Saskatchewan Air Quality Report

Meeting the Canadian Ambient Air Quality Standards
2018-2020

saskatchewan.ca/air

Saskatchewan

Contents

1.0 Summary

Saskatchewan is known for its natural features, including an abundance of beautiful open landscapes and scenic provincial parks. Measuring and evaluating air quality is critical to keeping our environment and people healthy and resilient.

This report summarizes the current state of ambient air quality in Saskatchewan. It describes the achievement of the Canadian Ambient Air Quality Standards (CAAQS) for 2018-2020, the associated management levels and recent and future actions designed to improve air quality in Saskatchewan. It also examines the long-term trends of four key air pollutants in the province:

- sulfur dioxide (SO_2),
- nitrogen dioxide (NO_2),
- ground-level ozone (O_3) and
- fine particulate matter ($PM_{2.5}$)

Overall, concentrations of SO_2, O_3, NO_2 and $PM_{2.5}$ are generally low in Saskatchewan and the health risk to humans from ambient air quality is generally low.

Over the last 16 years:

- Provincial annual averages show a decrease in SO_2 and NO_2 concentrations compared to 2005 values, with a decrease of 28.6 per cent for SO_2 and 47.3 per cent for NO_2. These decreases in concentrations can be attributed to lower emissions from industry and mobile or transportation sources.
- The province experienced a 67.4 per cent increase in $PM_{2.5}$ concentrations. This can be attributed to above-average forest fire activities observed in the province in recent years and changes in monitoring technology.
- O_3 concentrations have increased by 47.3 per cent since 2005. The increase in O_3 concentrations may be related to a rise in average background ozone concentrations and cross-border impacts.

Some of the important provincial actions that have been or will be taken to protect air quality and prevent CAAQS exceedances include:

- In 2018 and 2019, the Government of Saskatchewan enacted legislation to reduce greenhouse gas emissions, including the Methane Action Plan (MAP) January 2019. This will reduce methane emissions and emissions from electricity production. It should also result in a reduction in ground level ozone, as methane in the air can lead to ozone formation.
- The Government of Saskatchewan has engaged air zone associations to assess air quality issues and collaboratively identify, prevent and mitigate risks to human health and safety.

Additional provincial and air zone-specific actions are provided in Table 10.

This report satisfies Saskatchewan's commitment to the Canadian Council of Ministers of the Environment's (CCME) Air Quality Management System (AQMS) for monitoring and reporting to the public on air quality.

2.0 Background

2.1 Long-term Ambient Air Quality Monitoring

The Ministry of Environment, in cooperation with the National Air Pollution Surveillance (NAPS) program, operates a network of ambient air quality monitoring stations in Saskatchewan. The NAPS program is administered by Environment and Climate Change Canada (ECCC) and is managed through an agreement between the federal government and the provincial and territorial governments. The NAPS program was established to ensure quality, reliable data and to produce a standard method of obtaining measurements of ambient air quality across Canada.

Continuous ambient air quality monitoring in Saskatchewan began in the early 1970s. The number of stations and locations have varied over the years and as of 2020 there are six NAPS stations. They are in Buffalo Narrows, Estevan, Prince Albert, Regina, Saskatoon and Swift Current. Figure 2 in Section 2.4 shows the locations of the NAPS stations.

The long-term trend analysis presented in this report is focused on the four pollutants that have CAAQS: SO_2, O_3, NO_2 and $PM_{2.5}$.

These pollutants can cause a range of negative human health effects and impacts on the environment. For instance, all four pollutants can cause irritation of the lungs, eyes, nose, throat and respiratory tract. Chronic exposure can result in decreased lung function. Sulfur dioxide and nitrogen dioxide can react with moisture in the atmosphere to produce acid rain, which in turn can damage ecosystems. Nitrogen oxides also react with hydrocarbons in the air to form ozone, which is a component of smog.

Ambient air quality data at NAPS stations is measured with analyzers that meet the United States Environmental Protection Agency Federal Equivalent Methodology (USEPA FEM) requirements for ambient air quality monitoring. To ensure ambient air quality data is scientifically defensible and comparable in all jurisdictions across Canada, the Ministry of Environment carries out all the requirements of the NAPS *Ambient Air Monitoring and Quality Assurance/Quality Control (QA/QC) Guidelines* (2019). Annual averages of each parameter were calculated for each NAPS station, and both station and network-wide trends are presented and discussed in Section 4.1.

2.2 The Air Quality Management System

The AQMS was established in October 2012 by the CCME and is the national approach to managing air quality in Canada. The AQMS is built on a foundation of collaboration, accountability and transparency. Industry, non-governmental and Indigenous organizations worked with governments to develop the AQMS. The CCME continues to develop, monitor and improve the implementation of the AQMS. More information on the AQMS can be found on the CCME website: ccme.ca/en/air-quality-report. The driver for continuous air quality improvement is the CAAQS. Figure 1 provides a visual representation of the AQMS elements. As part of its commitment to the AQMS, the Government of Saskatchewan established Saskatchewan air zones and reports to the public on air quality.

Figure 1 - Air Quality Management System Elements

2.3 The Canadian Ambient Air Quality Standards

The CAAQS are national air quality standards intended to protect human health and the environment. The CAAQS were developed collaboratively with the federal, provincial and territorial governments and stakeholders under the direction of CCME. Table 1 shows the current 2020 CAAQS for $PM_{2.5}$, O_3, SO_2, NO_2 and their respective averaging times and statistical metrics. The 2020 CAAQS are used in this report to assess achievement for the 2018-2020 reporting period and include updated standards for $PM_{2.5}$ and O_3 and introduces new standards for SO_2 and NO_2. The standards are the concentration numerical values in Table 1 and are based on associated time-averaging periods and statistical forms, which account for varying exposures that may result in acute (short-term) and chronic (long-term) effects. More information on the CAAQS can be found on the CCME website: ccme.ca/en/air-quality-report

Table 1 - 2020 CAAQS

Pollutant	Averaging Time	Standard	Metric
		2020	
$PM_{2.5}$	24-hour	27 micrograms/cubic meter	The three-year average of the annual 98 percentile of the daily 24-hour average concentrations.
$PM_{2.5}$	Annual	8.8 micrograms/cubic meter	The three-year average of the annual average of the daily 24-hour average concentrations.
O_3	Eight-hour	62 parts per billion	The three-year average of the annual fourth highest daily maximum eight-hour average concentrations.
SO_2	One-hour	70 parts per billion	The three-year average of the annual 99 percentile of the SO_2 daily maximum one-hour average concentrations.
SO_2	Annual	5.0 parts per billion	The average over a single calendar year of all one-hour average SO_2 concentrations.
NO_2	One-hour	60 parts per billion	The three-year average of the annual 98 percentile of the daily maximum one-hour average concentrations.
NO_2	Annual	17.0 parts per billion	The average over a single calendar year of all one-hour average concentrations.

2.4 Air Zones

Air zones are established by provincial and territorial governments to define areas that exhibit similar air quality characteristics, issues and trends. These air zones form the basis for monitoring, reporting and acting on air quality issues. There are six air zones identified in Saskatchewan, each of which has at least one CAAQS reporting station, as seen in Figure 2.

