

Lower Athabasca Region 2016 Status of Air Quality

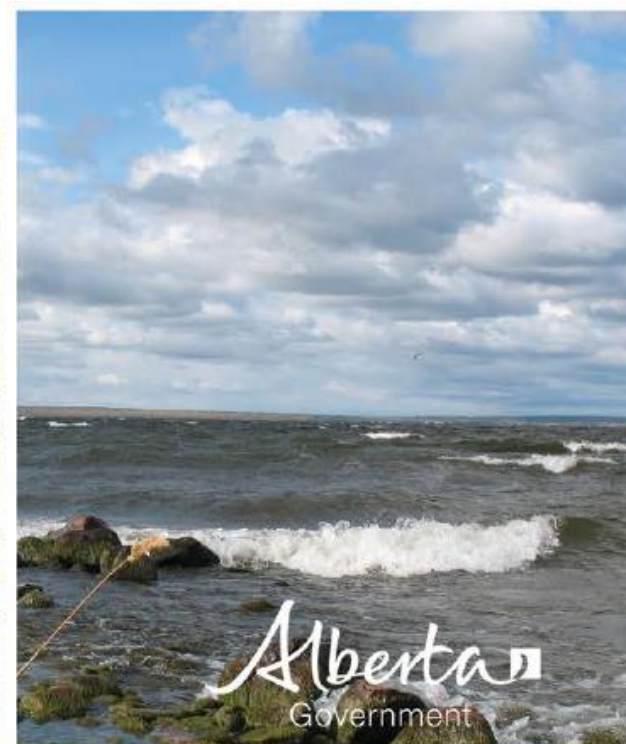
January 2016 – December 2016

Reporting on the Air Quality Management Framework

Alberta Environment and Parks
Environmental Monitoring and Science Division

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**2016 Status of Air Quality, Lower Athabasca Region, Alberta
for January 2016 – December 2016**
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This publication is part of the [Status of Ambient Environmental Condition](#) series.

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About EMSD

The Environmental Monitoring and Science Division (EMSD) is responsible for monitoring, evaluating and reporting on key air, water, land and biodiversity indicators. The division's mandate is to provide open and transparent access to scientific data and information on the condition of Alberta's environment, including specific indicators as well as cumulative effects, both provincially and in specific locations.

EMSD provides provincial environmental monitoring, evaluation and reporting:

- Based on sound science and evidence.
- Presented in a timely, open and transparent manner.
- That respects and incorporates community and Traditional Ecological Knowledge (TEK) from First Nations and Métis people.

This includes providing the information necessary to understand cumulative effects, and to inform the public, policy makers, regulators, planners, researchers, communities, and industry.

The role of EMSD is to provide proactive, objective reporting of scientific data and information on the condition of Alberta's environment, including:

- Baseline environmental monitoring.
- Cumulative effects monitoring.
- Data evaluation and management.
- On-going condition of environment reporting in all regions of Alberta.
- Credible data, evaluation, knowledge and reporting to inform policy and regulatory decision-making.

Learn more at <http://environmentalmonitoring.alberta.ca>

Executive Summary

Background

Prepared by the Alberta Environment and Parks Environmental Monitoring and Science Division, this report is on the state of ambient environmental conditions in 2016 in relation to the [Lower Athabasca Air Quality Management Framework](#) supporting the [Lower Athabasca Regional Plan](#) (LARP).

The 2016 report is the fifth annual report for the Lower Athabasca Region.

Reporting requirements for the LARP are determined by the Government of Alberta. The Environmental Monitoring and Science Division of AEP is responsible for monitoring, evaluation and reporting under the Environmental Management Frameworks, including the Air Quality Management Framework.

The information in this report is compared to triggers and limits previously established by the Government of Alberta.

2016 Results

In 2016, two air quality indicators, nitrogen dioxide (NO₂) and sulphur dioxide (SO₂), were continuously measured at air monitoring stations. The findings are summarized in Table 6 and were as follows:

- No limits were exceeded for air quality indicators.
- The trigger for Level 4 was exceeded at one monitoring station for SO₂.
- Two monitoring stations exceeded the Level 3 trigger for SO₂.
- Four monitoring stations had NO₂ and/or SO₂ ambient concentrations higher than the trigger for Level 2.

