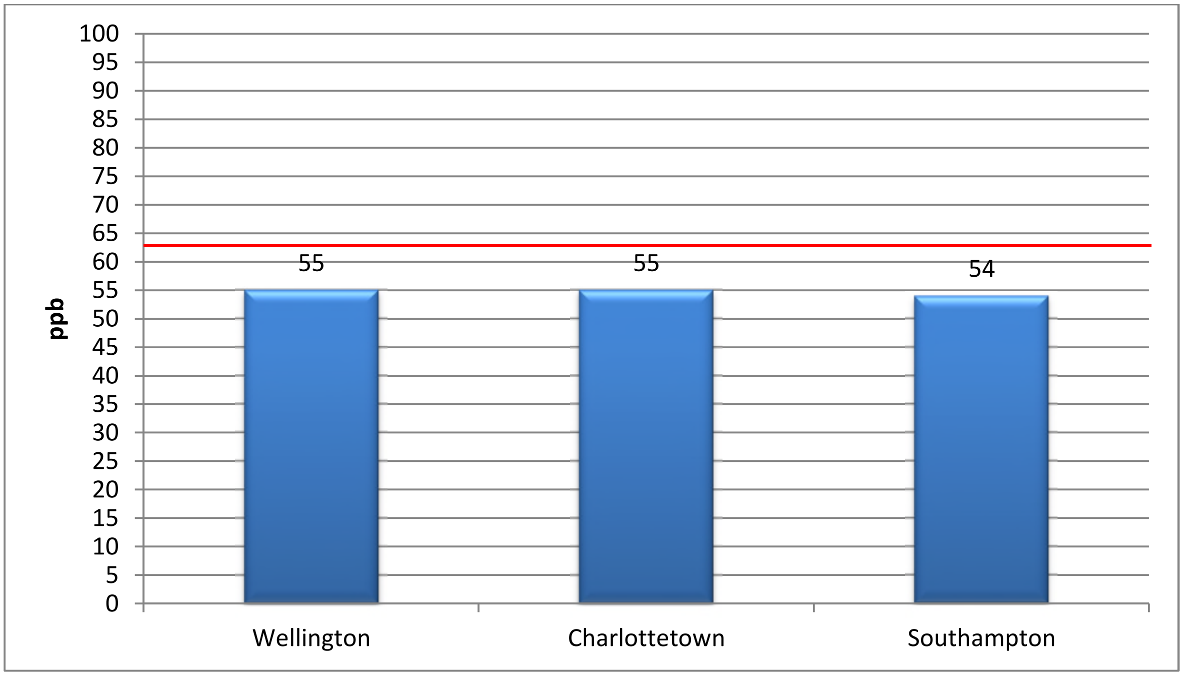
To determine compliance with this standard, the following steps were taken:

> The ozone standard is
> **63 ppb**
> (63 parts per billion)
>
> The standard is calculated as the *3-year-average* of the annual 4th highest of the daily maximum 8-hour average concentration for each of three consecutive years.

1. The 8-hour average ozone concentration was calculated for each hour of the day.

2. The maximum 8-hour average ozone concentration was calculated for each day.

3. The annual 4th highest maximum daily 8-hour ozone concentration was determined for each year and each station. Figure 6 presents the results.



Legend: The red line is at the value of the ozone standard, 63 ppb. The numbers above the vertical blue bars are the measured ground-level ozone concentrations.

Figure 6: Compliance with the 2015 ground-level ozone standard, 2011 to 2013

The highest ozone level was at the Charlottetown and Wellington monitoring stations, 55 ppb, so this was taken as representative of the air zone.

3.0 MANAGEMENT LEVELS

Under the Air Zone Management Framework (AZMF), progressively more rigorous actions are to be implemented in an air zone as air quality approaches or exceeds the CAAQS. Four Management Levels, covering $PM_{2.5}$ and ground-level ozone concentrations, provide general guidance on the nature of the management, monitoring and reporting actions to be implemented in air zones. The structure of the AZMF is illustrated in Figure 7.

