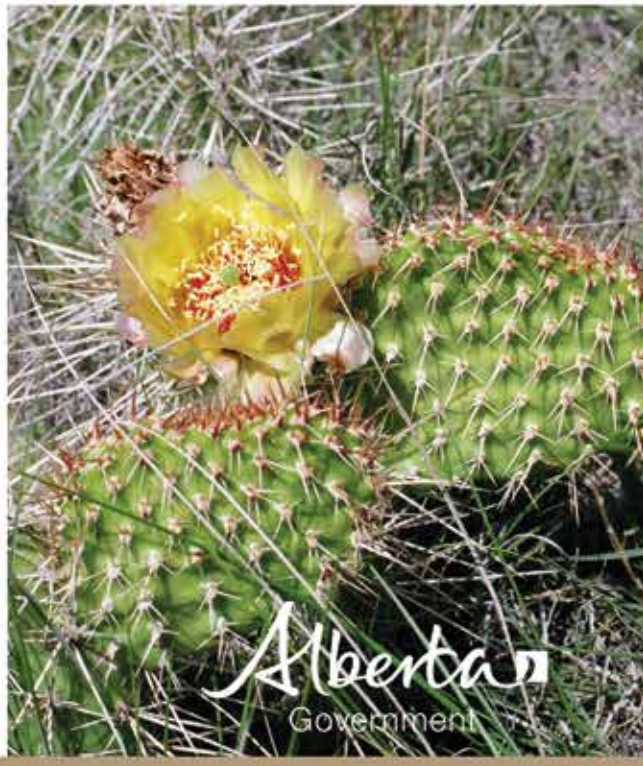
South Saskatchewan Region
Air Quality Management Framework

For Nitrogen Dioxide (NO_2), Ozone (O_3) and Fine Particulate Matter ($PM_{2.5}$)

environmental • social • economic
Land-use Framework





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1.0 Introduction

Alberta Environment and Sustainable Resource Development has developed environmental management frameworks for air quality and surface water quality under the South Saskatchewan Regional Plan. These frameworks are designed to maintain flexibility and proactively manage the cumulative effects of human activity on ambient air quality and surface water quality within the South Saskatchewan Region. The frameworks facilitate sustainable resource management within the context of regional development and related regulatory processes. The frameworks do not replace existing regulatory processes. They contribute to managing growth pressures on air, land and water over the coming decades, adding to and complementing existing policies, legislation, regulations and management tools.

The frameworks are policy documents that will be given legal authority as specified in the regional plan, and through the mandates and legislation of Environment and Sustainable Resource Development and, potentially, other government departments.

The Air Quality Management Framework sets ambient air quality triggers and limits for nitrogen dioxide (NO_2), fine particulate matter ($PM_{2.5}$) and ground-level ozone (O_3). Using the triggers and limits, the framework defines ambient air quality levels that help to guide long-term decision-making and air quality management.

The Surface Water Quality Management Framework focuses on the four mainstem reaches of the Bow, Milk, Oldman and South Saskatchewan rivers. It sets surface water quality triggers and limits for 15 indicators measured at nine monitoring stations.

2.0 Purpose

Cumulative effects management frameworks seek to balance anticipated development with environmental protection by using a triple bottom line approach to support the environment and social and economic objectives in the region. The Air Quality Management Framework (the framework) develops ambient triggers and limits for specific substances, which become the indicators for ambient air quality. Ambient air may be defined as outside air, any portion of the atmosphere not confined by walls and a roof to which the general public is exposed. Environment and Sustainable Resource Development uses monitoring data to determine ambient air quality in relation to the framework's triggers and limits. The framework further uses triggers and limits to define four levels of ambient air quality.

The use of ambient air quality indicators with triggers helps to clearly define the range of management responses that may be required when concentrations of substances move from one level of air quality to another. The triggers signal a need to take proactive action before the limits are exceeded; when limits are exceeded, the framework defines requisite management actions. This management approach, in conjunction with existing regulations and policies, contributes to the achievement of the desired regional objective for ambient air quality.

The South Saskatchewan Regional Plan is one of seven regional plans being advanced under the Land-use Framework and its enabling legislation, the *Alberta Land Stewardship Act*. The region has seen rapid population growth in recent decades, and associated air quality impacts, particularly in the Calgary area. The region's unique combination of industrial development, agricultural demands and city expansions make this framework's plan for coordinated action on current and future ambient air quality an integral part of the regional plan.

2.1. Substances of Concern

Sources of substances of concern in the region include building and home heating, road and construction operations, transportation, agriculture and industrial facilities. Building and home heating contribute to nitrogen dioxide (NO_2), which in sunlight can turn into ozone (O_3). Road and construction operations are the sources of most of the total suspended particulates (TSP) and other particulate matter (PM). Transportation, including private vehicles, is responsible for most of the carbon monoxide (CO) and contributes significantly to fine particulate matter ($PM_{2.5}$) and oxides of nitrogen (NO_x) emissions. Agricultural operations contribute to PM, hydrogen sulphide (H_2S) and most of the ammonia (NH_3) emissions.

Ambient air concentrations of most substances are not uniform throughout the region; rather, they are influenced by the location, geography, density and nature of developments in the area. There are also air quality issues in localized areas of the region, including sulphur dioxide (SO_2), ammonia (NH_3), dust, visibility and odour. Odour issues occur in localized areas due to operational facilities such as natural gas treatment plants and livestock feeding operations, but at the current time odour issues do not present a concern that needs to be addressed for the whole region. As appropriate, the Government of Alberta will continue to monitor and assess local issues and work collaboratively to determine appropriate place-based management actions and mitigation of effects. This will include the continued application of regulatory tools, such as regulation of industrial facilities under the *Environmental Protection and Enhancement Act* and requirements for Confined Feeding Operations under the *Agricultural Operation Practices Act*, and use of non-regulatory approaches such as beneficial management practices.

2.1.1. The Framework's Indicators

Ambient air quality is impacted by complex chemical interactions between substances. An Air Issues Scoping Study for the Alberta South Saskatchewan Land-use Planning Region (Stantec, 2009), endorsed by the terms of reference for the South Saskatchewan Regional Plan, informed the selection of the region's substances of concern for the work of this framework. The study also provided analysis of the potential for air quality management and planning triggers in the region. Environment and Sustainable Resource Development considered the study, other relevant strategies and frameworks, and analyses of air quality monitoring data trends to identify the substances of concern which will serve as indicators under the framework. These are NO_2, O_3 and $PM_{2.5}$. Section 5.1 provides more information on the selection criteria used for identifying the key indicators.

Some substances that contribute to ambient air quality issues are considered to be "primary" or emitted directly from a source. Other substances are "secondary" or are formed when other substances (including primary substances) react in the atmosphere. NO_2 is a primary pollutant. $PM_{2.5}$ can be both a primary and a secondary pollutant. O_3 is a secondary pollutant. At certain concentrations, these substances may affect human and ecosystem health.

Nitrogen dioxide (NO2) is released as a product of combustion from industrial, transportation and home heating sources. It is a major determinant of air quality in major population centres. Natural sources of NO_2 emissions make up a low percentage of the total NO_2 emissions in the region. The lowest concentrations of NO_2 tend to occur during the summer (Stantec, 2009). Nitrogen dioxide is also a precursor to O_3 and $PM_{2.5}$. Acid and nitrogen deposition and their long-term acidification and eutrophication impacts are other potential environmental issues associated with NO_2 emissions.

Ozone (O3) is not directly emitted into the atmosphere, but forms by secondary photochemical reactions of NO_x (NO_2 and nitric oxide (NO)) with volatile organic compounds (VOCs) in the presence of sunlight and stagnant meteorological conditions. The most important anthropogenic sources of NO_x are industry, transportation and home heating. The main anthropogenic sources of VOCs are industry and, in lower levels, transportation and other non-point sources including urbanization and agriculture. Nevertheless, natural sources represent more than 85 per cent of VOC emissions in Alberta. Ozone concentration levels at ambient air monitoring stations in the South Saskatchewan Region are lowest during mid-winter. The highest readings in the region were observed at the Lethbridge, Crescent Heights (located in Medicine Hat) and Calgary Northwest monitoring stations.