Lower Athabasca Regional Plan

The Lower Athabasca Regional Plan (LARP) is a management plan developed by the Government of Alberta under the [Land Use Framework](#). The plan sets outcomes that describe what the Government of Alberta wants to accomplish at a regional level, and is given legislative authority under the Alberta Land Stewardship Act.

The Lower Athabasca Regional Plan applies to the Lower Athabasca Region, an area approximately 93,212 square kilometers in size located in the northeast corner of Alberta (Figure 1).

For more information on the Lower Athabasca Region, see the [Lower Athabasca Regional Plan](#).

The Environmental Monitoring and Science Division of Alberta Environment and Parks is responsible for the monitoring, assessing and reporting on the condition of the environment in the Lower Athabasca Region, while other sections of the Government of Alberta are responsible for management and resources in response to environmental conditions.

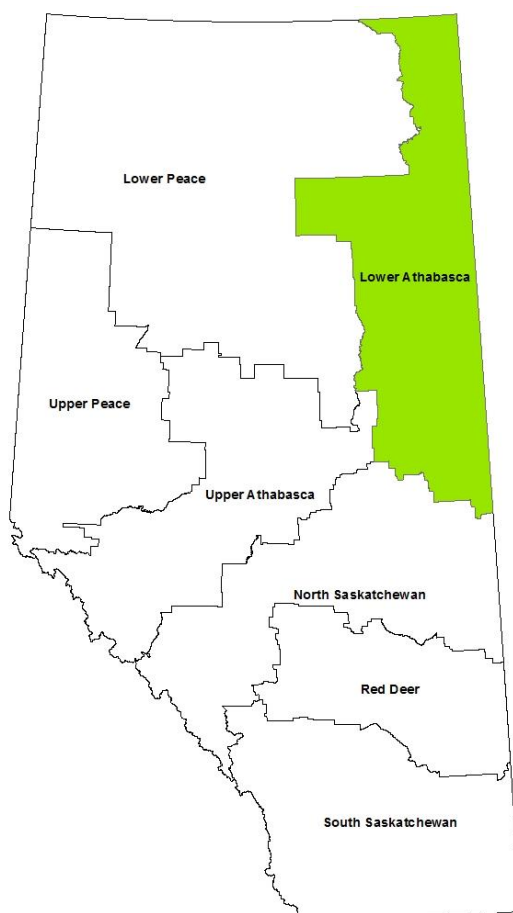


Figure 1: Land Use Framework Regions of Alberta

Monitoring Stations

Ambient air quality is measured at continuous air monitoring stations maintained by the Wood Buffalo Environmental Association (WBEA) and Lakeland Industry and Community Association (LICA) (see Figure 2 for station locations) on behalf of Alberta Environment and Parks (AEP).

In 2016, this regional monitoring network consisted of 15 air monitoring stations that measured nitrogen dioxide concentrations and 19 stations that measured sulphur dioxide concentrations (see Table 1).

AEP analyzed the 2016 hourly average data from these continuous air monitoring stations for the purposes of this annual report.