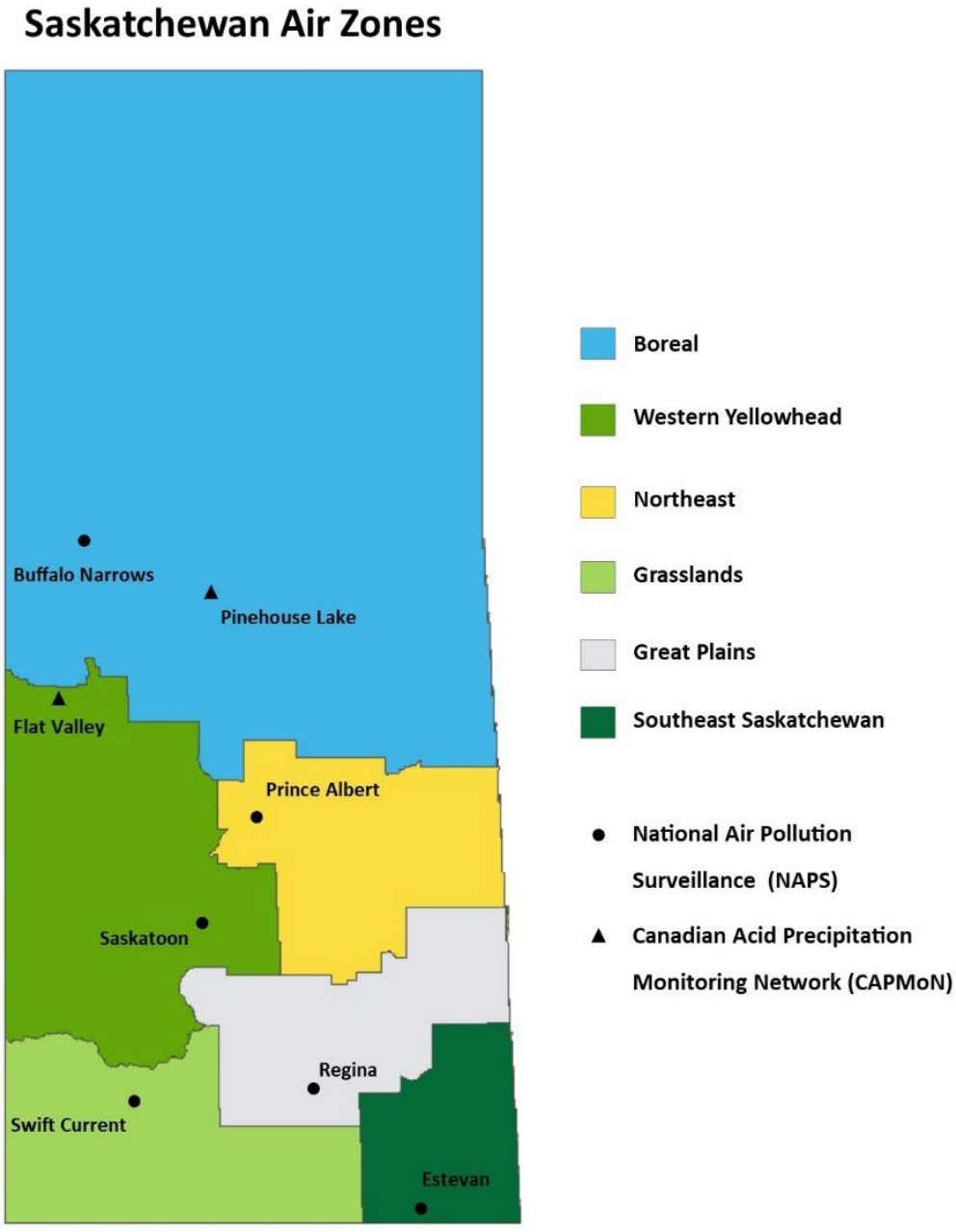

Figure 2 - Saskatchewan Air Zones and CAAQS Reporting Stations for 2018-2020

2.5 Air Zone Management Levels

Under the AQMS, progressively more rigorous actions are expected as air quality approaches or exceeds the CAAQS. The level of action is guided by the Air Zone Management Framework outlined in Tables 2 through 5 and Figure 3.

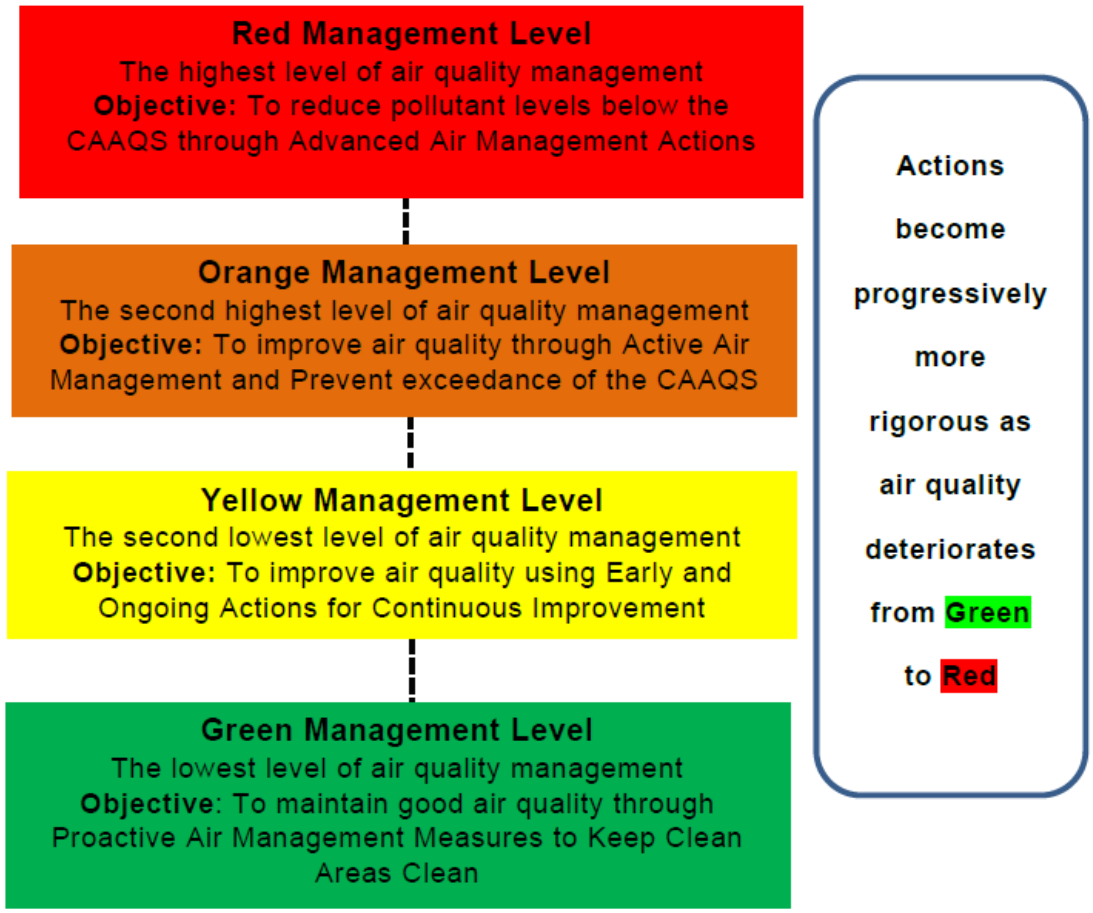

Figure 3 – The Air Zone Management Framework

Table 2 - Management levels for ozone (8-hour average)

Management level	2020
Red	> 62 ppb
Orange	57 to 62 ppb
Yellow	51 to 56 ppb
Green	≤ 50 ppb

***The concentrations have the same statistical form as the corresponding CAAQS and the metric values for comparison to the concentrations must be rounded to the same number of digits as the shown concentrations.**

Table 3 - Management levels for $PM_{2.5}$

Management level	$PM_{2.5}$ 24-hour	$PM_{2.5}$ annual
	2020	2020
Red	> 27 µg/m^3	> 8.8 µg/m^3
Orange	20 to 27 µg/m^3	6.5 to 8.8 µg/m^3
Yellow	11 to 19 µg/m^3	4.1 to 6.4 µg/m^3
Green	≤ 10 µg/m^3	≤ 4.0 µg/m^3

***The concentrations have the same statistical form as the corresponding CAAQS and the metric values for comparison to the concentrations must be rounded to the same number of digits as the shown concentrations.**

Table 4 - Management levels for SO_2

Management level		SO_2 1-hour	SO_2 annual
		2020	2020
Red		> 70* ppb	> 5.0 (CAAQS)
Orange		51 to 70 ppb	3.1 to 5.0 ppb
Yellow		31 to 50 ppb	2.1 to 3.0 ppb
Green		≤ 30 ppb	≤ 2.0 ppb

***The concentrations have the same statistical form as the corresponding CAAQS and the metric values for comparison to the concentrations must be rounded to the same number of digits as the shown concentrations.**

Table 5 - Management levels for NO_2

Management level	NO_2 1-hour	NO_2 annual
	2020	2020
Red	> 60 ppb	> 17.0 ppb
Orange	32 to 60 ppb	7.1 to 17.0 ppb
Yellow	21 to 31 ppb	2.1 to 7.0 ppb
Green	≤ 20 ppb	≤ 2.0 ppb

***The concentrations have the same statistical form as the corresponding CAAQS and the metric values for comparison to the concentrations must be rounded to the same number of digits as the shown concentrations.**

Each management level has associated actions. The *Guidance Document on Air Zone Management (CCME, 2019)* suggests that air zones in all management levels should:

- Prepare and publish annual reports on current ambient air quality levels and trends, air zone management levels and management actions to reduce air pollutant levels and
- Educate the public on local air quality.

Air zones assigned management levels other than green have additional emphasis on active management to improve air quality, both to prevent deterioration in air quality and to achieve the CAAQS. Yellow and orange levels initiate actions such as:

- Ensure air pollutant monitoring is adequate to capture variability in concentrations over time and in different locations.
- Compile, as required, emissions inventories for air zones to evaluate main sources of air pollutants.
- Engage local stakeholders as appropriate.
- Develop, implement and release air zone management plans to prevent air quality deterioration, taking into consideration all important sources of air pollutants and provincial and territorial policies and assess progress.

2.6 Transboundary Flows and Exceptional Events

Measured concentrations of air pollutants may reflect human activity, transboundary flows (TF) and exceptional events (EE). The achievement status and management levels of the CAAQS must be reported regardless of the pollutant source. However, adjusted metric values and management levels may be reported when considering TF or EE, when supported by evidence, in addition to the CAAQS values of all measured concentrations.

Transboundary flows (TF) refer to emissions of air pollutants related to human activity that are released in one jurisdiction and transported or moved by winds and weather systems into another. Exceptional events (EE) typically refer to smoke from forest fires or other non-controllable or accidental causes. For more information on TF or EE, please refer to the Guidance Document on Transboundary Flows and Exception Events (CCME 2019), which provides guidance on the procedures to use for considering the influences of TF-EE on CAAQS exceedances and management levels.