Fine particulate matter (PM2.5) can be emitted directly from emission sources or formed in the atmosphere by the transformation of gaseous emissions into secondary substances. Sources of $PM_{2.5}$ include all types of combustion activities, such as motor vehicle operation, power plants and industrial processes. Open sources such as agriculture activities, construction operations, dust from paved and unpaved roads, mining activities and prescribed burning also contribute to $PM_{2.5}$ in the region. In general, natural $PM_{2.5}$ source emissions are negligible in Alberta although grass and forest fires can create high levels of $PM_{2.5}$ on a short-term basis. The highest ambient $PM_{2.5}$ concentrations occurred at the Calgary Central and Calgary East monitoring stations. Unlike the Calgary urban stations, which exhibited no qualitative evidence of seasonal variability, the Lethbridge and Crescent Heights stations showed maximum values during the summertime.

2.2. Goals of the Framework

- Adopt cumulative effects management at the regional level and take a collaborative approach to proactively manage NO_2, O_3 and $PM_{2.5}$ in the South Saskatchewan Region considering both point and non-point sources of substances.
- Develop action triggers for NO_2, O_3 and $PM_{2.5}$ and use monitoring data to determine ambient air quality in relation to triggers, limits and levels.
- Provide effective and efficient management tools that support the flexibility needed to address local ambient air quality issues within the region.
- Proactively identify and address issues to help maintain and improve existing air quality and to address health and environment issues associated with development within the region.
- Align with regulatory and non-regulatory processes to help ensure that development can continue and air quality that supports a healthy human population and the environment will be maintained or improved.

2.3. The South Saskatchewan Region

The South Saskatchewan Region is a large and diverse region, covering 83,764 km^2 (Figure 1). The region is bounded by the Rocky Mountains to the west, the Canada-U.S. border to the south, the Alberta-Saskatchewan border to the east and the northern municipal boundaries of the municipal districts of Bighorn and Rocky View, and Wheatland, Newell and Cypress counties. The region contains diverse landscapes including urban centres and communities, industrial landscapes, grasslands, cultivated agricultural lands, parkland, foothills and Rocky Mountains. The South Saskatchewan Region includes very diverse natural ecoregions, and the climate and weather are similarly varied.

The region has seen rapid population growth in recent decades and is now home to about 1.6 million people, or 46 per cent of Alberta's population and contains the province's largest city, Calgary. Most residents live in urban centres, with two-thirds of the population in the Calgary area. As more people move to the region, the cumulative effects of human activity on the environment may also increase. Residents have expressed concerns about the impacts of air emissions on health, the environment and overall quality of life.

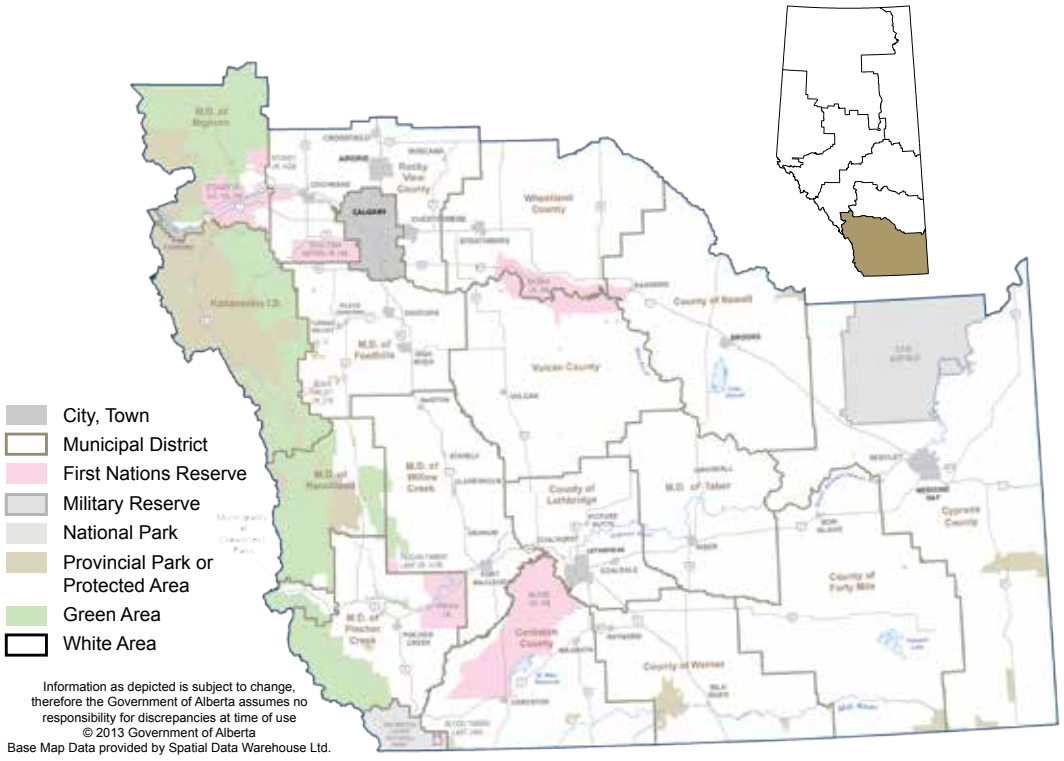


Figure 1 Map of the South Saskatchewan Region

2.4. Framework Development

The initial drafting and detailed revision of this framework relied on input from key stakeholders. An engagement process led by Environment and Sustainable Resource Development involved targeted stakeholders. At the same time, the Land Use Secretariat led a consultation process about the South Saskatchewan Regional Plan that involved gathering feedback from stakeholders and the public on the draft South Saskatchewan Regional Plan and an opportunity to provide input on the management frameworks.

All input was considered as the framework was developed. Overall, the comments supported the framework as a beneficial tool for environmental management within the South Saskatchewan Region.

3.0
Key Concepts and Principles

3.1. Cumulative Effects Management and Management Frameworks

The Government of Alberta has made a commitment to cumulative effects management, which focuses on the achievement of outcomes, understanding the effects of multiple development pressures (existing and new), assessing risk, collaborative work with shared responsibility for action, and improved integration of economic, environmental and social considerations. It follows an adaptive management model where decision-makers learn from experience and new information and adapt to changing social expectations and demands. Performance management, along with pollution prevention principles, is essential to providing information on environmental conditions and identifying the need for any adjustments and changes on an ongoing basis. The development of management frameworks is an important addition to accomplish this shift to a cumulative effects management system. Management frameworks will play an important role in long-term planning and decision making in accordance with the outcomes defined in the regional plan. The management framework approach is depicted in Figure 2.

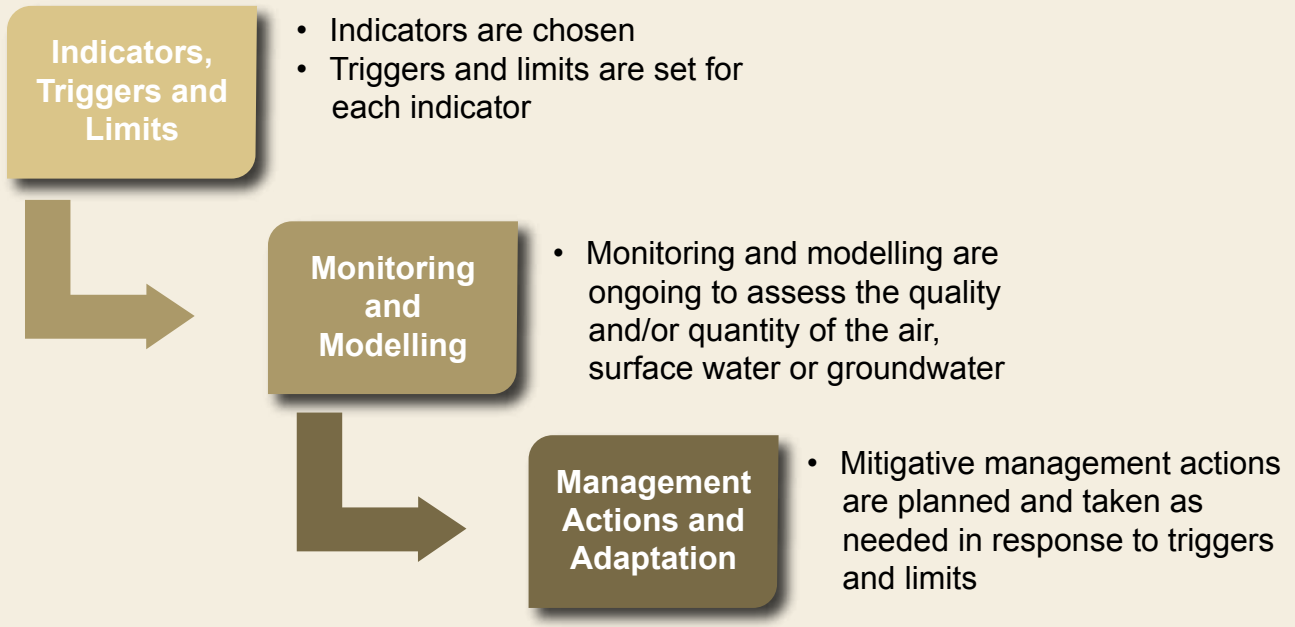


Figure 2 Management Framework Approach

3.2. Addressing Point and Non-point Sources

The framework addresses point source emissions as well as emissions from non-point sources. Point source is a term used to describe emissions from a single discharge source that can be easily identified. Non-point source pollution is subtle and gradual, caused by the release of substances from many different and diffuse sources, largely managed in Alberta by a mixture of municipal, provincial and federal initiatives, and associated with activities such as industry, transportation, urbanization and agriculture.