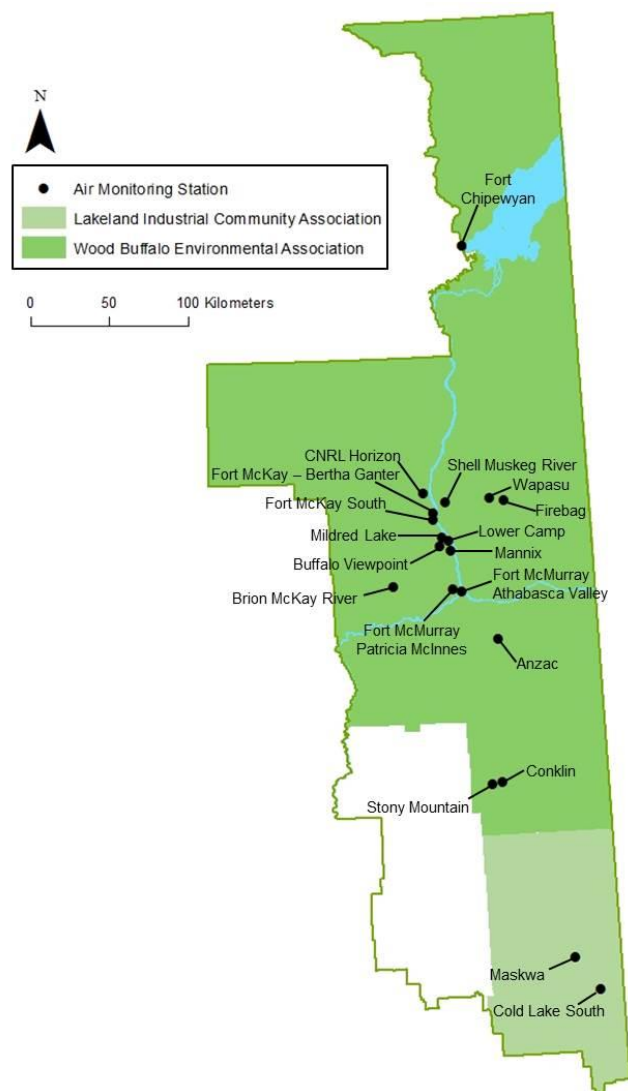


Figure 2: Location of Ambient Air Monitoring Stations in the Lower Athabasca Region.

Table 1: Ambient Air Quality Monitoring Stations in the Lower Athabasca Region

Both NO ₂ and SO ₂	SO ₂ Only
Anzac, Fort McKay - Bertha Ganter, Brion McKay River, CNRL Horizon, Cold Lake South, Conklin, Firebag, Fort Chipewyan, Fort McKay South, Fort McMurray – Athabasca Valley, Fort McMurray – Patricia McInnes, Maskwa, Shell Muskeg River, Stony Mountain, Wapasu	Buffalo Viewpoint, Lower Camp, Mannix, Mildred Lake

Ambient Air Quality Triggers and Limits

The LARP sets the following values for the triggers and limits for NO₂ and SO₂ shown in Table 2 and 3.

As discussed in the [Air Quality Management Framework](#), ambient air quality limits (based on annual averages of the hourly data) are determined by existing Alberta Ambient Air Quality Objectives (AAAQO) and air quality triggers are set at 1/3 and 2/3 of the limit (Table 2). For NO₂ and SO₂, the short-term (upper range) and long-term (annual average) AAAQOs were established to protect human health and ecosystem health, respectively. Ambient air quality triggers based on the upper range of the hourly data (as represented by the 99th percentile of the hourly data) are also established as a statistical measure of the peak air quality concentrations (Table 3). The methods of derivation for triggers based on the upper range of the hourly data are found in Appendix A of the Air Quality Management Framework. By using two types of triggers (annual averages and upper range), management actions can respond to undesirable air quality conditions before they become critical. One considers average air quality over the course of the year (long-term) while the other considers peak air quality conditions that occur over the short-term.

Table 2: Ambient Air Quality Triggers and Limits for the Annual Average of the Hourly Data

Description	NO ₂	SO ₂
Limit ^{1,2}	45 µg/m ³ (24 ppb)	20 µg/m ³ (8 ppb)
Trigger for Level 3	30 µg/m ³ (16 ppb)	13 µg/m ³ (5 ppb)
Trigger for Level 2	15 µg/m ³ (8 ppb)	8 µg/m ³ (3 ppb)

¹ Annual air quality limits are determined by the annual Alberta Ambient Air Quality Objectives (AAAQOs)

² Conversion between µg/m³ and ppb assumes 25°C and 101.325 kPa.

Table 3: Ambient Air Quality Triggers for the Upper Range of the Hourly Data (as represented by the 99th Percentile of the hourly data)

Description	NO ₂	SO ₂
Trigger for Level 4 ^{1,2}	176 µg/m ³ (92 ppb)	94 µg/m ³ (36 ppb)
Trigger for Level 3	118 µg/m ³ (62 ppb)	63 µg/m ³ (24 ppb)
Trigger for Level 2	57 µg/m ³ (30 ppb)	31 µg/m ³ (12 ppb)

¹ 99th percentile triggers are calculated in relation to the hourly AAAQOs. The hourly AAAQO for SO₂ is 450 µg m⁻³ (172 ppb) and for NO₂ is 300 µg m⁻³ (159 ppb).