3.0 CAAQS Assessment Methodology

3.1 Saskatchewan CAAQS reporting stations for 2018-2020

Saskatchewan CAAQS achievement reporting for the 2018-2020 reporting period was accomplished using data from the NAPS program and the Canadian Acid Precipitation Monitoring Network (CAPMoN). The NAPS ambient air monitoring program is operated by the Government of Saskatchewan and provides accurate, long-term air quality data. The CAPMoN program is operated by the federal government and collects continuous ozone data, in addition to monitoring for wet deposition.

Based on data availability in the 2018-2020 reporting period, the following air quality stations were used to calculate the CAAQS metric values:

- **Boreal** – NAPS 2018-monitoring station, Buffalo Narrows; CAPMoN site, Pinehouse Lake.
- **Western Yellowhead** – NAPS monitoring station, Saskatoon; CAPMoN site, Flat Valley.
- **Grasslands** – NAPS monitoring station, Swift Current.
- **Southeast Saskatchewan** –NAPS monitoring station, Estevan.
- **Great Plains** – NAPS monitoring station, Regina.
- **Northeast** – NAPS monitoring station, Prince Albert.

3.2 Achievement Assessment

Data from the NAPS and CAPMoN reporting stations is assessed for completeness and used to calculate the metric values as specified in the appropriate *Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards* for $PM_{2.5}$, O_3, NO_2 and SO_2. These calculated values are then compared against the CAAQS standards, which are provided in Table 1, Section 2.3.

An air zone achieves the standard if the calculated metric value is equal to or less than the standard. An air zone does not achieve the standard if the metric value is greater than the standard.

3.3 Management Levels Assignment

Values that were equal to or greater than the orange management level threshold values, and that were identified as being influenced by transboundary flows and exceptional events, were removed from the dataset as described in Appendix B. The metric values were recalculated without the influenced data to assign management levels and are referred to as the adjusted metric values. Since the management level dictates the types of actions the province should take, long-term management strategies should be developed based on factors that the province can influence.

4.0 Results

4.1 Long-term Ambient Air Quality Trends

Long-term trends were evaluated for SO_2, ozone, NO_2, and $PM_{2.5}$ for the period of 2005 to 2020, and are presented in Figures 4 to 7 for each station and for each pollutant. Network wide annual average concentrations and change in concentrations since 2005 are presented in Appendix A and graphically in Figure 8. Overall, concentrations of these pollutants are generally low in Saskatchewan and the health risk to humans from ambient air quality is generally low. There have been some changes in measured concentrations over the last 16 years. Provincial annual averages show a decrease in SO_2 and NO_2 concentrations compared to 2005 values, with a decrease of 28.6 per cent for SO_2 and 47.3 per cent for NO_2. These decreases in concentrations can be attributed to lower emissions from industry and mobile or transportation sources.

O_3 and $PM_{2.5}$ concentrations have increased throughout the province in the last 16 years. The province experienced a 67.4 per cent increase in $PM_{2.5}$ concentrations. This can be attributed to above-average forest fire activities observed in the province in recent years and changes in monitoring technology. O_3 concentrations have increased by 47.3 per cent since 2005. The increase in ozone concentrations may be related to a rise in average background ozone concentrations and cross-border impacts. Background ozone includes naturally occurring ozone. The formation of ozone is complex and dependent on a chemical reaction involving NO_x and hydrocarbons in the presence of sunlight. When low levels of NO are present there is less of what is referred to as ozone scavenging, which can result in levels of O_3 remaining high and even increase in concentration.