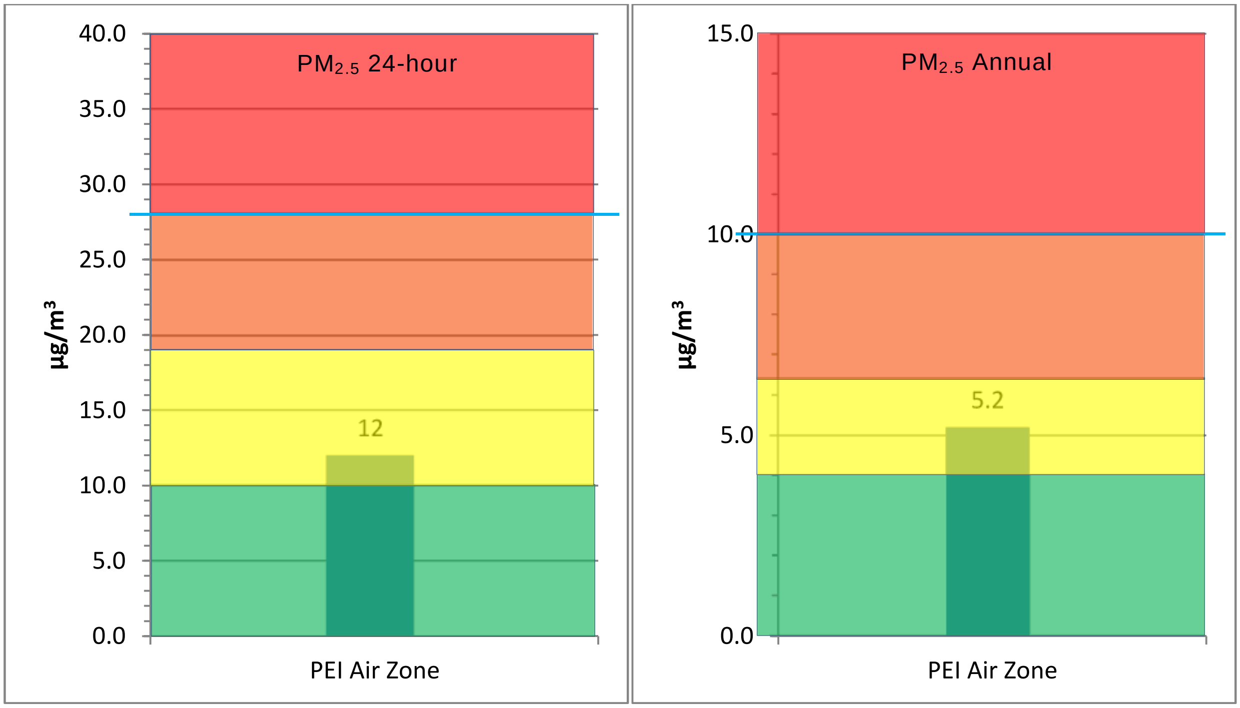
Management Level	Management Actions	Air Management Threshold Values		
		$PM_{2.5}$ 24h (µg/m^3)	$PM_{2.5}$ Annual (µg/m^3)	Ozone (ppb)
RED	Actions for Achieving Air Zone CAAQS			
Threshold		28 µg/m^3	10 µg/m^3	63 ppb
ORANGE	Actions for Preventing CAAQS Exceedance			
Threshold		19 µg/m^3	6.4 µg/m^3	56 ppb
YELLOW	Actions for Preventing AQ Deterioration			
Threshold		10 µg/m^3	4.0 µg/m^3	50 ppb
GREEN	Actions for Keeping Clean Areas Clean			

Figure 7 – Management Levels

In an Air Zone, the pollutant that has the highest concentration relative to its threshold value is called the driver, as it is this number that "drives" or determines what action needs to be taken. It is possible to have more than one driver, if two or three values are at the same percentage of their threshold values. For example, if the ground-level ozone concentration was 80% of the standard (63 ppb) it would be 50 ppb. If the $PM_{2.5}$ annual concentration was 80% of the standard (10 µg/m^3) it would be 8 µg/m^3. In this case, both of these pollutants would be drivers.

3.1 Management Levels for $PM_{2.5}$

Figure 8 presents the management levels for $PM_{2.5}$ 24-hour, and $PM_{2.5}$ annual from 2011-2013. The colour where the vertical bar ends is the management level for the air zone. The concentrations in the left and right charts are the same as those in Figures 4 and 5 respectively; 12 µg/m^3 and 5.2 µg/m^3.