² Conversion between µg/m³ and ppb assumes 25°C and 101.325 kPa.

2016 Status of Air Quality

Nitrogen Dioxide (NO₂)

Annual Average of the Hourly Data for NO₂

In 2016, one air monitoring station measured annual average ambient concentrations of NO₂ above the trigger value for Level 2 (8 ppb) (Table 4). This station (Shell Muskeg River) also had ambient concentrations above the trigger for Level 2 each year from 2012-2015 (Figure 3).

Thirteen stations had ambient air quality concentrations below the trigger for Level 2 in 2016. All of these stations were also below the trigger for Level 2 in 2015. The Conklin station was not in operation until April 2016 and therefore did not meet the completeness criteria for the NO₂ metric in 2016.

Upper Range of the Hourly Data for NO₂

In 2016, one air monitoring station had upper range of hourly ambient concentrations for NO₂ above the trigger for Level 2 (30 ppb) (Table 4). This station (Shell Muskeg River) also had ambient concentrations above the trigger for Level 2 each year from 2012-2015 (Figure 4).

Thirteen stations had ambient air quality concentrations below the trigger for Level 2 in 2016. One of these stations (CNRL Horizon) had ambient concentrations above the trigger for Level 2 each year from 2012-2015. The Conklin station was not in operation until April 2016 and therefore did not meet the completeness criteria for the NO₂ metric in 2016.

Table 4: Summary Statistics for hourly NO₂ concentrations in the Lower Athabasca Region

NO ₂	2016 Levels						
	Annual Average		Upper Range		Hours Measured	Data Completeness	AAAQO Exceedances
Station	ppb	Management Level	ppb	Management Level	Count	%	Count
Anzac	2	1	17	1	8046	92	1
Fort McKay – Bertha Ganter	7	1	28	1	8220	94	0
Brion McKay River	3	1	23	1	8218	94	0
CNRL Horizon	6	1	30	1	8315	95	0
Cold Lake South	4	1	20	1	8321	95	0
Conklin ^a	-	-	-	-	6252	71	0
Firebag	3	1	18	1	8304	95	0
Fort Chipewyan	1	1	11	1	8324	95	0
Fort McKay South	6	1	26	1	8307	95	0
Fort McMurray – Athabasca Valley	7	1	30	1	8277	94	0
Fort McMurray – Patricia McInnes	6	1	27	1	8305	95	0
Maskwa	3	1	13	1	7412	84	0
Shell Muskeg River	9	2	36	2	8321	95	0
Stony Mountain	1	1	8	1	8286	94	0
Wapasu	2	1	16	1	8316	95	0

^a Conklin station was operational starting April 2016. Therefore, the station did not meet the completeness criteria of at least 75% data completeness.