Management of non-point source emitters is inherently complex: it is an inter-governmental and cross-jurisdictional issue. Point and non-point sources of emissions come together in the South Saskatchewan Region to contribute to ambient concentrations and must be understood to ensure that appropriate actions are taken.

Benefits of cumulative effects management are that cumulative sources in the region are examined and understood. The framework adds the opportunity for collective direction and commitment among various parties to manage point and non-point sources and for coordinating management actions already underway. These opportunities allow for overall more effective and efficient management.

3.3. Key Principles

The following are key principles that form the foundation for this management framework:

3.3.1. Maintains and Improves Air Quality

- Opportunities for keeping clean areas clean and continuous improvement will be considered in planning for required management actions.
- The framework addresses potential adverse impacts on ambient air quality from air emissions in the South Saskatchewan Region that could arise, despite the requirement for continuous improvement.

3.3.2. Applies a Regional Perspective

- The framework contributes to management of local air quality in the region by considering that the ambient air concentrations of substances are influenced by the location, density and nature of developments in the area.
- The framework contributes to proactively managing air quality within the region with consideration of human population and ecosystem health.
- The framework consistently assigns and applies ambient air quality triggers to NO_2, O_3 and $PM_{2.5}$ across the region.

- As development proceeds and emissions grow over time, the use of ambient air quality triggers and limits will ensure that emissions from various sources and at various scales are managed so they do not, collectively, result in unacceptable air quality.

3.3.3. Builds on Existing Legislation, Regulations and Policies

- The framework is intended to complement, not replace, existing management frameworks, policies, legislation and regulations. This includes requirements related to pollution prevention and incorporation of the Best Available Technology Economically Achievable (BATEA).
- The framework is consistent with national and provincial policies, strategies and frameworks, and with the stated desired outcomes for the region.

3.3.4. Incorporates Flexibility and Adaptability

- Flexibility and adaptability result when place-based management actions are tailored to address specific issues associated with local emissions. A range of actions and potential tools are used, as required, to manage ambient air quality with respect to the action triggers for NO_2, O_3 and $PM_{2.5}$.
- The framework recognizes that development plans, emission control technology and scientific understanding may change over time, and flexibility is needed to ensure that the desired environmental outcomes continue to be achieved.
- Environment and Sustainable Resource Development will review and update the framework to ensure alignment with other policies that are developed or revised at a regional, provincial or national level, or at a minimum 10-year interval to align with regional planning.

3.3.5. Clearly Communicates

- The framework supports long-term certainty in Alberta's policy and regulatory process and non-regulatory programs.
- The system described in this framework and the expectations for emissions management are clearly defined and transparent.
- Public access to ambient air quality monitoring data from continuous air monitoring stations is available through Alberta's Ambient Air Quality Data Warehouse[1].This data is used to evaluate air quality within the South Saskatchewan Region.

[1] Alberta's current central repository of ambient air quality data is known as the Clean Air Strategic Alliance (CASA) Data Warehouse.

3.3.6. Involves Partnerships

- Ambient air monitoring and data collection is currently conducted by local airshed organizations under the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) who gather data at existing continuous air monitoring stations and store it in Alberta's Ambient Air Quality Data Warehouse.
- As the framework is implemented, Environment and Sustainable Resource Development involves local airshed organizations, industry, aboriginal people, municipalities, and other stakeholders who live and work in the area.

4.0

The Current Alberta Air Quality Management System

4.1. Policy Context

The following briefly describes key aspects of the policy context for this management framework.

4.1.1. National Air Quality Management System

Alberta has endorsed the national Air Quality Management System as a comprehensive approach for improving air quality in Canada. It was developed through the Canadian Council of Ministers of the Environment (CCME) and is the product of unprecedented collaboration by the federal, provincial and territorial governments, First Nations peoples and other stakeholders. It includes the following.

- New Canadian Ambient Air Quality Standards (CAAQS) that set the standard for outdoor ambient air quality management across the country. CAAQS will replace the existing Canada-wide Standards (CWS). Standards for $PM_{2.5}$ and O_3 have been developed and work has begun on standards for NO_2 and SO_2. New CAAQS will be phased into the Framework's approach as they become available.
- Base-level Industrial Emission Requirements (BLIERs) that set a base level of performance for major industries in Canada. BLIERs are intended to ensure that all significant industrial sources in Canada, regardless of where facilities are located, achieve a minimum performance. BLIERs are quantitative or qualitative emissions requirements proposed for new and existing major industrial sectors and some equipment types.
- A framework for air zone management within provinces and territories that enables actions tailored to specific sources of air emissions in a given area. Air zones are part of a place-based approach to manage local air quality. The goal in all air zones will be to drive continuous improvements in air quality and to prevent the CAAQS from being exceeded.
- Regional airsheds that facilitate coordinated action where air pollution crosses a border. Six regional airsheds that together cover all of Canada have been established to coordinate efforts to reduce transboundary air pollution flows and report on regional air quality. Alberta is contained within the Prairie Airshed along with parts of the Yukon, Northwest Territories, British Columbia and Saskatchewan. Coordinating mechanisms will be built on existing mechanisms or established as needed to address air pollution issues, including transboundary pollution from the United States, and across interprovincial and inter-regional boundaries.

- Improved intergovernmental collaboration to reduce emissions from the transportation sector. A working group has been established with federal, provincial, and territorial government representatives in the environment, transport, energy, natural resources and health fields who are involved with policies and programs addressing emissions from mobile sources (transportation and small engines).

In Alberta, air zones are aligned with the regions under the Land-use Framework. Therefore an air zone that aligns with the South Saskatchewan Region has been delineated as part of implementation of the national Air Quality Management System.

Monitoring and public reporting are critical to transparency, accountability and the effective implementation of the national Air Quality Management System. Provinces and territories, with assistance from the federal government, will be responsible for monitoring in the air zones and reporting to the general public in their jurisdictions on air quality and the measures taken to implement the national Air Quality Management System. In Alberta, the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) is established to oversee environmental monitoring across the province.

4.1.2. Alberta's Renewed Clean Air Strategy

Clearing the Air, Alberta's Renewed Clean Air Strategy (2012) is a 10-year plan to enhance the provincial ambient air quality management system. Addressing the cumulative impacts of non-point sources is a key action area for enhancement. The strategy includes development and implementation of policies and management tools, including regional ambient air quality management frameworks, to manage both point and non-point sources of air emissions. Other directions focus on shared responsibility and partnerships, integrated monitoring evaluation and reporting, and knowledge enhancement. The strategy provides continuing guidance for enhancing the management of air quality in the province and is the umbrella over the regulations, existing programs and the framework, and under which the province will implement the national Air Quality Management System.

The strategy has the following outcomes:

- The well-being of Alberta's population is supported by effective ambient air quality management.
- Air quality will maintain, protect and sustain healthy ecosystems.
- Ambient air quality management supports economic sustainability.

4.2. The Regulatory Context

Under the existing regulatory system, proponents of new activities assess the effects of cumulative emissions from natural, transboundary, non-point and industrial sources as part of Environmental Impact Assessments and applications for operating approvals or their renewal. Regulators use mechanisms such as those listed in Table 1 along with applicable performance standards and air dispersion modelling guidelines to identify appropriate mitigation and define allowable releases from each facility. These regulatory and non-regulatory mechanisms will continue to be instrumental for the successful implementation of the Air Quality Management Framework.

4.2.1. Regulating Greenhouse Gas Emissions

In 2007, Alberta became the first jurisdiction in North America to legislate greenhouse gas emissions reductions from large facilities by passing the Specified Gas Emitters Regulation.