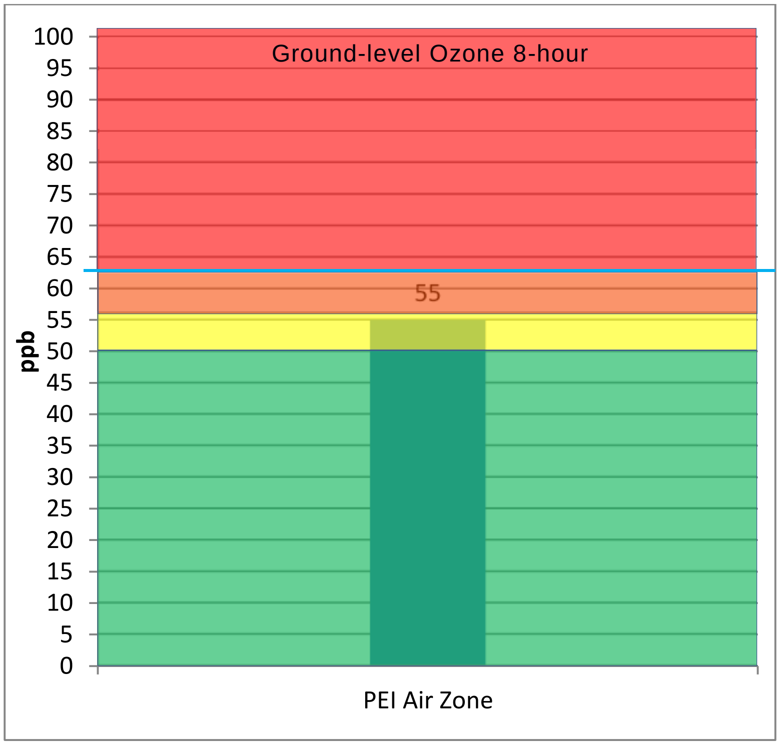


Legend: The concentrations indicated by the vertical bars are the $PM_{2.5}$ 24-hour and $PM_{2.5}$ annual values. The blue horizontal lines where red and orange meet are the standards, 28 $\mu g/m^3$ and 10 $\mu g/m^3$.

Figure 8 - Management levels for $PM_{2.5}$ 24-hour and $PM_{2.5}$ annual, 2011-2013

3.2 Management Level for Ozone

The management level for ozone is presented in Figure 9.



Legend: The concentration indicated by the vertical bar is the 8-hour ozone concentration. The blue horizontal line where red and orange meet is the standard, 63 ppb.

Figure 9: Air zone management level for ozone, 2011 to 2013.

3.3 Final Management Levels for PEI

Figure 10 shows the final management levels for the air zone. Both $PM_{2.5}$ values and the ground-level ozone value are in the yellow management level. The 8-hr ozone value was the driver.

Air zone	Management Level	Management Actions	Driver*	Results		
				$PM_{2.5}$ 8-hour ($\mu g/m^3$)	$PM_{2.5}$ Annual ($\mu g/m^3$)	Ozon8-hour (ppb)
PEI		Actions for Preventing AQ Deterioration	Ground-level Ozone	12	5.2	55

Figure 10 - Final Air Zone Management Levels

*The driver indicates which of $PM_{2.5}$ 24-hour, $PM_{2.5}$ annual, or Ozone provided the most stringent management level, based on the one that reached the highest percentage of its CAAQS

4.0 ACTIONS TO IMPROVE AIR QUALITY

4.1 Fossil Fuel Usage

A number of large facilities in PEI use heavy fuel oil (HFO), often referred to as Bunker oil, to heat their plants, produce steam and hot water for various processes, and to generate electricity. In comparison to furnace oil (No. 2 fuel oil) used to heat homes and small/medium commercial businesses, heavy fuel oils have historically been dirty. They are the fractions of the refining process that are left over after the lighter and more valuable cuts (gasoline, kerosene and distillate oils) have been taken. HFO contains significant quantities of ash, nitrogen, and sulphur that results in the release of particulate matter, nitrogen oxides, sulphur dioxide and volatile organic compounds (VOCs). Nitrogen oxides and VOCs, also emitted by vehicles, combine in the presence of sunlight to form ground-level ozone. Sulphur dioxide and moisture in the air produce sulphuric acid that contributes to acid rain. All of these pollutants have an effect on health and the environment so their reduction is important.

Some years ago, refiners began producing a better quality heavy fuel oil. Although it is more expensive, the department worked with users to encourage them to steadily move to HFO with fewer contaminants as it became available. This trend is expected to continue.

In 2009, Cavendish Farms opened a biogas plant at their New Annan facility to convert more than 120,000 tons of potato waste into methane gas annually. This reduced its heavy fuel oil consumption by approximately 50%, and in turn, greenhouse gas generation by 35%. Additionally, as the waste no longer had to be trucked off-site for disposal, about 1,600 km of driving per day was eliminated. The Provincial Government was instrumental in the success of the project by providing a $14 million loan to the company.