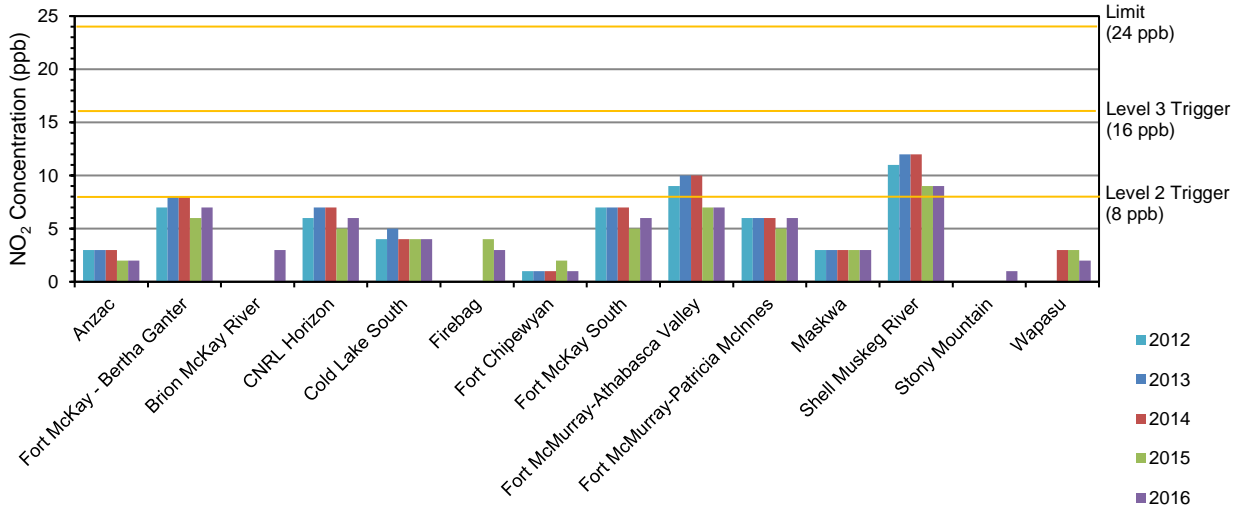


Figure 3: Annual Average of the Hourly Data for 2012-2016 from Air Monitoring Stations in the Lower Athabasca Region for NO₂.

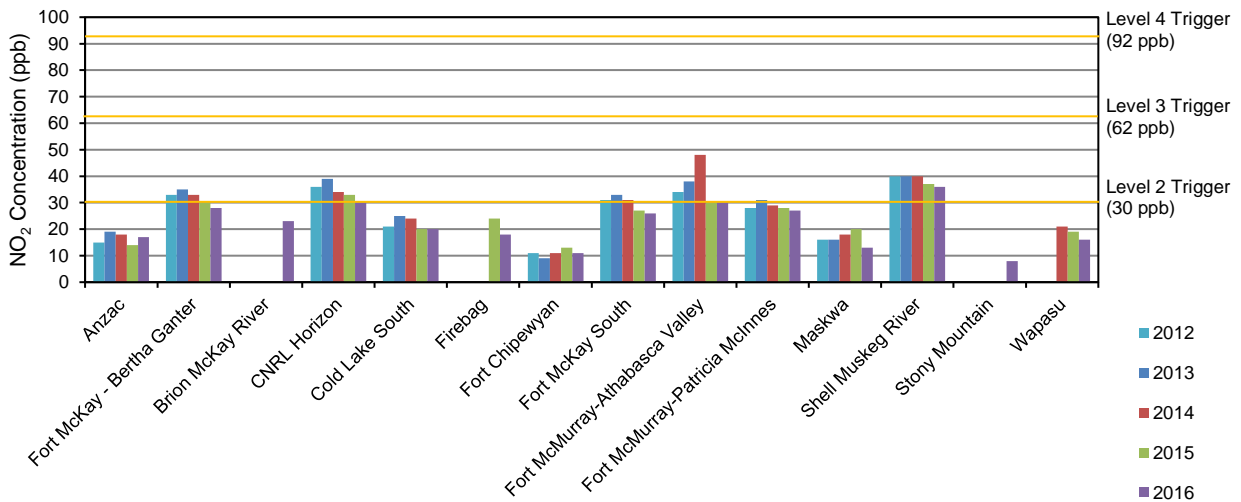


Figure 4: Upper Range of the Hourly Data for 2012-2016 from Air Monitoring Stations in the Lower Athabasca Region for NO₂.

Sulphur Dioxide (SO₂)

Annual Average of the Hourly Data for SO₂

In 2016, none of the air monitoring stations measured annual average ambient concentrations of SO₂ above the trigger for Level 2 (3 ppb) (Table 5 and Figure 5). The Conklin station was not in operation until April 2016 and therefore did not meet the completeness criteria for the SO₂ metric in 2016.

Upper Range of the Hourly Data for SO₂

In 2016, one air monitoring station had an upper range ambient SO₂ concentration above the trigger for Level 4 (36 ppb). This station (Lower Camp) had an upper range ambient concentration that was below the trigger for Level 4 but above the trigger for Level 3 in 2015.

An additional two air monitoring stations had ambient concentrations above the trigger for Level 3 (24 ppb) in 2016. Both of these stations (Mannix and Mildred Lake) were above the trigger for Level 3 in 2014 and 2015 (Figure 6).

Four air monitoring stations had ambient concentrations above the trigger for Level 2 (12 ppb) in 2016. Three of these stations (Fort McKay – Bertha Ganter, Fort McKay South, and Shell Muskeg River) were above the Level 2 trigger in each of the years from 2012-2015. One station (Buffalo Viewpoint) had ambient concentrations below the trigger for Level 2 in 2014 and 2015.