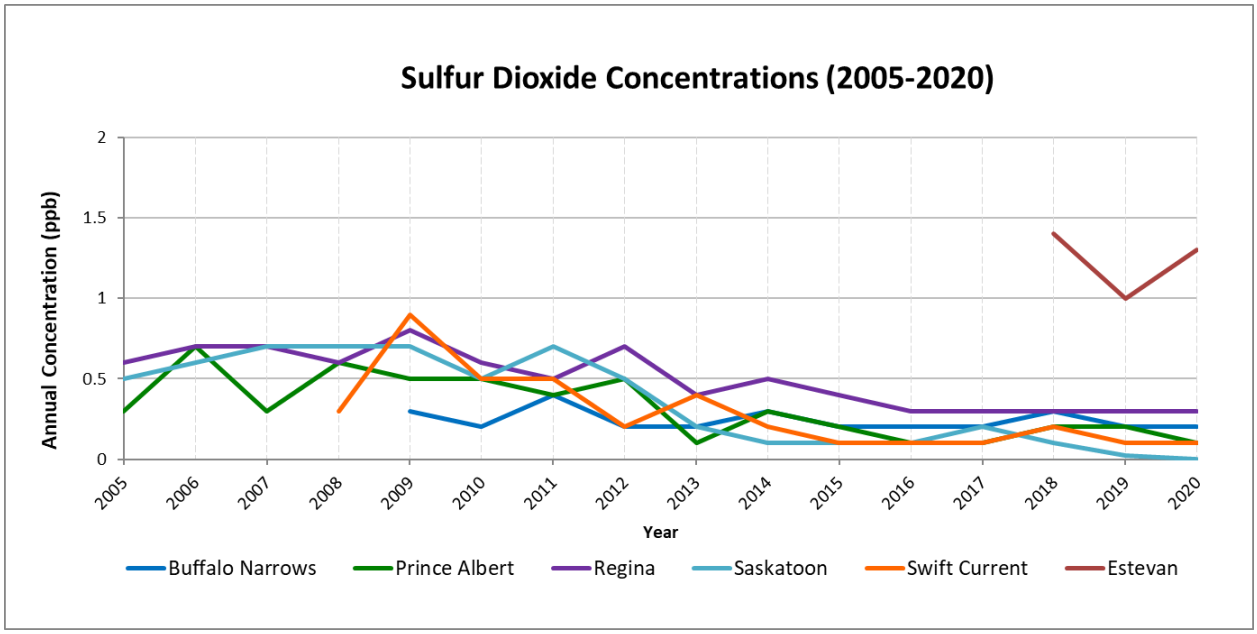

Figure 4 - Annual Average Concentrations of SO_2 Since 2005

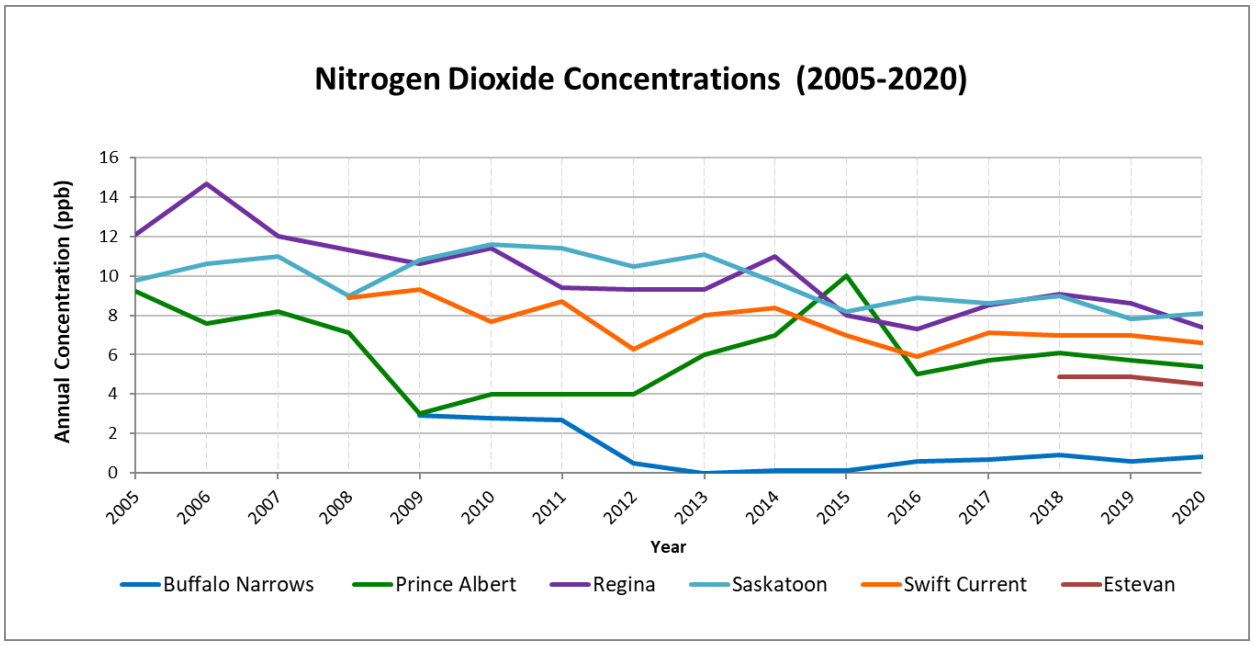

Figure 5 - Annual Average Concentrations of NO_2 Since 2005

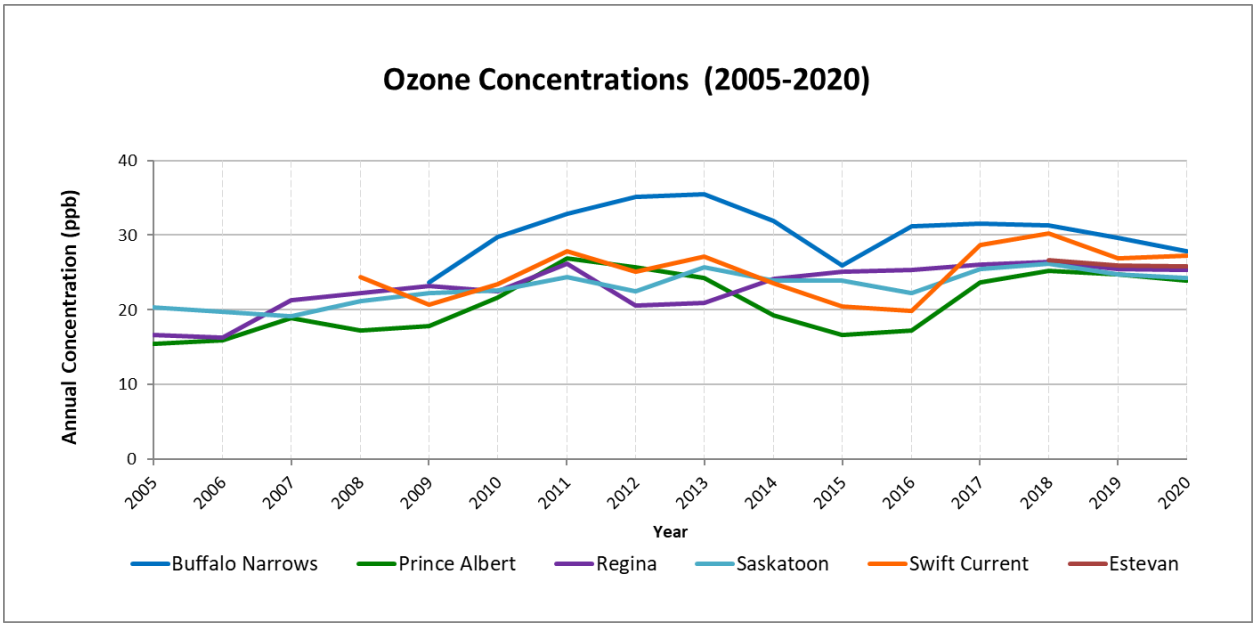

Figure 6 - Annual Average Concentrations of O_3 Since 2005

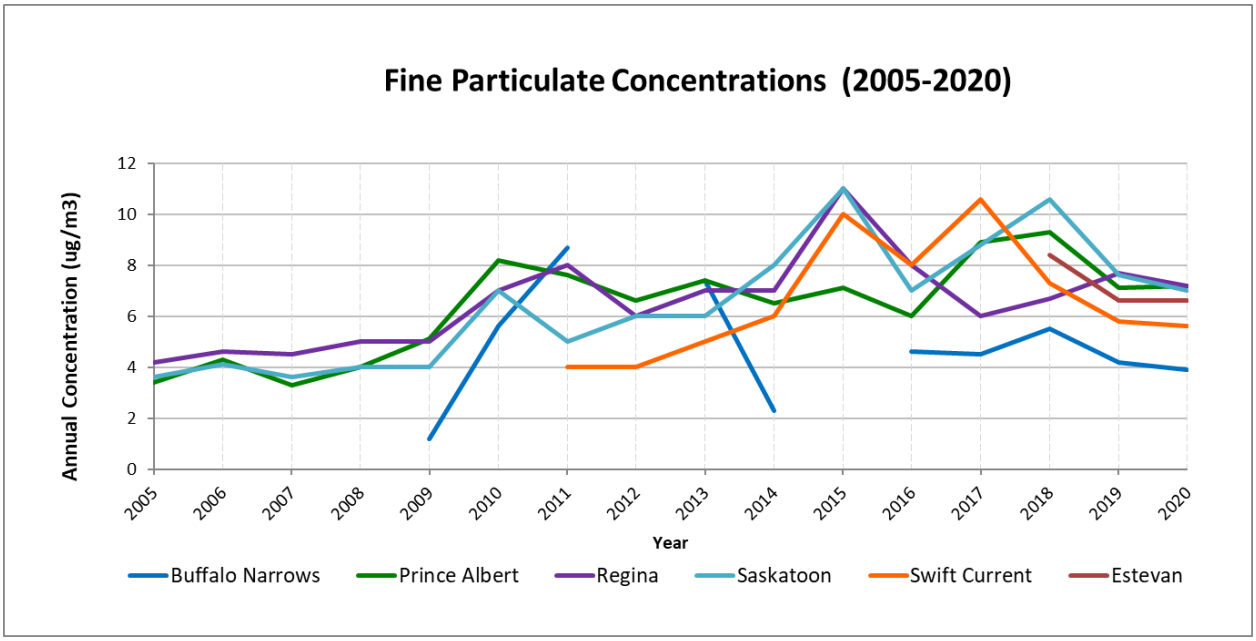

Figure 7 - Annual Average Concentrations of $PM_{2.5}$ Since 2005

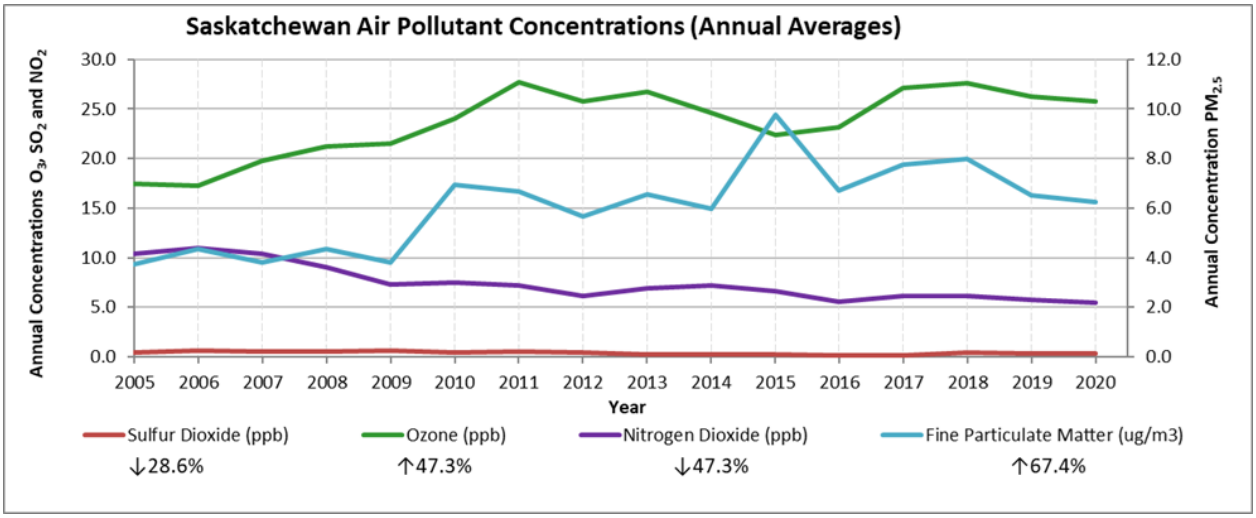

Figure 8 - Network-wide annual average concentrations of O_3, SO_2, NO_2 and $PM_{2.5}$ and percentage change in concentrations since 2005

4.2 CAAQS Achievements and Management Levels

Maps of the effective management levels in Saskatchewan during the 2018-2020 reporting period are provided in **Figure 9 and Figure 10.**

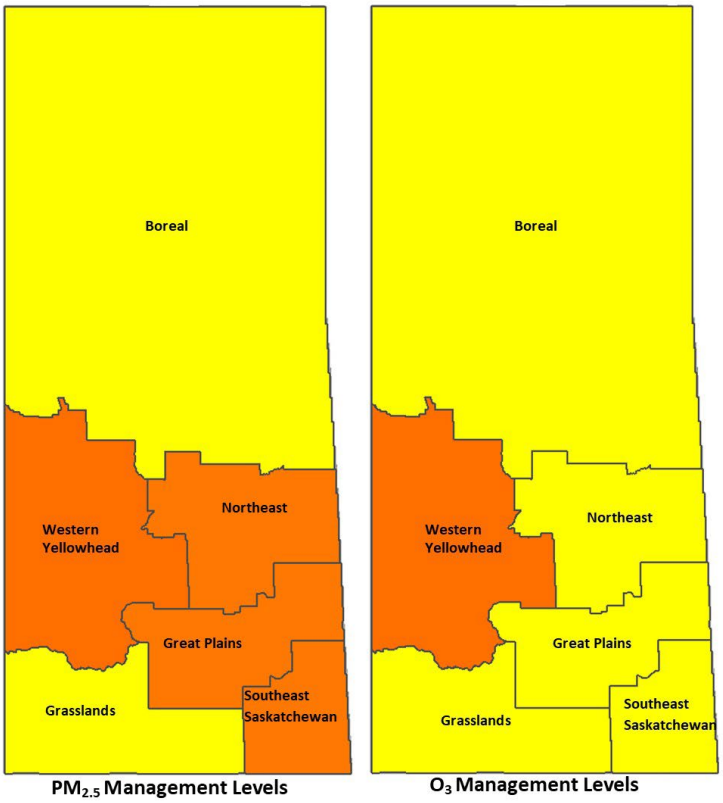

Figure 9 – Air Zone Management Levels of $PM_{2.5}$ and O_3

For $PM_{2.5}$, four air zones were assigned the orange management level and two air zones were assigned the yellow management level. The Boreal air zone has adjusted $PM_{2.5}$ metric values in the low range of values captured by the yellow management level.