In June of 2012, Cavendish Farms replaced the remaining HFO used at their facility with liquid natural gas. This resulted in a further reduction of greenhouse gasses, bringing the total to 50% relative to the pre-2009 level, and a significant reduction in air contaminants. The fuel mix at the facility is now 70% natural gas and 30% biogas, with heavy fuel oil only used as a back-up source if needed. Again, support by the Provincial Government, in the form of a $15 million, 5 year loan, was key to moving the project forward.

In April of 2013, AgraWest Foods Ltd., another large potato processor in Souris, stopped using heavy fuel oil, approximately 5.8 million litres per year, and switched to liquid natural gas. Not only is natural gas far cleaner than HFO, it is cleaner than the furnace oil we use to heat our homes.

Also in April of 2013, a Charlottetown business switched from Bunker C oil (approximately 300,000 litres per year) to propane, again reducing the volume of air pollutants and GHGs emitted.

4.2 Renewable Energy

Prince Edward Island has no known commercial resources of oil, natural gas or other fuels for traditional forms of electrical generation. However, we do have an excellent wind regime with potential for development and expansion as a cost-effective source of electricity.

In 2001, the PEI Energy Corporation developed Atlantic Canada's first commercial wind farm at North Cape. The first phase of development generated 5.28 MW (megawatts) from eight turbines. In 2003, capacity was doubled. In 2002, Aeolus Wind PEI established a 3 MW wind turbine at the site, bringing the total generation to 13.56 MW.

The Island's largest wind farm, with a nominal generating capacity of 99 MW, is found at West Cape. The facility was established in two phases by GDF Suez North America. Phase one was commissioned in 2007 and phase 2 in 2009. Suez also established a 9 MW wind farm in Norway which is 30 km south of North Cape.

In 2007, the PEI Energy Corporation began operating a 30 MW wind farm at East Point. All of the energy from the wind plant is sold to Maritime Electric Co. Ltd. for domestic consumption.

In 2010, the City of Summerside established the first municipally owned and operated wind facility in Prince Edward Island. Located on the outskirts of the community, this facility generates up to 12 MW of electricity. The city also purchases electricity from the West Cape Wind Farm making it one of the greenest municipalities in the world.

In 2012, the former Wind Energy Institute of Canada established the nation's premiere site for testing and demonstrating wind technology at North Cape. The Atlantic Wind Test Site generates10 MW of electricity and deploys innovative energy storage equipment. The development of a cost-effective method of storing electricity would overcome the limitations that are imposed by the intermittent nature of wind.

In January 2014, the Energy Corporation commissioned a 30 MW facility at Hermanville/Clearspring, north-northwest of Souris.

The Island's seven wind facilities have a combined generating capacity of 203 MW that represents approximately 25% of our total energy requirement. This strategy has successfully reduced the need to purchase energy from off-Island as well as the need to increase on-Island generation. Additionally, the overall emission of air contaminants and greenhouse gasses has been substantially reduced.

4.3 Incineration and Waste Management

PEI's Waste Watch Program, managed by the Island Waste Management Corporation, is based on sorting of "waste" at the home, business and institutional levels, into recyclables, compostables and waste. There are also programs to manage metals and white goods, tires, household hazardous waste, electronics, paint, batteries, plastic silage wrap, and used oil. The process diverts approximately 56% of the waste stream from our single landfill, which is among the highest diversion rates in Canada.

PEI Energy Systems, a division of Veresen Energy Infrastructure Inc., operates an energy from waste plant and district heating system in Charlottetown that incinerates what is left over after all of the mentioned components are removed from the waste stream. Although incineration is often considered to be an undesirable disposal option, it is an important part of PEI's waste management strategy, given our population density (the highest of any province in Canada), and small geographic area, that makes finding space for a new landfill very difficult.

Approximately 26,000 tonnes of waste are burned at the plant annually, and this number has been steadily dropping as the Waste Watch program continues to evolve. The facility employs the latest technologies to minimize emissions and is tested annually to verify that it remains in compliance.

4.4 Transportation

The driver in the PEI Air Zone during the 2011-2013 averaging period was ground-level ozone. As noted previously, this pollutant is formed when nitrogen oxides (NOx) and volatile organic compounds (VOCs) combine in the presence of sunlight. For PEI, the transportation sector is of primary interest. In 2014, it accounted for 85% of NOx emissions and 32% of VOC emissions. It is anticipated that advanced technologies will continue to improve fuel efficiency and reduce emissions, particularly with respect to heavy-duty diesel engines that are the largest air pollution contributor in the transportation sector. In addition, ongoing education reinforces the need for proper vehicle maintenance, and efficient management of commercial vehicle fleets.