Eleven stations had ambient air quality concentrations below the trigger for Level 2 in 2016. All of these stations were also below the Level 2 trigger in 2015. Two stations (CNRL Horizon and Fort McMurray – Patricia McInnes) were above the trigger for Level 2 in 2013 and/or 2014. The Conklin station was not in operation until April 2016 and therefore did not meet the completeness criteria for the SO₂ metric in 2016.

Table 5: Summary Statistics for SO₂ in the Lower Athabasca Region

SO ₂	2016 Levels						
	Annual Average		Upper Range		Hours Measured	Data Completeness	AAAQO Exceedances
Station	ppb	Management Level	ppb	Management Level	Count	%	Count
Anzac	<1	1	5	1	7854	89	0
Fort McKay – Bertha Ganter	1	1	15	2	8317	95	0
Brion McKay River	<1	1	8	1	8217	94	0
Buffalo Viewpoint	1	1	14	2	8361	95	0
CNRL Horizon	1	1	12	1	8310	95	0
Cold Lake South	<1	1	1	1	8323	95	0
Conklin ^a	-	-	-	-	6258	71	0
Firebag	1	1	12	1	8338	95	0
Fort Chipewyan	<1	1	5	1	8336	95	0
Fort McKay South	1	1	15	2	8341	95	0
Fort McMurray – Athabasca Valley	1	1	11	1	8311	95	0
Fort McMurray – Patricia McInnes	1	1	12	1	8353	95	0
Lower Camp	3	1	43	4	8356	95	0
Mannix	3	1	36	3	8351	95	1
Maskwa	<1	1	6	1	7591	86	0
Mildred Lake	2	1	29	3	8342	95	0
Shell Muskeg River	1	1	15	2	8318	95	0
Stony Mountain	<1	1	2	1	8288	94	0
Wapasu	1	1	12	1	8352	95	0

^a Conklin station was operational starting April 2016. Therefore, the station did not meet the completeness criteria of at least 75% data completeness.

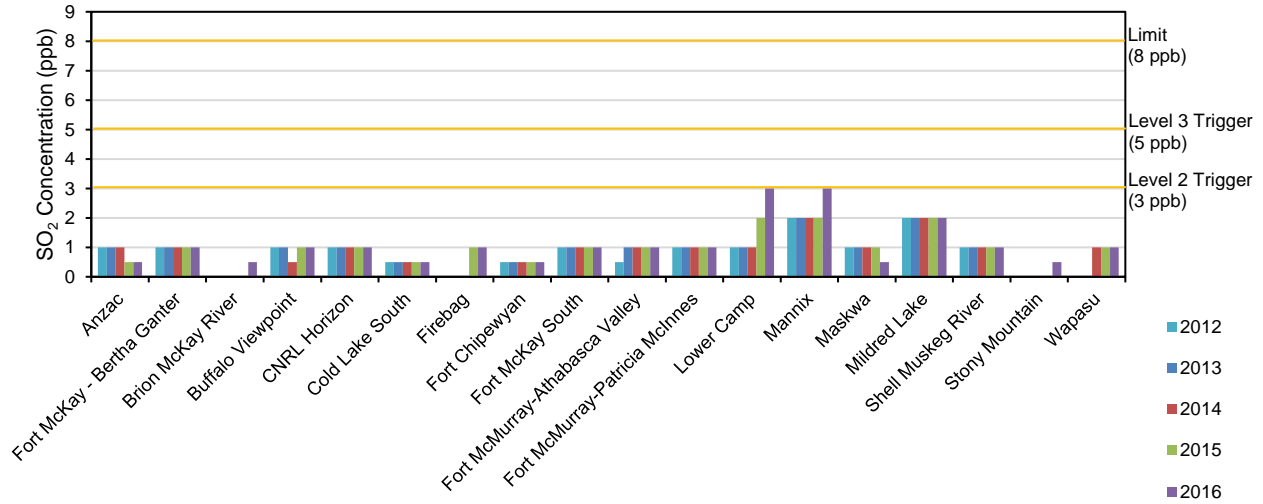


Figure 5: Annual Average of the Hourly Data¹ for 2012-2016 from Air Monitoring Stations in the Lower Athabasca Region for SO₂.