This legislation requires all facilities in Alberta emitting over 100,000 tonnes of carbon dioxide per year to reduce their emissions intensity by 12 per cent below their 2003-05 baseline emissions intensity. Facilities that fail to meet this requirement can buy Alberta-based emissions offset credits from Alberta's Emissions Offset Registry, purchase Emissions Performance Credits from facilities that have reduced their emissions intensity beyond their reduction targets or pay $15 per tonne of carbon dioxide equivalent over reduction targets into the Climate Change and Emissions Management Fund which supports clean energy technology and projects aimed at reducing Alberta's greenhouse gas emissions.

4.3. Evolving Requirements for $PM_{2.5}$, O_3 and NO_2

This framework is part of the province's shift to cumulative effects management. Nationally, the evolution in systems designed to protect and improve air quality also addresses cumulative effects outcomes for human and environmental health. A brief picture of the evolving requirements will assist the reader in understanding the framework's flexible approach, which allows for adapting the new policies as they are brought into force over the coming years.

Table 2 summarizes the evolving requirement for ambient air quality for nitrogen dioxide, particulate matter and ozone.

Table 1 Regulatory and Non-regulatory Management of Air Emissions and Effects in the South Saskatchewan Region

Governance	Jurisdiction
Acts	
Canadian Environmental Protection Act	Federal
Environmental Protection and Enhancement Act (EPEA)	Provincial
Agricultural Operation Practices Act	Provincial
Alberta Land Stewardship Act (ALSA)	Provincial / Regional
Regulations	
Approvals, monitoring and reporting requirements	Alberta (EPEA)
Compliance and enforcement	Alberta (EPEA)
Directives	
Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting (AER, 2011)	Alberta
Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry (AER, 2009)	Alberta
Guidelines/Objectives	
Alberta Ambient Air Quality Objectives (Alberta Environment, 2013)	Alberta
Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (CCME, 2012a)	National
Guidance Document on Air Zone Management (CCME, 2012b)	National
Policies and Frameworks	
Land-use Framework (LUF)	Provincial / Regional
Alberta Acid Deposition Management Framework (Alberta Environment, 2008a)	Alberta
Industrial Release Limits Policy (Alberta Environment, 2000)	Alberta
Air Quality Management System	National
Strategies	
Clearing the Air: Alberta's Renewed Clean Air Strategy (GOA, 2012a)	Alberta
Provincial Energy Strategy	Alberta
Climate Change Strategy	Alberta

4.3.1. Evolving Requirements for $PM_{2.5}$ and O_3

In June 2000, the CCME established ambient Canada-wide Standards (CWS) for $PM_{2.5}$ and O_3 that were to be achieved by 2010, as well as provisions on monitoring and reporting of progress and activities. Alberta's plan to achieve the CWS by the 2010 target date was set out in the Clean Air Strategic Alliance's Particulate Matter and Ozone Management Framework (CASA, 2003a).

In October 2012, Alberta endorsed the national Air Quality Management System, developed through the CCME. One aspect of the national Air Quality Management System is the Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$ and O_3 that are to be achieved by 2015 and 2020.

The CAAQS replace the CWS, with reporting against the CAAQS beginning in 2014.

4.3.2. Evolving Requirements for NO_2

Current Alberta Ambient Air Quality Objectives (AAAQO) for NO_2 are developed and implemented under the Alberta *Environmental Protection and Enhancement Act*. This includes hourly and annual AAAQOs. Their purpose is to protect the environment and human health while recognizing principles of sustainable development that include environmental as well as technical, social and economic considerations. The AAAQOs are set values that are compared to actual air quality measurements to report on the state of Alberta's environment, special ambient air quality surveys and current air quality through the Air Quality Health Index.

The AAAQO values are reviewed through Environment and Sustainable Resource Development's multi-stakeholder process, which involves consultation within government and among the scientific community, environmental groups, First Nations peoples, industry and the general public. The multi-stakeholder group may recommend new AAAQOs or revisions to existing AAAQOs for Environment and Sustainable Resource Development to consider and implement.

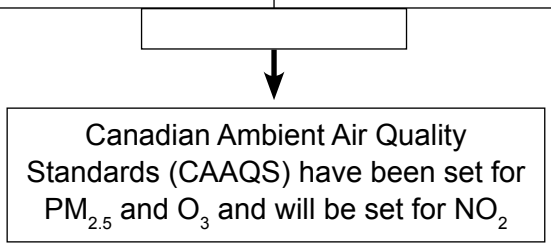
The federal government has also set hourly, 24-hour and annual National Ambient Air Quality Objectives (NAAQOs) for NO_2. CAAQS are currently being developed for NO_2 that will replace the NAAQOs and will be phased into this framework's approach as they become available.

4.3.3. Current Ambient Air Quality Objectives $PM_{2.5}$, O_3 and NO_2

There are a number of different objectives and standards to measure impacts of ambient air quality on human and ecosystem health, which are summarized in Table 3.

Table 2 Evolving Requirements for Ambient Air Quality

Provincial Policy	Nationwide Policy
Particulate Matter and Ozone	
CASA Particulate Matter and Ozone Management Framework (2003) (which uses the CWS)	Canada-Wide Standards (CWS) for $PM_{2.5}$ & O_3
Nitrogen Dioxide	
Alberta Ambient Air Quality Objectives (AAAQOs) for hourly and annual values	National Ambient Air Quality Objectives (NAAQOs) for hourly, 24-hour and annual values



4.4. Understanding Ambient Air Quality within the Region

The current ambient air quality management system focuses on measurements and responses at the local level, and in this way accounts for the variability and diversity of air quality within the South Saskatchewan Region's 83,764 km^2. The local management of air quality addresses problems where they are occurring and prevents the concerns from spreading beyond the local level.

The Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) has been established and operates as an arm's length agency reporting and accountable to the Alberta Minister of Environment and Sustainable Resource Development. The agency's purpose is to provide open and transparent access to scientific data and information on the condition of Alberta's environment. Monitoring is currently conducted by three local airshed organizations and, industry and coordinated under the direction of the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA). The Calgary Region Airshed Zone (CRAZ) and the Palliser Airshed Society (PAS) together cover more than half of the region. The Parkland Airshed Monitoring Zone (PAMZ), which largely covers the Red Deer Region, extends its southern tip into the Crossfield-Carstairs area of the South Saskatchewan Region, where it operates several passive monitoring stations. These local airshed organizations, industry and the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) operate monitoring networks around industrial sources as well as in communities to gather information about ambient air quality. The current monitoring networks within the region will be adapted as air monitoring needs change.

Table 3 Current Air Quality Objectives and Standards for $PM_{2.5}$, O_3 and NO_2

Substance	Averaging Time	Current Objective	Standard (Effective Date)
NO_2	One hour	300 µg/m^3(159 ppb)	AAAQO (2009)
	One hour	Under Review	NAAQO
	Annual	45 µg/m^3 (24 ppb)	AAAQO (2009)
	Annual	Under Review	NAAQO
O_3	One hour daily maximum	160 µg/m^3 (82 ppb)	AAAQO (2007)
	Eight-hour daily maximum*	63 ppb	CAAQS (2015)
		62 ppb	CAAQS (2020)
$PM_{2.5}$	24-hour average **	30 µg/m^3	AAAQO (2007)
		28 µg/m^3	CAAQS (2015)
		27 µg/m^3	CAAQS (2020)
	Annual average***	10 µg/m^3	CAAQS (2015)
		8.8 µg/m^3	CAAQS (2020)

* Achievement to be based on the 4th highest measurement annually, averaged over three consecutive years.

** Achievement to be based on the 98th percentile annual value, averaged over three consecutive years.

*** Achievement to be based on the 3-year average of the annual average concentrations

4.4.1. Types of Stations

Existing air monitoring was designed to monitor air quality in communities within the region as well as to monitor air quality for industrial compliance. Individual stations measure local air quality as influenced by nearby emission sources. To understand air quality within the region, air monitoring must be described with respect to what the stations were designed to monitor.

Each station, whether continuous or passive, is designed to sample and represent air quality at a specific location and for a specific purpose. Meteorological monitoring is also important and the local airshed organizations have a number of stations that collect representative sub-regional meteorological data.

4.4.1.1. Continuous Stations

Continuous air monitoring stations comprise part of the regional monitoring networks for air quality and are designed to monitor air quality both in the populated areas and around the industrial activity in the region. These stations monitor continuously on an hourly basis.

Currently, hourly data collected for NO_2, O_3, and $PM_{2.5}$ comes from community air monitoring stations. The industrial source monitoring stations collect information on substances to satisfy specific regulatory requirements.

Community Stations

Community air monitoring stations are located in populated areas and are sited to measure the ambient air quality to which people are exposed. Air quality measured at most community stations in the region is influenced by transportation emissions and emissions from local urban sources (e.g., home heating). Community stations may also be influenced by nearby industrial sources and transboundary issues.