For O_3, one of the air zones was assigned the orange management level and five of the air zones were assigned the yellow management level. Western Yellowhead air zone had O_3 metric values in the mid-range of values captured by the orange management level. Northeast air zone had O_3 metric values in the low range of values captured by the yellow management level.

In previous reporting years, management levels were assigned to each air zone for $PM_{2.5}$ and O_3. For the 2018-2020 reporting period, air zones have now also been assigned management levels for SO_2 and NO_2.

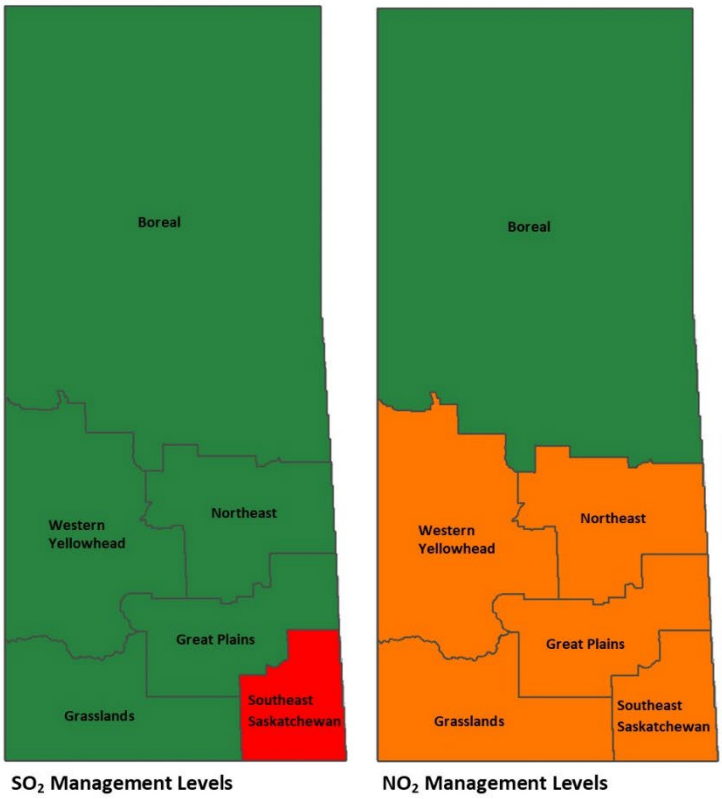

Figure 10 – Air Zone Management Levels of SO_2 and NO_2

For SO_2, five air zones were assigned the green management level and one air zone was assigned the red management level. The Southeast Saskatchewan air zone was in the red management level for SO_2.
For NO_2, five air zones were assigned the orange management level and one air zone was assigned the green management level. Great Plains and Western Yellowhead air zones had NO_2 metric values in the mid-range of values captured by the orange management level. Northeast, Southeast Saskatchewan and Grasslands air zones had NO_2 metric values in the lower range of the values captured by the orange management level.

4.2.1 $PM_{2.5}$ Achievement

Wildfire smoke was the largest contributor to $PM_{2.5}$ in the 2018-2020 reporting period and the only pollutant for which the guidelines for removing exceptional events was triggered and an adjusted metric value calculated.

Before the removal of wildfire influenced data:

- All six air zones achieved the $PM_{2.5}$ annual standard of 8.8 micrograms per cubic meter.
- Five air zones achieved the $PM_{2.5}$ 24-hour standard of 27 micrograms per cubic meter: Great Plains, Grasslands, Boreal, Northeast and Southeast Saskatchewan; and,
- One air zone exceeded the $PM_{2.5}$ 24-hour standard of 27 micrograms per cubic meter: Western Yellowhead.

After the removal of data influenced by wildfires, the resulting adjusted metric values achieved the $PM_{2.5}$ 24-hour CAAQS in all six air zones.

Table 6 presents each air zone's 2018-2020 actual $PM_{2.5}$ metric values, their adjusted metric values and their associated $PM_{2.5}$ management level. Since there are two CAAQS averaging periods for $PM_{2.5}$ (24-hour and annual), the final management level is the most stringent of the two adjusted levels.

Table 6 - $PM_{2.5}$ CAAQS RESULTS

Air Zone	Station	Type of Station	# of Valid Years	PM 2.5 24-hour micrograms/cubic meter		PM 2.5 Annual micrograms/cubic meter		Air Zone Management Level
				Actual	Adjusted	Actual	Adjusted	
Great Plains	Regina	NAPS	3	22	16	7.2	6.6	Orange
Northeast	Prince Albert	NAPS	3	26	17	7.9	6.9	Orange
Southeast Saskatchewan	Estevan	NAPS	3	21	15	7.3	6.6	Orange
Grasslands	Swift Current	NAPS	3	21	14	6.3	5.5	Yellow
Boreal	Buffalo Narrows	NAPS	3	24	12	4.6	3.8	Yellow
Western Yellowhead	Saskatoon	NAPS	3	30	17	8.4	7.4	Orange

4.2.2 O_3 Achievement

All air zones achieved the O_3 eight-hour standard of 62 parts per billion. Table 7 presents the 2018-2020 O_3 metric values for each air zone and their associated management level.

Table 7 - O_3 CAAQS RESULTS

Air Zone	Station	Type of Station	# of Valid Years	O_3 8-hr Metric parts per billion	Air Zone Management Level
Great Plains	Regina	NAPS	3	56	Yellow
Northeast	Prince Albert	NAPS	3	51	Yellow
Southeast Saskatchewan	Estevan	NAPS	3	54	Yellow
Grasslands	Swift Current	NAPS	3	54	Yellow
Boreal	Buffalo Narrows	NAPS	3	54	Yellow
	Pinehouse	CAPMoN	3	55	
Western Yellowhead	Flat Valley	CAPMoN	3	59	Orange
	Saskatoon	NAPS	3	53	

* CAPMoN is operated by Environment and Climate Change Canada to study the regional patterns and trends of atmospheric pollutants such as acid rain, smog, particulate matter and mercury, in both air and precipitation. CAPMoN stations also monitor for ambient ozone concentrations.

4.2.3 SO_2 CAAQS Achievement

Achievement of the SO_2 CAAQS is summarized below.

- All six air zones achieved the SO_2 annual standard of 5.0 parts per billion.
- Five air zones achieved the SO_2 one-hour standard of 70 parts per billion: Great Plains, Northeast, Grasslands, Boreal, and Western Yellowhead.
- One air zone exceeded the SO_2 one-hour standard of 70 parts per billion: Southeast Saskatchewan.

Table 8 presents the 2018-2020 SO_2 values for each air zone and their associated management level.

Table 8 – SO_2 CAAQS RESULTS

Air Zone	Station	Type of Station	# of Valid Years	SO_2 1-hr Metric parts per billion	SO_2 Annual Metric parts per billion	Air Zone Management Level
Great Plains	Regina	NAPS	3	12	0.3	Green
Northeast	Prince Albert	NAPS	3	1	0.1	Green
Southeast Saskatchewan	Estevan	NAPS	3	101	1.3	Red
Grasslands	Swift Current	NAPS	3	4	0.1	Green
Boreal	Buffalo Narrows	NAPS	3	3	0.2	Green
Western Yellowhead	Saskatoon	NAPS	3	1	0.0	Green

4.2.4 NO_2 CAAQS Achievements

All six air zones achieved the NO_2 one-hour standard of 60 parts per billion. Table 9 presents the 2018-2020 NO_2 values for each air zone and their associated management level.

Table 9 - NO_2CAAQS RESULTS

Air Zone	Station	Type of Station	# of Valid Years	NO_2 1-hr Metric parts per billion	NO2 Annual Metric parts per billion	Air Zone Management Level
Great Plains	Regina	NAPS	3	46	7.4	Orange
Northeast	Prince Albert	NAPS	3	37	5.4	Orange
Southeast Saskatchewan	Estevan	NAPS	3	34	4.5	Orange
Grasslands	Swift Current	NAPS	3	40	6.6	Orange
Boreal	Buffalo Narrows	NAPS	2	9	0.8	Green
Western Yellowhead	Saskatoon	NAPS	3	45	6.6	Orange

5.0 Air Zone Management Plan

Saskatchewan's air zone management plan is provided in Table 10. The management plan is a compilation of targeted actions that will improve air quality and will help to identify air quality issues that may require further assessment.