¹ Sites with annual averages that round to zero are shown as 0.5 ppb to distinguish them from sites that did not meet data completeness requirements.

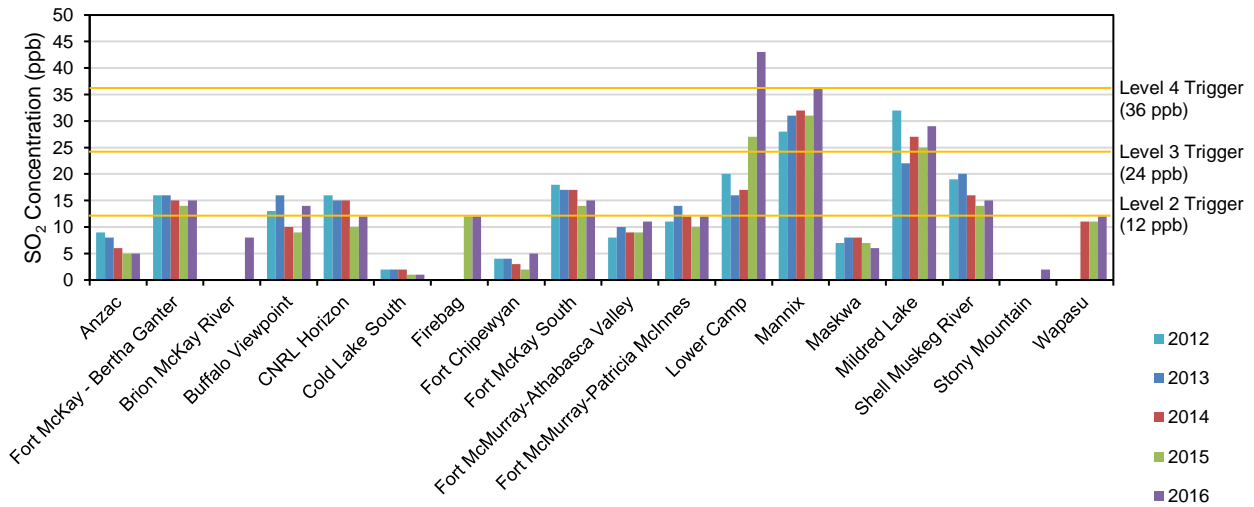


Figure 6: Upper Range of the Hourly Data for 2012-2016 from Air Monitoring Stations in the Lower Athabasca Region for SO₂

The Lower Camp air monitoring station measured a number of short-term (1 hr) elevated SO₂ concentrations (1.4% of measurements > 36 ppb) in exceedance of the upper range trigger for Level 4. Wind directions corresponding to these elevated SO₂ concentrations were predominantly from the south/southwest direction (Figure 7b). The Mannix air monitoring station, located south of Lower Camp, also measured a number of elevated SO₂ concentrations (0.94% of measurements > 36 ppb) and was close to exceeding the upper range Level 4 trigger. Elevated SO₂ concentrations at Mannix corresponded with wind directions from the north (Figure 7c). These stations are located in close proximity with oil sands operations. The elevated SO₂ concentrations and corresponding wind directions suggest a relationship between trigger exceedances of upper range SO₂ concentrations and the nearby facilities.