Human activity in populated areas is the most important source of the three indicators used in this framework; therefore, community stations are the most relevant kind of stations capturing information on these substances.

Five community stations report the ambient air concentrations for several substances including NO_2, O_3, and $PM_{2.5}$ to Alberta's Ambient Air Quality Data Warehouse. The stations are Calgary Central, Calgary East, Calgary Northwest, Lethbridge and Medicine Hat, and are managed by the Calgary Region Airshed Zone, the Palliser Airshed Society and the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA). These five stations are the framework's current source of monitoring data. If stations are moved or new stations are added to the network they will be included in the framework.

Industrial Stations

Industrial source stations measure ambient air concentrations as a result of their respective industrial operations. The industrial stations tend to be associated with larger emission sources and the monitors are typically located in the areas where the highest concentrations are expected. The locations are determined through dispersion modelling. The monitoring is done to measure direct off-location impacts, conduct source attribution or analyze characteristics of air quality near a large industrial source. Short-term peaks may be more prevalent due to point-source plume impingement, which can be exacerbated by rare meteorological events. Industrial stations supply data essential to effectively determine compliance of industrial sources but this data is not useful for the purpose of determining and managing overall regional air quality. Data collected from these stations only represents the air quality near those industrial facilities; therefore this data is not used in the framework.

The industrial stations in the region are operated by individual industries and data are reported to Environment and Sustainable Resource Development. Since these stations are part of operation approval conditions, these stations basically monitor for sulphur-containing compounds such as hydrogen sulphide (H_2S) and sulphur dioxide (SO_2). One industrial station also reports NO_2 and $PM_{2.5}$ on a continuous basis.

Portable Air Monitoring Equipment

Portable air monitoring equipment is used to temporarily monitor areas of interest. Portable monitors can be used in both urban and rural areas to respond to specific complaints or simply to obtain a snapshot of air quality.

4.4.1.2. Passive Stations

Passive air monitoring stations are also part of the regional monitoring networks for air quality. They are located in more remote areas and provide information about how both point and non-point source (e.g. transportation) releases disperse within the region. They also provide data for understanding longer term effects of emissions within the region.

With passive air monitoring stations, a reactive surface on the sampler is exposed to the air, and substances are transferred from the air to the sampler surface by diffusion. Samplers are typically exposed for one month and are useful for looking at long-term trends of substances at specific locations. Since passive sampling is conducted over a longer period, short-term events (such as those occurring over an hour) may be “averaged out” and may not be detected. An advantage of a passive sampling system is that networks of samplers can be used over a large area to determine the spatial variation of ambient air concentrations. Samplers are located to enable the analysis of ecological effects and to assist with analysis of acid deposition, not to assess hourly trends in ambient concentrations or measure short-term exceedances.

The Calgary Region Airshed Zone, Palliser Airshed Society, and Parkland Airshed Monitoring Zone operate passive stations in the region. Industry operates several passive stations in the region; these stations monitor H_2S and SO_2, and they report to Environment and Sustainable Resource Development.

4.4.2. Monitoring Networks in the South Saskatchewan Region

The Calgary Region Airshed Zone, Palliser Airshed Society, Parkland Airshed Management Zone and the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) monitoring networks cover approximately 75 per cent of the region, as shown in Figure 3. Additional monitoring to meet the needs of long-term ecological monitoring programs has also been historically conducted as required. The southwest corner of the South Saskatchewan Region is not covered by a local airshed organization; however, it will continue to be included in modelling and planning that is done as part of the framework’s assessment process.

More information on the Calgary Region Airshed Zone, Palliser Airshed Society and Parkland Airshed Monitoring Zone as well as the ambient air concentrations they monitor is publicly available on their websites. These local airshed organizations report annually on their monitoring results and summarize their activities and initiatives within the region.

Table 4 summarizes the current assets of the monitoring networks in the South Saskatchewan Region.

Table 4 South Saskatchewan Region Monitoring Networks

	Continuous Stations	**Passive Stations**
Calgary Region Airshed Zone (CRAZ)	Operates three continuous stations, all in the City of Calgary, monitoring for NO_2, NO_x, NO, $PM_{2.5}$, O_3, CO and total hydrocarbons (THC)	40 passive stations
Palliser Airshed Society (PAS)	Operates one continuous station, in the City of Medicine Hat, monitoring for NO_2, NO_x, NO, $PM_{2.5}$, O_3, CO and total hydrocarbons (THC)	20 passive stations
Parkland Airshed Monitoring Zone (PAMZ)	No continuous stations located in the South Saskatchewan Region	4 passive stations in the South Saskatchewan Region
Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA)	Operates one continuous monitoring station in Lethbridge Maintains the Mobile Air Monitoring Laboratory (MAML) and a Portable Air Monitoring Station (PAML)	
Industry	Compliance continuous monitoring stations	Industry passive stations collect monthly data for SO_2 and H_2S

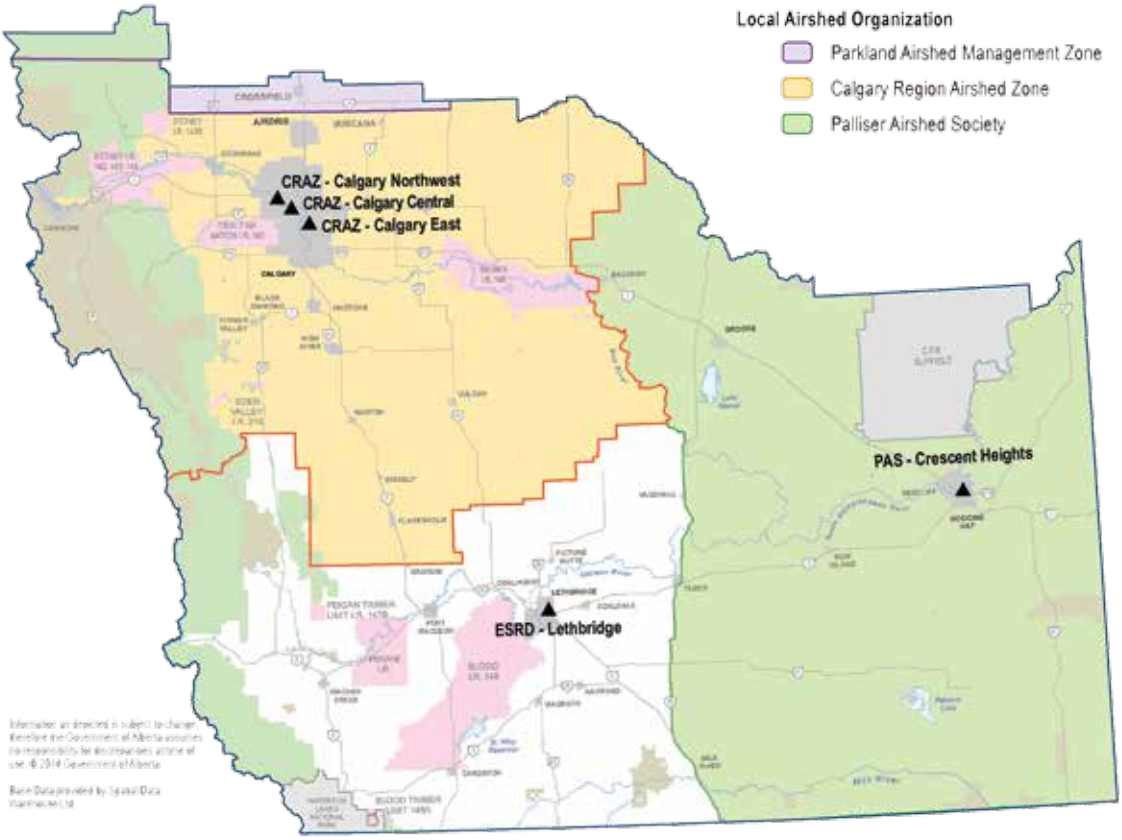


Figure 3 Local Airshed Organization and Alberta Environmental Monitoring, Evaluation and Reporting Agency Air Monitoring Stations

4.5. Managing Local Exceedances

Environment and Sustainable Resource Development will continue to respond to local exceedances of AAAQOs if they have occurred, as part of the regulatory compliance system. This includes determining the cause of the exceedance, notifying the responsible sources and affected parties and communities, and determining any requirements to prevent a re-occurrence. If an AAAQO (hourly, daily or annual) is exceeded, parties responsible for the identified source or sources (if industrial) are required to submit details of management actions aimed at preventing the event from happening again. In some situations, remedial and preventative actions may be needed to reduce releases from anthropogenic sources.