Table 10 - PROVINCIAL AND AIR ZONE MANAGEMENT PLAN

	Current Reporting Period Management Levels (2018/2020)				Action	Action Category	Status
	$PM_{2.5}$	O_3	NO_2	SO_2			
Saskatchewan	Yellow and Orange	Yellow and Orange	Green and Orange	Green and Red	In January 2019, the Government of Saskatchewan adopted *The Oil and Gas Emissions Management Regulations.* This regulation will lead to an annual reduction of flared and vented methane emissions of 40 to 45 per cent by 2025. The reduction in methane emissions should result in a reduction in ground level ozone as methane can lead to the formation of ozone.	Actions to be undertaken by governments and stakeholders to reduce emissions with short, medium and long-term milestones and targets	Regulations adopted 2019
					In January 2018, the Government of Saskatchewan adopted *The Management and Reduction of Greenhouse Gases (General and Electricity Producer) Regulations*. This is anticipated to lead to 40 per cent emissions reduction of greenhouse gases from electricity generation by 2030. The reduction of greenhouse gases may lead to the reduction in methane, which should result in a reduction in ground level ozone as methane can lead to the formation of ozone.	Actions to be undertaken by governments and stakeholders to reduce emissions with short, medium and long-term milestones and targets	Regulations adopted 2018
					The federal government has adopted the *Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)*. These regulations detail requirements for the upstream oil and gas industry with respect to the reduction of targeted methane and other VOC emissions. This targeted reduction should help to improve ambient air quality.	Actions to be undertaken by governments and stakeholders to reduce emissions with short, medium and long-term milestones and targets	First set of requirements were implemented in 2020 and the second set of requirements will be implemented in 2023

					The Government of Saskatchewan will review air quality trends to identify any air quality deterioration concerns, with a specific focus on the orange management level zones.	Monitor Air Quality	2022-2023
					The Federal Government has adopted regulations respecting reduction in the release of nitrogen oxides emitted from gaseous fuel-fired non-utility boilers, heaters and stationary spark-ignition gaseous fuel-fired engines (the *Multi-Sector Air Pollutants Regulations*). They also limit the amount of nitrogen oxides and SO_2 emitted from and cement kilns. These regulations set air pollution emission standards for several industrial sectors with respect to the reduction of targeted nitrogen oxide (NO_x) emissions. This targeted reduction should help to improve ambient air quality.	Actions to be undertaken by governments and stakeholders to reduce emissions with short, medium and long-term milestones and targets	Regulations adopted 2017
					The Government of Saskatchewan will improve its collaborative efforts with air zone associations.	Stakeholder Engagement	2022-2023
Great Plains	Yellow	Orange	Orange	Green	The Great Plains Air Zone Association monitors ambient air quality in Pense and east Regina.	Characterizing Air Pollutant Concentrations in Air Zones	East Regina May 2018. Pense 2017
					The Government of Saskatchewan will engage the air zone association to collaboratively identify air quality issues related to NO_2 with a focus on understanding the risk of exceeding the CAAQS.	Stakeholder Engagement	2022-2023
					A mobile air quality monitoring station was set up on the west side of Regina.	Characterizing Air Pollutant Concentrations in Air Zones	October, November 2022
					The Government of Saskatchewan will assess if the operation of an air zone association in this air zone could help to prevent air quality deterioration.	Stakeholder Engagement	2020-2023

Southeast Saskatchewan	Orange	Orange	Orange	Red	SESAA will engage with operators of industrial SO_2 sources and work with its members to inform and identify conditions or factors leading to high SO_2 events and identify mitigation measures for future similar conditions.	Characterizing Air Pollutant Concentrations in Air Zones	2022-2023
					SESAA will engage other significant SO_2 emitters in the air zone to encourage membership and partnership in SESAA, determine future activity/emissions trends relating to SO_2 emissions and determine the feasibility of additional monitoring of SO_2 nearer to these sources.	Characterizing Air Pollutant Concentrations in Air Zones	2022-2024
					The Government of Saskatchewan will engage the air zone association to collaboratively identify air quality issues related to ozone with a focus on evaluating and assessing existing data.	Stakeholder Engagement	2022-2024
Grasslands	Orange	Yellow	Orange	Green	The Government of Saskatchewan will evaluate the physical placement of the NAPS Station in Swift Current to ensure it provides representative data.	Characterizing Air Pollutant Concentrations in Air Zones	2022-2023
					The Government of Saskatchewan will temporarily monitor for $PM_{2.5}$, ozone, NO_2 and SO_2 using its mobile air quality station at targeted locations.	Characterizing Air Pollutant Concentrations in Air Zones	2022-2023
					The Government of Saskatchewan will assess if the operation of an air zone association in this air zone could help to prevent air quality deterioration.	Stakeholder Engagement	2022-2023
Boreal	Yellow	Yellow	Green	Green	The provincial monitoring station in Buffalo Narrows will continue to monitor under the NAPS network. This will ensure that the data quality for this air zone will meet AQMS requirements for reporting.	Characterizing Air Pollutant Concentrations in Air Zones	Added to NAPS Network in 2018
Western Yellowhead	Orange	Orange	Orange	Green	The Government of Saskatchewan will engage the air zone association to collaboratively identify air quality issues related to ozone and $PM_{2.5}$ with a focus on evaluating and assessing existing data.	Stakeholder Engagement and Characterizing Air Pollutant Concentrations in Air Zones	2020-2022
					A mobile air quality station was sited in Meadow Lake to evaluate ambient air quality.	Characterizing Air Pollutant Concentrations in Air Zones	Winter 2022-Spring 2023
					The Government of Saskatchewan/Western Yellowhead Air Management Zone (WYAMZ) will evaluate the physical placement of	Characterizing Air Pollutant Concentrations in Air Zones	2022-2024

					the NAPS station in Saskatoon to ensure it provides representative data.		
					WYAMZ will review air quality trends to identify any air quality deterioration concerns with a specific focus on the orange management level zones.	Monitor Air Quality	2022-2024

6.0 Conclusion

The Government of Saskatchewan is committed to the AQMS and will continue to collaborate with stakeholders to ensure that Saskatchewan has a healthy, resilient environment. This is the first reporting year for SO_2 and NO_2 under the AQMS.

Long term trends in annual concentrations of O_3 and $PM_{2.5}$ suggest that the province might be challenged to meet future CAAQS as the standards become increasingly more stringent in the future. The NO_2 long term trend suggests that NO_2 concentrations are decreasing as best management practices and pollution abatement technology improves. However, except for the Boreal air zone, the province is in the orange management level for NO_2, suggesting that additional long-term management strategies may need to be developed. The Government of Saskatchewan will work with the air zone associations to develop management strategies to improve air quality.

Saskatchewan air zones achieved the green management level for SO_2 for the 2018-2020 reporting period except for the Southeast Saskatchewan air zone. The Southeast Saskatchewan air zone exceeded the SO_2 CAAQS one-hour standard of 70 ppb, resulting in it being assigned to the red management level. It should be noted that Southeast Saskatchewan achieved the annual CAAQS standard of 5 ppb with a metric value of 1.3 ppb. This suggests that only a small number of isolated incidents of one-hour SO_2 concentrations greater than 70 ppb in the Southeast Saskatchewan air zone, specifically in Estevan, caused the one-hour CAAQS metric value to be exceeded. The method by which the management levels is assigned to an air zone dictates that the reporting station with the highest metric value will determine the management level for the entire air zone. This does not necessarily represent a fair evaluation of the pollutant levels of the air zone. In this case, the metric values for SO_2 at all the other monitoring locations in the Southeast Saskatchewan air zone, which are operated by the Southeast Saskatchewan Airshed Association (SESAA), are in the green management level for SO_2. The only elevated SO_2 values are observed at the Estevan air monitoring station and so truly only represents Estevan and is not representative of the rest of the entire air zone.

The Saskatchewan Health Authority has indicated that there are potential health impacts associated with elevated levels of SO_2, including respiratory adverse effects and aggravation of existing cardiac disease particularly for the at-risk population - asthmatics, elderly and young children [(1)]. The Government of Saskatchewan will continue to work with SESAA to develop management strategies for the continuous improvement of air quality in the Estevan area.

Saskatchewan's ambient air monitoring data is available to the public so that residents have the information they need to make informed decisions about their activities. Residents concerned about air quality, especially during wildfire events, should check the Air Quality Health Index for their community and follow Health Canada's recommendations on how to reduce their exposure.

For more information on this report, please contact the Ministry of Environment Inquiry Centre at centre.inquiry@gov.sk.ca or 1-800-567-4224.

References

1. Available at https://www.canada.ca/en/health-canada/services/publications/healthy-living/human-health-risk-assessment-sulphur-dioxide-executive-summary.html

Appendix A

Network-wide annual average concentrations of ozone, SO_2, NO_2 and $PM_{2.5}$ concentrations since 2005.