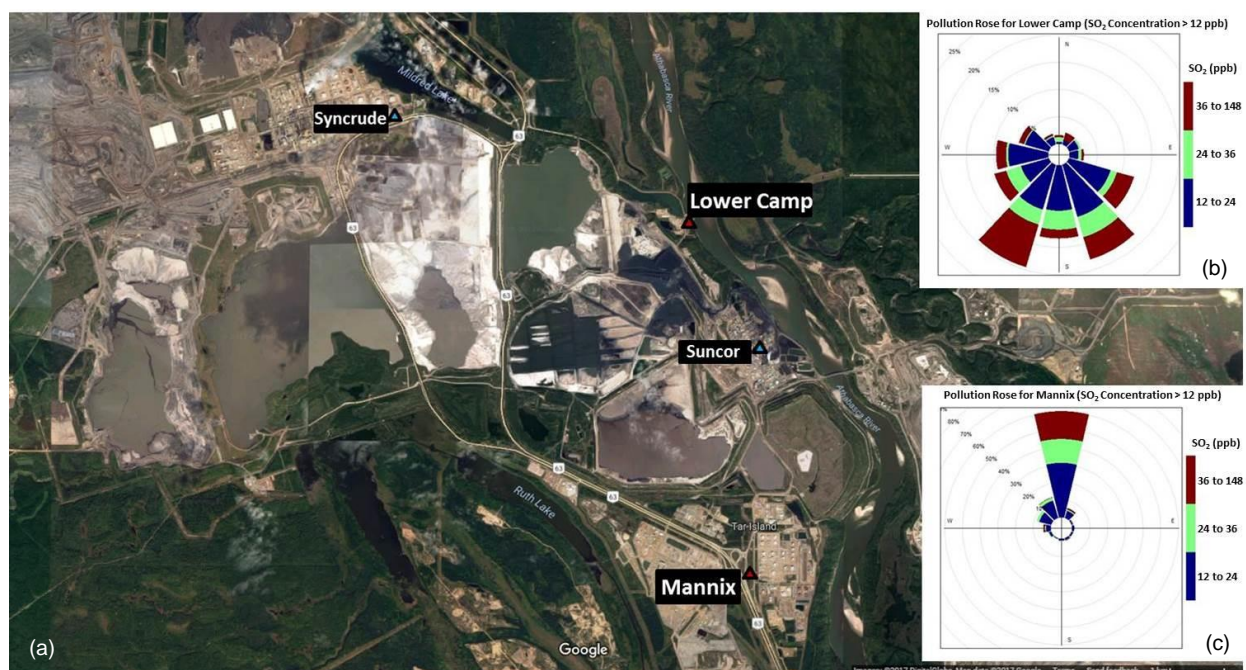


Figure 7: (a) Map showing the locations of the Lower Camp and Mannix air monitoring stations, as well as the Syncrude and Suncor facilities. Also shown are the pollution roses for the Lower Camp (b) and Mannix (c) stations (SO₂ concentrations greater than 12 ppb).

Assigning Management Levels

Table 6: Status of Ambient Air Quality Indicators at Monitoring Stations in 2016

Level	Description	Management Intent	2016 Status of Indicators
4	Ambient air quality exceeding air quality limits	Improve ambient air quality to below limits or Level 4 trigger	SO ₂ was above the upper range trigger at: <ul style="list-style-type: none"> • Lower Camp
Limit or Trigger for Level 4			
3	Ambient air quality below but approaching air quality limits	Proactively maintain air quality below limits or Level 4 trigger for upper range	SO ₂ was above the upper range trigger at: <ul style="list-style-type: none"> • Mannix • Mildred Lake
Trigger for Level 3			
2	Ambient air quality below air quality limits	Improve knowledge and understanding and plan	NO ₂ was above the annual average trigger at: <ul style="list-style-type: none"> • Shell Muskeg River NO ₂ was above the upper range at: <ul style="list-style-type: none"> • Shell Muskeg River SO ₂ was above the upper range at: <ul style="list-style-type: none"> • Fort McKay – Bertha Ganter • Buffalo Viewpoint • Fort McKay South • Shell Muskeg River
Trigger for Level 2			
1	Ambient air quality well below air quality limits	Apply standard regulatory and non-regulatory approaches	All remaining stations

In 2016, one air monitoring station (Lower Camp) exceeded the Level 4 trigger established by the Air Quality Management Framework. No other air monitoring stations measured ambient NO₂ or SO₂ concentrations above the limits or triggers for Level 4 established by the Framework.

For triggers based on the annual average of the hourly data:

- One station was assigned to Level 2 for NO₂: Shell Muskeg River

For triggers based on the upper range of the hourly data:

- One station was assigned to Level 4 for SO₂: Lower Camp
- Two stations were assigned to Level 3 for SO₂: Mannix and Mildred Lake
- Four stations were assigned to Level 2 for SO₂: Fort McKay – Bertha Ganter, Buffalo Viewpoint, Fort McKay South, and Shell Muskeg River
- One station was assigned to Level 2 for NO₂: Shell Muskeg River