5.0 Regional Objective for Ambient Air Quality

The framework supports desired regional outcomes by setting the following regional objective for air:

Releases from point and non-point sources are managed so that they do not collectively result in unacceptable air quality.

The framework establishes ambient air quality indicators to provide information about whether or not the regional objective is being met. For each indicator – NO_2, O_3 and $PM_{2.5}$ – ambient limits, triggers and levels are set. Limits are intended to be clear boundaries that are not to be exceeded. Triggers are used as warning signals to allow for evaluation, adjustment and innovation on an ongoing basis. The levels identify where concentrations of the indicators are in relation to the triggers and limits, and have a range of management responses, which increase in stringency as the levels increase.

5.1. Identifying Key Indicators

The framework focuses on managing ambient air quality in the South Saskatchewan Region with respect to ambient air concentrations of NO_2, O_3 and $PM_{2.5}$ because these indicators:

- are three of the major substances being released or formed in the region
- are actively monitored throughout the region at community stations
- are predicted to increase with expanding development and growing populations
- have a direct relationship with issues related to human and ecosystem health
- are being detected at increasing and/or elevated levels in some areas of the region
- are regulated under the *Environmental Protection and Enhancement Act*
- have established AAAQOs and/or CAAQS
- have monitoring data in areas of concern from an air quality perspective to allow assessment of local ambient air quality against the ambient air quality triggers
- can be managed through a range of options applied to the various sources.

5.2. Setting Ambient Triggers and Limits

The data for the development of the triggers was collected by the five community stations and retrieved from Alberta's Ambient Air Quality Data Warehouse. As mentioned earlier, the indicators, triggers and limits for this framework address point and non-point emissions.

Setting ambient air quality triggers and limits for key indicators is a proactive approach to managing air quality. The triggers and limits provide the framework with a consistent, flexible, adaptable mechanism for regional integration and also align with provincial and federal strategies and guidelines.

Ambient air quality limits are based on the AAAQOs and CAAQS. As defined by the Clean Air Strategic Alliance, an AAAQO is a numerical concentration, value or narrative statement which is intended to provide protection of the environment and human health to the extent that is technically and economically feasible, and is socially and politically acceptable (CASA, 2009a). Table 3 shows the current AAAQOs and CAAQS for NO_2, O_3 and $PM_{2.5}$.

An ambient air quality limit signals the need to undertake a management response to:

- assess the ambient air quality
- determine the spatial extent of the ambient air quality issue
- identify and ensure management actions are implemented.

Ambient air quality triggers are ambient concentration values set lower than the ambient air quality limit. Triggers signal the need to undertake a management response to:

- assess the ambient air quality
- determine if there is an issue
- identify and implement management actions, if needed.

By setting triggers below the ambient air quality limits, the framework allows sufficient time to plan and react to manage air quality so as to avoid exceeding that limit.

Metrics

A metric is a system or standard of measurement used in analyzing air quality data. For each metric, the specific calculations performed on the raw data are defined (i.e., associated time-averaging period and statistical form of the values). For example, 2 metrics have been defined for $PM_{2.5}$: 24-hour concentration and annual concentration. Values are then set to define the triggers and limits for each metric. Monitoring data is analyzed according to the specifications for the relevant metrics, and compared to the trigger and limit values. The calculation of metrics for NO_2, O_3 and $PM_{2.5}$ is described in Appendices A and B.

5.2.1. Nitrogen Dioxide

The ambient air quality data for NO_2 will be analyzed using two metrics.

1. **Average of the Annual Hourly Data**, which identifies any systematic or re-occurring issues that are evident in annual average concentrations.
2. **Upper Range of the Hourly Data** (represented by the annual 99th percentile of the hourly data), which examines episodic events and helps to signal if there have been changes in peak values for a concentration of a substance.

5.2.1.1. Average of the Annual Hourly Data

Evaluation of the average of the annual hourly ambient concentrations will occur after the yearly data is gathered for each monitoring station. The limit marks the move into Level 4, and is set at the AAAQO for nitrogen dioxide. The ambient air quality triggers for Levels 2 and 3 are set at 1/3 and 2/3 of the AAAQO to provide time to plan and implement management actions to prevent the ambient concentrations from exceeding the limit. Revisions to national or provincial objectives or standards, such as the AAAQOs or any newly developed CAAQS, will result in revisions to limits and trigger values. The average of the annual hourly ambient air quality triggers and limits are shown in Table 5.

Table 5 Average of the Annual Hourly Data Ambient Air Quality Triggers and Limit for NO_2

Description	NO_2
Level 4	
Limit	45 µg/m^3 (24 ppb)
Level 3	
Trigger into Level 3	30 µg/m^3 (16 ppb)
Level 2	
Trigger into Level 2	15 µg/m^3 (8 ppb)
Level 1	

Ambient air quality triggers and limits apply at continuous air monitoring stations, as described in this framework. Limits are based upon Alberta Ambient Air Quality Objectives.

5.2.1.2. Upper Range of the Hourly Data

Represented by the annual 99th percentile of the hourly data, this second metric looks at peak concentrations that occur over the year by examining episodic events. For this metric, the trigger into Level 4 was determined using a calculation described in Appendix A. The remaining two triggers are 1/3 and 2/3 of this value. At the writing of this framework, the triggers are interim values. When the CAAQS are available for NO_2, the methodology to determine these triggers will be re-evaluated. Table 6 shows the interim triggers that are being used for the upper range of the hourly data.

Table 6 Interim Upper Range of the Hourly Data Ambient Air Quality Triggers for NO_2

Description	NO_2
Level 4	
Trigger into Level 4 *	196 µg/m^3 (104 ppb)
Level 3	
Trigger into Level 3	130 µg/m^3 (69 ppb)
Level 2	
Trigger into Level 2	66 µg/m^3 (35 ppb)
Level 1	

*This is an ambient trigger not a limit

Ambient air quality triggers and limits apply at continuous air monitoring stations, as described in this framework

5.2.2. Fine Particulate Matter and Ozone

In October 2012, Alberta endorsed the national Air Quality Management System adopting CAAQS as the new standards for $PM_{2.5}$ and O_3 that are to be achieved by 2015 and 2020, as well as provisions on monitoring and reporting of progress and activities. Thus, the CAAQS replace the CWS following similar principles to the Clean Air Strategic Alliance Particulate Matter and Ozone Framework. This framework uses those national Air Quality Management System standards and guidelines (CAAQS) as the basis for triggers and limits for $PM_{2.5}$ and O_3.

In accordance with the national Air Quality Management System, Environment and Sustainable Resource Development will perform annual assessments of $PM_{2.5}$ and O_3, following the procedures set out in the Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (CCME, 2012). Alberta will assign levels based on Table 7 for the purpose of this framework. It should be noted that as part of the national Air Quality Management System other reporting may be done for national consistency.

First reporting under the framework is anticipated be done in the year following the regional plan coming into force. This will be aligned with monitoring and reporting of progress and activities under the national Air Quality Management System.

Table 7 Action Levels, Triggers and Limits for Ozone and Fine Particulate Matter

Description	O_3 (*)	$PM_{2.5}$ 24-hour(**)	$PM_{2.5}$ annual(***)
Level 4(iv)			
Limit(i)	63 ppb	28 µg/m^3	10.0 µg/m^3
Level 3(v)			
Trigger for Level 3(ii)	56 ppb	19 µg/m^3	6.4 µg/m^3
Level 2(vi)			
Trigger for Level 2(iii)	50 ppb	10 µg/m^3	4.0 µg/m^3
Level 1(vii)			

* 8-hour averaging time, achievement to be based on 4th highest annual measurement, averaged over three consecutive years

** 24-hour averaging time, achievement to be based on 98th percentile annual value, averaged over three consecutive years

*** Achievement to be based on annual average value, averaged over three consecutive years

i CAAQS refers to this as Highest Threshold

ii CAAQS refers to this as Middle Threshold

iii CAAQS refers to this as Lowest Threshold

iv CAAQS refers to these as Actions for Achieving Air Zone CAAQS, or Red Management Level

v CAAQS refers to these as Actions for Preventing CAAQS exceedances, or Orange Management Level

vi CAAQS refers to these as Actions for Preventing Air Quality Deterioration, or Yellow Management Level

vii CAAQS refers to these as Actions for Keeping Clean Areas Clean, or Green Management Level

6.0
The Management System

This framework brings the following elements to the existing system:

- establishment of a regional objective for ambient air quality
- identification of key indicators for that objective
- setting of ambient air quality triggers and limits for those indicators with associated ambient air quality levels
- identification of a management response that will be initiated if triggers and limits are exceeded and concentrations of indicators moves from one air quality level to another
- alignment with the national Air Quality Management System's four ambient air quality levels, thresholds and management response
- adaptability to respond to major changes in air quality, and accommodate the need for modifications to the management approach that may arise
- description of roles and responsibilities for government, monitoring associations and emitters
- integration, robustness and consistent management approach between and among the province's different regions.