Province Wide Averages	SO_2 (ppb)	O_3 (ppb)	NO_2 (ppb)	$PM_{2.5}$ (µg/m^3)
2005	0.5	17.5	10.4	3.7
2006	0.7	17.3	11.0	4.3
2007	0.6	19.8	10.4	3.8
2008	0.6	21.3	9.1	4.3
2009	0.6	21.5	7.3	3.8
2010	0.5	24.0	7.5	7.0
2011	0.5	27.7	7.2	6.7
2012	0.4	25.8	6.1	5.7
2013	0.3	26.7	6.9	6.6
2014	0.3	24.6	7.2	6.0
2015	0.2	22.4	6.7	9.8
2016	0.2	23.2	5.5	6.7
2017	0.2	27.1	6.1	7.8
2018	0.4	27.7	6.2	8.0
2019	0.3	26.2	5.8	6.5
2020	0.3	25.7	5.5	6.3

Station and Network-wide change (percentage) in ozone, SO_2, NO_2 and $PM_{2.5}$ concentrations since 2005

Percentage change since 2005	SO_2	O_3	NO_2	$PM_{2.5}$
Buffalo Narrows*	-33.3%	17.7%	-41.3%	225.0%
Prince Albert	-66.7%	55.2%	-38.0%	111.8%
Saskatoon	-100.0%	14.6%	-10.0%	75.0%
Regina	-50.0%	51.5%	-38.8%	71.4%
Swift Current*	-66.7%	11.5%	11.5%	40.0%
Estevan **	-7.1%	-3.0%	-8.2%	-21.4%
Network-wide	**-28.6**	**47.3**%	**-47.3**%	**74.1%**

* (monitoring began 2008 and 2009)

**(monitoring began 2018)

Appendix B

A weight of evidence approach to assessing transboundary flow and exceptional events (TF/EE) is outlined in the *Guidance Document on Transboundary Flows and Exceptional Events for Air Zone Management (2019).* This section describes TF/EE influences that were removed to determine fine particulate ($PM_{2.5}$) management levels.

Wildfire smoke, both from forest and grass fires, was the largest contributor to $PM_{2.5}$ TF/EE events in Saskatchewan during this reporting period. Many of the wildfires occurred in jurisdictions outside of Saskatchewan, including Alberta, British Columbia and the United States. TF/EE influences were identified using:

- Maps of fire hot spots from the Canadian Wildland Fire Information System, Natural Resources Canada (CWFIS).
- Annual reports from the Canadian Interagency Forest Fire Centre and provincial ministries.
- Satellite imagery of wildfire smoke from NASA Worldview; and
- Smoke forecasts provided by FireSmoke Canada, a collaboration between British Columbia, Alberta and the federal government.

$PM_{2.5}$ 24-hour metric 2018-2020 TF/EE Assessment

TABLE A-1 SUMMARY OF NOTABLE WILDFIRES THAT INFLUENCED SASKATCHEWAN $PM_{2.5}$ CONCENTRATIONS

Date Discovered	Size (ha)	Geographic Location	Description
May 13, 2018	~	Saskatchewan	Forest and grass fires
July 31, 2018	1,354,284	British Columbia	Large fires in all BC fire centres
October 24, 2018	~	Saskatchewan	Southern half of province
May 12, 2019	334 722	Northern Alberta	Chuckegg Creek fire

~ Means that the data was not provided in the sources used to compile this table

$PM_{2.5}$ 24-hour data that was identified as influenced by wildfire and had values greater than 19 micrograms per cubic meter (the orange management level threshold) was removed. The $PM_{2.5}$ 24-hour and $PM_{2.5}$ annual metrics were then re-calculated and the adjusted metrics used to determine $PM_{2.5}$ management levels.

Example of TF/EE assessment

On August 9, 2018, several monitoring stations across Saskatchewan reported $PM_{2.5}$ concentrations that were greater than the orange management threshold value of 19 micrograms/cubic meter.

TABLE A-2

Air Zone	Station	August 9, 2018 PM2.5 Concentration ($PM_{2.5}$ 24-hour)
Great Plains	Regina	45.0
Northeast	Prince Albert	61.1
Southeast Saskatchewan	Estevan	57.6
Grasslands	Swift Current	40.3
Boreal	Buffalo Narrows	74.0
Western Yellowhead	Saskatoon	62.8

* Data listed is in micrograms/cubic meter

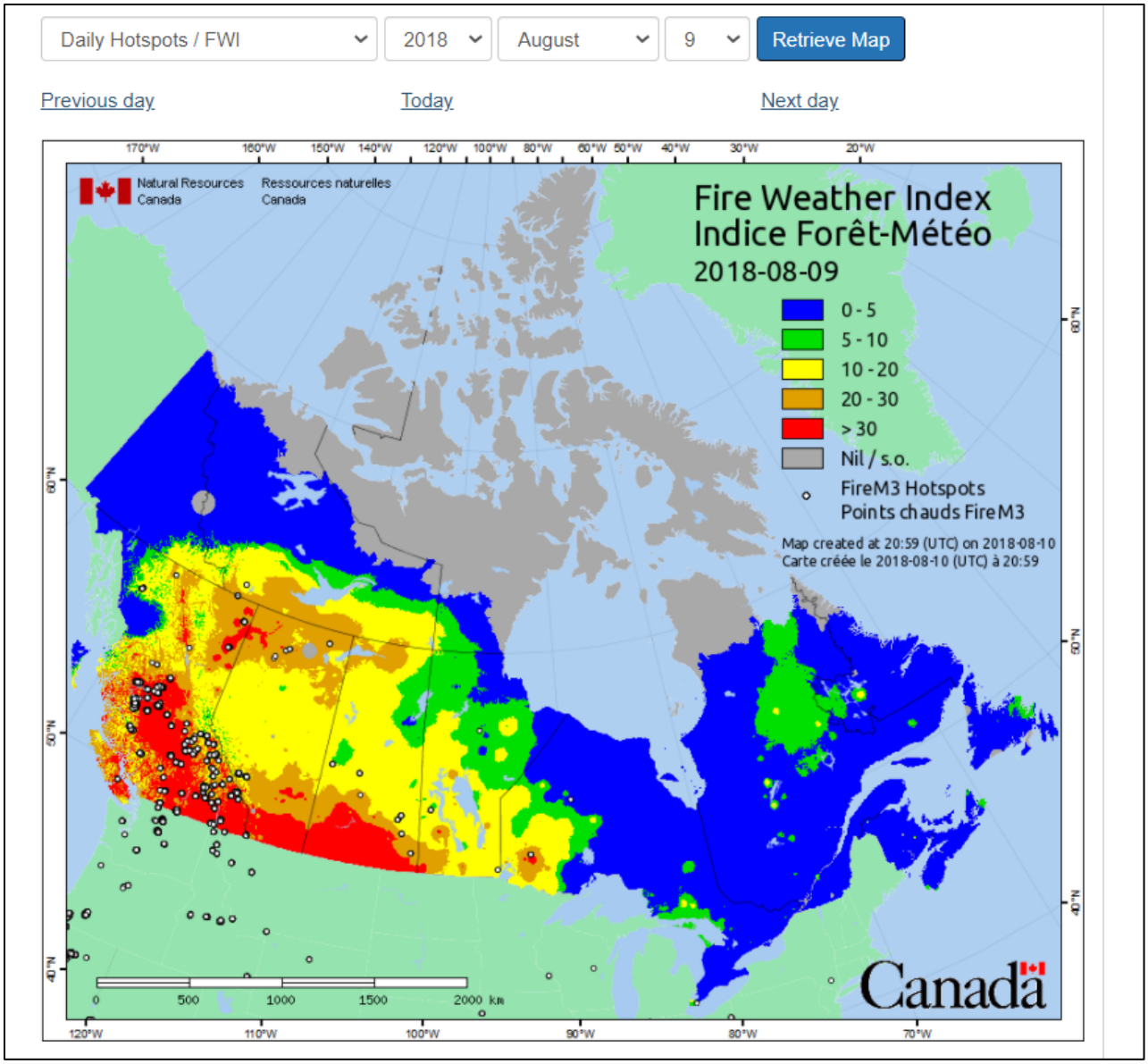

Figure A-1 - Map of fire hot spots for August 9, 2018, from the CWFIS.

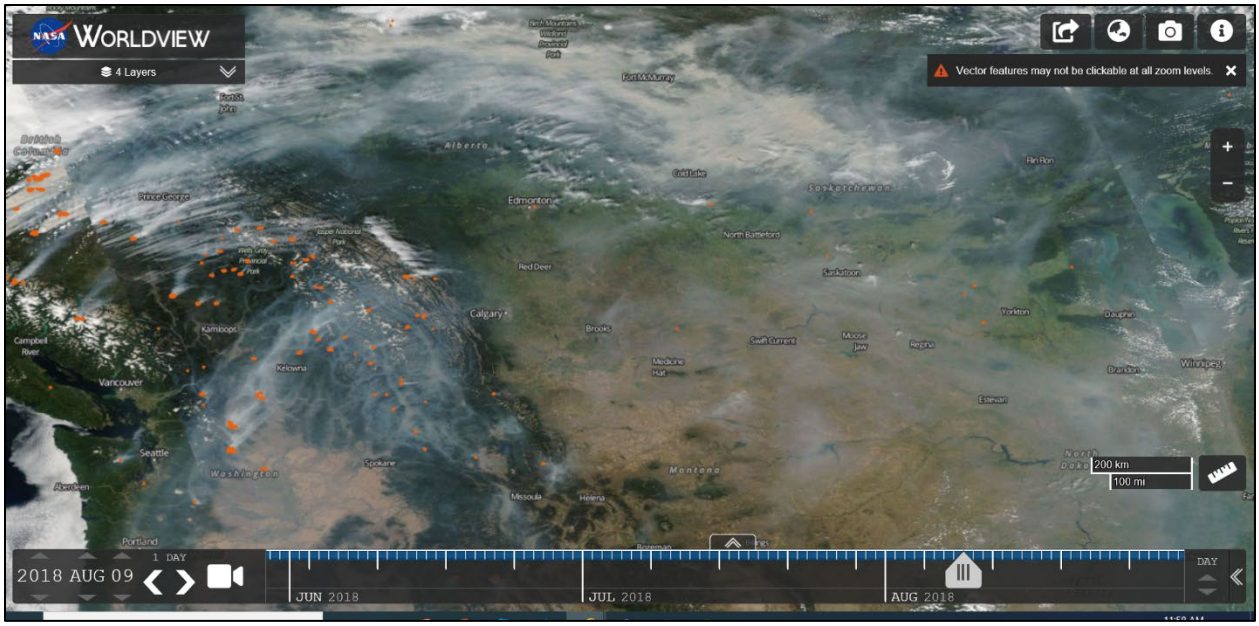

Figure A-2 - Satellite Images August 9, 2018, from NASA Worldview showing wildfire smoke (grey plumes) over Saskatchewan and fires/thermal anomalies (red dots)