5.0 SUMMARY

The quality of the air in PEI is influenced by two sources; the emissions we generate within the province and those that come to us from provinces to the west and from the northeastern United States. Although we can make efforts at home to improve air quality, we don't have control over what happens elsewhere. However, as the AQMS is a national effort, improvements in other provinces are occurring at the same time. As well, the Canada-United States Air Quality Agreement, signed in 1991 to address transboundary air pollution leading to acid rain, has led to benefits for Atlantic Canada. In 2000, the Ozone Annex was added to address ground-level ozone that is a major component of smog.

The Air Quality Health Index (AQHI) is a public information tool that helps Canadians protect their health on a daily basis from the negative effects of air pollution. This tool was developed by Health Canada and Environment and Climate Change Canada, in collaboration with the provinces and key health and environment stakeholders. It measures the air quality in relation to your health on a scale from 1 to 10 (Figure 11) and provides related health messages. The higher the number, the greater the health risk associated with the air quality. The AQHI is calculated based on the relative risks of a combination of common air pollutants that is known to harm human health. These pollutants are ground-level ozone, particulate matter and nitrogen dioxide.

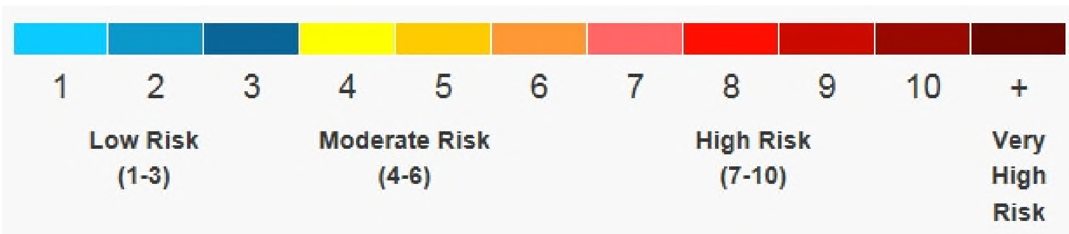


Figure 11 – Air Quality Health Index

The AQHI has been available in Prince Edward Island[2] since May 1, 2009, for each of the areas in which we monitor; Charlottetown, St. Peters Bay (Southampton) and Summerside (Wellington). We provide data continuously to Environment and Climate Change Canada, who then calculate the Index. Most of the time, the AQHI across the province is 2. It will often dip to 1 or occasionally rise to 3. In unusual circumstances, such as a forest fire in a neighbouring province, it may increase beyond 3.

With respect to $PM_{2.5}$ and ground-level ozone, the concentrations measured in PEI are all below their respective standards. Although the quality of the air in our province is good, there is still work to be done to ensure that continual improvements are made.

[2] Charlottetown https://weather.gc.ca/airquality/pages/peaq-003_e.html
St. Peters Bay (Southampton) https://weather.gc.ca/airquality/pages/peaq-001_e.html
Summerside (Wellington) https://weather.gc.ca/airquality/pages/peaq-002_e.html
Provincial Summary https://weather.gc.ca/airquality/pages/provincial_summary/pe_e.html
https://www.princeedwardisland.ca/en/service/air-quality-health-index

APPENDIX

Canadian Climate Normals for Selected Stations in PEI
From Environment and Climate Change Canada[i]

Canadian Climate Normals 1981-2010

Precipitation (rain and snow in millimeters) for Summerside, Charlottetown and Bangor PEI

Weather Stations Closest to Air Monitoring Stations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Summerside (Wellington)	96.2	74.9	79.4	84.2	97.7	91.3	74.1	92.7	96.7	87.7	97.7	100.3	1,072.9
Charlottetown	101.0	83.2	86.3	83.7	91.0	98.8	79.9	95.7	95.9	112.2	112.5	118.1	1,158.2
Bangor (Southampton)	119.9	99.0	99.4	93.7	96.0	94.4	81.9	95.7	112.5	120.0	128.9	141.0	1,282.4

Canadian Climate Normals 1981-2010

Wind (max hourly speed in km/hr and direction of max hourly speed) for Summerside, Charlottetown and Bangor PEI

Weather Stations Closest to Air Monitoring Stations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Summerside (Wellington)	121	105	105	109	77	89	64	74	97	105	93	97
	N	NW	N	N	NW	N	S	N	SE	N	N	N
Charlottetown	105	97	80	82	80	64	64	64	97	80	78	97
	SE	NW	N	E	E	SW	SE	W	S	W	S	N
Bangor (Southampton)	63	71	64	61	50	47	48	43	55	50	58	60
	S	SE	W	W	W	S	SW	NE	NW	W	N	NW

[i] Can be found at http://climate.weather.gc.ca/climate_normals/index_e.html