Elements from the framework will be included in the South Saskatchewan Regional Plan and will be implemented as part of the plan with legal force as provided by the *Alberta Land Stewardship Act*.

Management of non-point sources is inherently complex: it is an inter-governmental and cross-jurisdictional issue. Point and non-point sources of emissions come together in the South Saskatchewan Region to contribute to ambient concentrations and must be understood to ensure that appropriate actions are taken. Benefits of cumulative effects management are that cumulative sources in the region are examined and understood. The framework adds the opportunity for collective direction and commitment to manage point and non-point sources and for coordinating management actions already underway. These opportunities allow for more overall effective and efficient management.

Implementation of this framework requires annual assessment and evaluation of the ambient air quality conditions. The Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) will prepare this assessment by using data from the network of air monitoring stations to evaluate ambient concentrations of NO_2, O_3 and $PM_{2.5}$ in relation to the ambient air quality levels.

6.1. The Purpose of Assigning Ambient Air Quality Levels

The purpose of assigning ambient air quality levels to monitoring stations under the framework is to identify where NO_2, O_3 and $PM_{2.5}$ ambient concentrations are in relation to the defined ambient air quality triggers and limits. These ambient air quality levels are described Table 8.

Ambient air quality levels are assigned to individual stations based on the NO_2, O_3 and $PM_{2.5}$ metrics and comparisons with triggers and limits.

Triggers associated with the lower levels provide time to address ambient concentrations, and by management response, to avoid exceeding the ambient air quality limits for NO_2, O_3 and $PM_{2.5}$.

The management system aims to prevent ambient air concentrations from approaching or exceeding the limit by proactively managing the sources or influences. Once ambient air quality levels are assigned, the main influences can be identified, and any required mitigative management actions can be chosen.

It is possible for an area to be assigned an air quality level and need management actions one year, then fall below an ambient air quality trigger, and thus into a lower level, the next year. In this case, management actions will still be carried out; however they may be modified accordingly, as determined by Environment and Sustainable Resource Development. Management actions are meant to be flexible, taking into consideration the concentration trends, the air monitoring station in question and the magnitude of indicator concentration above the ambient air quality triggers.

The interim upper range of hourly data triggers for NO_2 are used to understand peak concentrations of ambient air quality. The description and management intent vary from the average metrics and are described in Table 9. Higher level triggers signal a need to plan and implement actions to reduce the probability that the hourly AAAQO will be exceeded during peak events.

6.2. Management Response

The terms management response and management action have distinct meanings in the context of this management framework. The management response is a set of steps that will be undertaken (all or in part) if the data shows that an ambient air quality trigger or limit has been exceeded. Part of the management response is determining the need for management actions. Management actions become more stringent as stations are assigned to higher ambient air quality levels.

The management response begins with verifying whether an ambient air quality trigger or limit has been exceeded. Depending on the findings of assessment and investigation, determinations are made about contributing sources and the need for

Table 8 Description and Management Intent for Average of Annual Hourly Data for NO_2 and the $PM_{2.5}$ and O_3 Ambient Air Quality Levels

Level	Description	Management Intent
4	Ambient air quality exceeding the air quality limit	Improve ambient air quality to below the limit
Limit		
3	Ambient air quality below but approaching the air quality limits	Proactively maintain air quality below the limit
Trigger into Level 3		
2	Ambient air quality below air quality limits	Improve knowledge and understanding, and plan
Trigger into Level 2		
1	Ambient air quality well below air quality limits	Maintain air quality through standard regulatory and non-regulatory approaches

Table 9 Description and Management Intent for Upper Range of the Hourly Data Ambient Air Quality Levels for NO_2

Level	Description	Management Intent
4	Peak ambient air quality concentrations are likely exceeding the hourly objective	Reduce probability that hourly objectives are exceeded during peak events
Trigger into Level 4		
3	Peak ambient air quality concentrations may be approaching or exceeding the hourly objective	Maintain air quality to reduce probability that objectives are exceeded during peak events
Trigger into Level 3		
2	Peak ambient air quality concentrations below hourly objective	Improve knowledge and understanding, and plan
Trigger into Level 2		
1	Peak ambient air quality concentrations well below hourly objective	Maintain air quality through standard regulatory and non-regulatory approaches

management actions. When a trigger is exceeded, varying options are considered, depending on the trigger exceeded and the trend over consecutive years. Management actions will be place-based, designed to avoid exceeding the limit and focused on maintaining or improving air quality. If an ambient limit is exceeded, there is a commitment that steps will be taken to return to conditions below the ambient limit. To confirm that desired outcomes are met, Environment and Sustainable Resource Development provides oversight of management actions, evaluates the effects of implementation, and communicates progress toward meeting regional outcomes.

The system described below includes the Government of Alberta management response and describes the management tools from which regulators, in collaboration with relevant parties, can select appropriate place-based management actions to address specific circumstances.

It should be noted that this management response does not replace other responses that are taken as part of ensuring compliance under the environmental regulatory system.

6.2.1. Verification

The Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) will conduct an annual assessment of ambient air quality data gathered from continuous ambient air monitoring stations in the region. Data is downloaded from Alberta's Ambient Air Quality Data Warehouse and checked for accuracy and completeness. Once the data have been verified, the air quality metrics that will be used to assess ambient conditions relative to triggers and limits are calculated.

- For NO_2 ambient air quality data is analyzed with respect to both the annual average and the upper range of hourly data. Using two metrics, described in Appendix A, provides different signals about change in ambient air quality and the need to undertake a management response.
- For $PM_{2.5}$ and O_3, data are analyzed according to the Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (CCME, 2012), as described in Appendix B.

6.2.2. Preliminary Assessment

Once the ambient air monitoring data is verified, and the necessary metrics are calculated as described in Appendices A and B, the results are compared to ambient air quality triggers and limits. This includes ensuring that rare events or natural circumstances that cannot be controlled through emissions management (e.g., forest fires) are understood as part of the annual assessment.

Figure 4 Management Response

- Appendix C describes a process to analyze episodes and to demonstrate what influenced an exceedance for NO_2 that could be used to help understand what rare events or natural circumstances may have contributed to an exceedance.
- For $PM_{2.5}$ and O_3, accounting for transboundary flows and exceptional events will be done according to the Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (CCME, 2012a), as summarized in Appendix B.

The assessment of NO_2, O_3 and $PM_{2.5}$ data in the South Saskatchewan Region will be performed on an annual basis. The ambient air quality levels are described in terms of the metrics associated with each indicator and comparison with ambient triggers and limits as well as details regarding the purpose of the air monitoring station and what it is measuring. The ambient air quality triggers and limits are consistent for all station locations; however, management actions and tools are place-based.

If any station in the planning region exceeds the ambient air quality trigger or limit a management response will be initiated by Environment and Sustainable Resource Development. The process then continues onto the following steps as required.

6.2.3. Investigation

The first part of the investigation is to review the ambient air quality levels with respect to expectations for the region. Development occurring within the region will contribute to ambient concentrations of NO_2, O_3, and $PM_{2.5}$. The concentrations should be compared to predictions from modelling to understand whether the ambient concentrations are trending as predicted. This assessment helps to determine the extent of the investigation and whether previous plans and initiatives are having their anticipated effects on ambient concentrations. If ambient concentrations are increasing faster than expected, or in areas where increases were not predicted, these factors will assist in determining management actions.

Another part of the investigation is to identify the natural and anthropogenic sources that are responsible for the exceedance. Episode analysis (Appendix C) is one technique that may be used and may highlight a need for management actions such as the placement of additional monitoring, compilation of emissions inventories, and analyzing monitoring data for trends.

Ambient air quality characterization and source attribution are challenging at community monitoring stations, as these can be influenced by urban, transportation, industrial and other anthropogenic emissions. Source attribution is further challenged by the nature of the secondary formation of ozone and fine particulate matter in the region. A wider range of parties (including the public, industry, non-governmental groups and various orders of government) would likely be engaged to understand the regional issue and explore options to address the ambient concentrations.