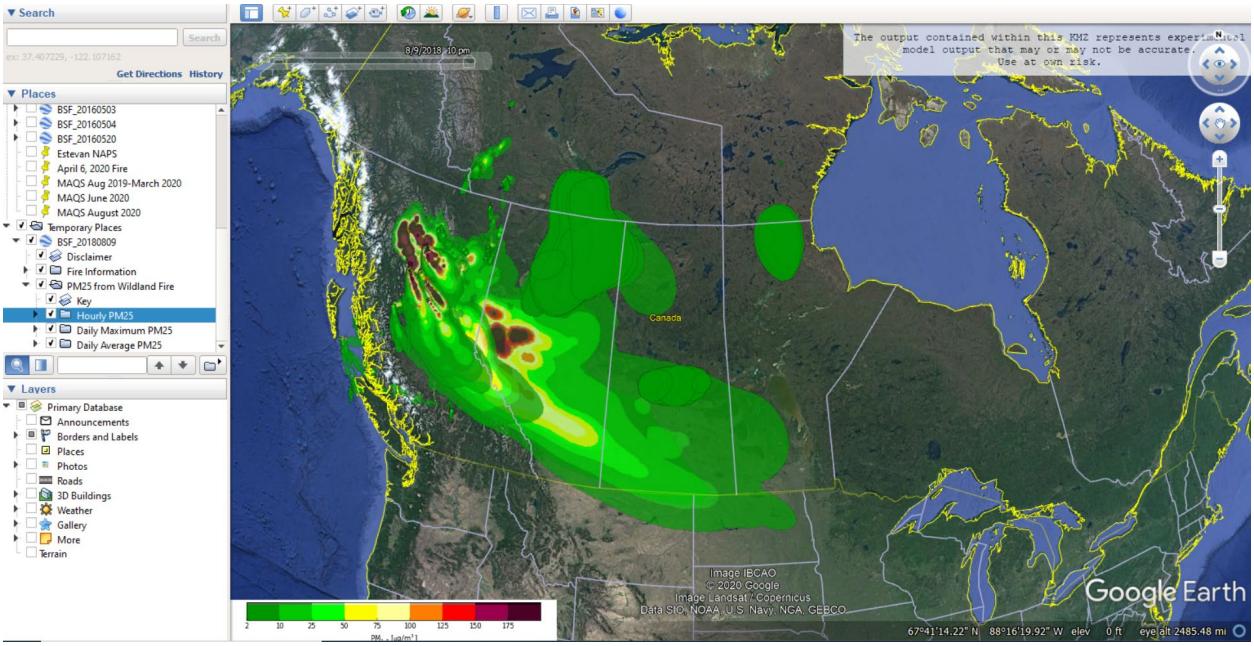

Figure A-3 - Screenshot of Smoke Forecasts for August 9, 2018, from Firesmoke.ca

With this evidence, $PM_{2.5}$ 24-hour values for August 9, 2018, were removed to determine effective management levels.

Wildfire-Influenced $PM_{2.5}$ Data for 2018-2020 reporting period

Table A-3 Wildfire influenced $PM_{2.5}$ data for Boreal Air Zone

Buffalo Narrows NAPS Station	
Date	**$PM_{2.5}$ 24-hour (micrograms/cubic meter)**
5/20/2018	21.9
5/23/2018	25.3
5/24/2018	33.4
8/7/2018	45.7
8/8/2018	65.4
8/9/2018	74
8/10/2018	122.5
8/11/2018	58.6
8/15/2018	38.6
8/17/2018	60.8
8/18/2018	78.7
8/21/2018	40.1
8/22/2018	54.8
5/27/2019	37.9
5/28/2019	48
5/29/2019	49.8
9/20/2020	29.5

Table A-4 Wildfire influenced $PM_{2.5}$ data for Northeast Air Zone

Prince Albert NAPS Station	
Date	**$PM_{2.5}$ 24-hour (micrograms/cubic meter)**
5/13/2018	24.3
5/14/2018	29.7
5/15/2018	20.9
5/22/2018	20.5
8/7/2018	41.8
8/8/2018	68.5
8/9/2018	61.1
8/10/2018	58.6
8/11/2018	158.7
8/15/2018	84.6
8/16/2018	39.2
8/17/2018	34.7
8/18/2018	108
8/19/2018	23.1
8/20/2018	20.9
8/21/2018	35.5
8/22/2018	29.2
8/26/2018	21.6
10/24/2018	21.7
5/22/2019	20.5
5/27/2019	22.7
5/28/2019	46.5
5/29/2019	21.2
9/19/2020	24.5
9/20/2020	20.4

Table A-5 Wildfire Influenced PM2.5 Data for Great Plains Air Zone

Regina NAPS Station	
Date	**$PM_{2.5}$ 24-hour (micrograms/cubic meter)**
8/8/2018	35.4
8/9/2018	45
8/10/2018	44.8
8/11/2018	23.6
8/12/2018	19.7
8/15/2018	27.7
8/16/2018	46.9
8/17/2018	34.3
8/18/2018	44.5
8/19/2018	26.1
8/21/2018	21
8/24/2018	19
8/26/2018	22.3
8/27/2018	24
5/28/2019	27.4
5/29/2019	26.5
5/30/2019	23.9
6/1/2019	21.5
6/2/2019	19.1
6/3/2019	20.8
9/19/2020	19.0
9/20/2020	24.5

Table A-6 Wildfire influenced $PM_{2.5}$ data for Western Yellowhead Air Zone

Saskatoon NAPS Station	
Date	**$PM_{2.5}$ 24-hour (micrograms/cubic meter)**
4/29/2018	72.3
5/22/2018	25.3
8/7/2018	21.9
8/8/2018	56.9
8/9/2018	62.8
8/10/2018	57.4
8/11/2018	120.7
8/15/2018	89.8
8/16/2018	76.8
8/17/2018	52.7
8/18/2018	92.3
8/19/2018	27.8
8/20/2018	36.6
8/21/2018	32.5
8/22/2018	24.9
8/23/2018	22.5
8/26/2018	27.4
8/27/2018	25.8
9/1/2018	20.7
10/25/2018	20.9
10/26/2018	20.8
5/28/2019	22.2
5/30/2019	20.3
9/19/2020	19.5
9/20/2020	19.8

Table A-7 Wildfire influenced $PM_{2.5}$ data for Southeast Saskatchewan Air Zone

Estevan NAPS Station	
Date	**$PM_{2.5}$ 24-hour (micrograms/cubic meter)**
8/8/2018	36.1
8/9/2018	57.6
8/10/2018	59.2
8/11/2018	35.7
8/12/2018	25.5
8/15/2018	21.9
8/16/2018	41.9
8/17/2018	33.3
8/18/2018	43.1
8/19/2018	38.5
8/20/2018	21.1
8/21/2018	32.0
8/22/2018	24.8
8/23/2018	27.8
8/24/2018	25.0
8/25/2018	20.8
8/26/2018	33.5
8/27/2018	24.2
9/2/2018	22.9
10/25/2018	26.0
5/29/2019	24.9
5/30/2019	20.0
6/1/2019	19.1
9/20/2020	19.7
9/21/2020	19.0

Table A-8 Wildfire influenced $PM_{2.5}$ data for Grasslands Air Zone

Swift Current NAPS Station	
Date	**$PM_{2.5}$ 24-hour (micrograms/cubic meter)**
8/8/2018	34.6
8/9/2018	40.3
8/10/2018	39.8
8/11/2018	36.5
8/12/2018	61.3
8/15/2018	33.6
8/16/2018	56.7
8/17/2018	68.1
8/18/2018	73.5
8/19/2018	31.6
8/20/2018	24.4
8/21/2018	28.3
8/23/2018	21.0
8/24/2018	28.5
8/26/2018	27.0
8/27/2018	26.3
5/31/2019	28.7
6/1/2019	38.4
6/2/2019	20.6
9/19/2020	22.2
9/20/2020	35.2