6.2.4. Mitigative Management Actions

Once ambient air quality levels have been assigned and the primary sources and spatial extent have been defined, the need for mitigative management actions is determined and the appropriate management actions are chosen by Environment and Sustainable Resource Development. Before determining the need for a management action, Environment and Sustainable Resource Development will review whether other initiatives are taking steps to address the issue.

Relevant parties may be invited to collaborate on identifying and implementing management actions. If upon analysis, the ambient air quality level has been attributed to natural events (such as wildfire) or transboundary transport, this will be taken into consideration when management actions are chosen. If natural sources are deemed to be the main influence of ambient concentrations at a particular station, no additional management action may be required.

6.2.4.1. Level 1

In Level 1, ambient air quality conditions are well below air quality limits. Management includes operation of the existing regulatory system and ensuring ambient air quality monitoring is conducted and results reported. Policies such as pollution prevention, continuous improvement and use of best available technology are applied. Degradation is avoided or minimized wherever reasonable through employing appropriate technology and the use of non-regulatory management approaches. For non-point sources, non-regulatory approaches such as education and awareness activities occur.

6.2.4.2. Level 2

In Level 2, ambient air quality conditions are below air quality limits. Level 2 management actions may involve determining the need for and placement of additional monitoring, the use of modeling, compilation of emissions inventories and analyzing monitoring data for trends. If management actions are deemed necessary, Environment and Sustainable Resource Development will define implementation timelines, tools and parties to be involved in management actions by considering the ambient air quality levels and magnitude of trends as well as the type, location and number of air monitoring stations measuring those trends.

6.2.4.3. Level 3

In Level 3, ambient air quality conditions are below but approaching air quality limits. Appropriate management actions for Level 3 may be required to ensure that the ambient air quality limit is not exceeded. Environment and Sustainable Resource Development will identify the urgency and need for measures and if they are deemed necessary, define implementation timelines, tools and parties to be involved in management actions by considering the ambient air quality levels and magnitude of trends as well as the type, location and number of air monitoring stations measuring those trends.

6.2.4.4. Level 4

In Level 4, the ambient air quality conditions have exceeded either the air quality limit or the Level 4 trigger. Mandatory actions are required so that the limit is no longer exceeded or in the case of the upper range of data metric, exceedances of the hourly AAAQO are avoided. The limit is not considered to be a “pollute-up-to level,” but a marker for stringent management actions. Environment and Sustainable Resource Development retains the responsibility to implement an emissions reduction plan for the affected area. This will include identifying the parties to be involved in the plan as well as the timelines required to achieve the reductions necessary to get below the ambient air quality limit.

6.2.4.5. Range of Mitigative Management Actions, Measures and Tools Available

Management actions become more stringent as the ambient air quality level increases. They include a range of measures and tools with varying degrees of rigour and are meant to be flexible to consider the magnitude of the exceedance above an ambient air quality trigger. If trends are downward and the concentration level is close to the trigger value, actions taken may not need to be extensive; whereas if there are upward trends or the level is approaching the next ambient air quality trigger or limit, actions taken may be more significant.

Table 10 lists potential measures and tools that could be used to manage ambient air quality as part of the management framework. The lists are not exhaustive, but rather can be used as a range of options for selection to manage ambient air quality as appropriate. Some of the more restrictive tools would typically be used at the higher air quality levels, but depending on the specific situation, Environment and Sustainable Resource Development and the parties involved may choose the tools that are deemed most effective. Management actions may require amendments to existing approvals. These amendments would be made in accordance with existing authority under the *Environmental Protection and Enhancement Act* including Director-initiated amendments to monitoring or reporting requirements, or amendments arising from unforeseeable effects.

An example of a management action that is currently being undertaken is the Calgary Region Airshed Zone Particulate Matter and Ozone management plan. In November 2006, Environment and Sustainable Resource Development notified the Edmonton, Calgary and Red Deer census metropolitan areas of the need to develop ambient air quality management plans. This was in response to the 2001-2003 particulate matter and ozone assessment, which placed these three regions in a “management action level” for ozone under the provincial Particulate Matter and Ozone Management Framework. The Calgary Region Airshed Zone developed, and released in 2009, a management plan for the Calgary Metropolitan area (CRAZ, 2009) and implementation of the plan is ongoing.

Table 10 List of Potential Measures and Tools for Ambient Air Quality Management

	Potential Management Level for Tool Application			
Potential Measures and Tools	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Education and awareness	x	x	x	x
Beneficial management practices	x	x	x	x
Ambient air quality management plan	x	x	x	x
Approval conditions or restrictions	x	x	x	x
Approval conditions to participate in local airshed organizations, regional initiatives	x	x	x	x
Director-initiated approval amendments (in accordance with authority under EPEA)	x	x	x	x
Codes of practice	x	x	x	x
Economic instruments	x	x	x	x
Additional regional monitoring	x	x	x	x
Air modelling	x	x	x	x
Enforcement of regional, municipal and local programs and plans	x	x	x	x
Municipal bylaws, First Nations bylaws	x	x	x	x
Revise policies, performance standards for new or existing sources		x	x	x
Introduce new mechanisms for managing non-regulated sources		x	x	x
Emission caps including mechanisms for management (i.e., trading)			x	x
More stringent performance standards or regulations			x	x
Emission reduction requirements to allow for new sources			x	x
Restrictions on further emission sources				x

6.2.5. Oversight/Delivery of Management Actions

Environment and Sustainable Resource Development will identify the appropriate parties to be involved in the development and implementation of management actions. There will be shared responsibility amongst these parties to make sure the actions are taken. Environment and Sustainable Resource Development will ensure that any changes in regulatory requirements or management approaches that are needed are undertaken, and will serve in an oversight role for actions being taken by other parties.

6.2.6. Assess Implementation Effectiveness

As implementation of management actions moves forward, it is important to evaluate the effectiveness of those actions. Each year, when the annual analysis and reporting on the assignment of levels is done, the status of ambient air quality conditions (i.e., the assigned level) will be a key measure of the effectiveness of the management actions. It should be recognized however that it may take some time for the effects of management actions to be seen, especially when non-point sources of substances are involved. Other monitoring, modeling and reporting will also be used, as appropriate, to help understand and evaluate the status of ambient environmental conditions and in turn the effectiveness of management actions.

6.2.7. Communication

Communication and transparency are underlying principles of the framework. Providing information about ambient conditions, any management responses that have been initiated, and management actions being taken are essential under the framework. The Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) will prepare and release annual assessment reports. Environment and Sustainable Resource Development will prepare and release reports on management responses, and will communicate with key parties and the public on an ongoing basis. The reports on management responses will be developed with consideration for consistency with reporting done for other management frameworks within the region, and at the provincial and national levels. The contents and details of the reports will be determined as part of implementation of the management framework.

6.2.8. Modelling: A Tool for Assessment and Planning

Air quality modelling is a very useful tool to support air planning. Air dispersion models use a set of scientific equations to describe and simulate the dispersion, transformation and deposition of substances emitted into the atmosphere. Models can address substances that are non-reactive or which account for chemical transportation processes, and are applied either on a local (within 50 km of a source) or on a regional basis. There are a variety of different dispersion models and their application depends on the modelling objective. For example, air dispersion modelling can describe the current state of an airshed, predict the impact of various

activities and development plans on the ambient air quality, and test the effects of potential air management strategies to determine the most effective mitigative management actions.

Regional air quality modelling to support the South Saskatchewan Regional Plan was completed in April 2012. The study developed modelling inputs for the Community Multiscale Air Quality (CMAQ) modelling system for the 2006, 2007 and 2008 base years and two future year emission scenarios (2020 and 2050). The CMAQ model is being used to understand the spatial distribution of predicted concentrations and to estimate the contributions of local sources to air quality and deposition in the South Saskatchewan Region and its vicinity.

Other dispersion modelling studies are undertaken by proponents and operators when completing Environmental Impact Assessments and industrial approval applications. These studies are used to evaluate the effect of proposed facilities or modifications to existing facilities on ambient air concentrations. This modelling function will continue as part of the regulatory process and results will be considered by Environment and Sustainable Resource Development in the context of the framework to understand the relative impacts of proposed projects on ambient concentrations in the region.

While modelling results will not be used to determine into which ambient air quality level a given area or station falls, they may be used for investigation and planning. Table 11 outlines the uses for modelling.

Table 11 Use of Modelling Results for Assessment and Planning

Level	Use of Modelling
4	Modelling to be used as planning tool as in Level 2 and 3, but also: Understand relative influences for reduction plans
3	As in Level 2, but also: Determine source attribution for increasing trend, forecast future trends
2	Assess data and model for accuracy Assess monitoring data, if available to validate model and baseline data Refine emissions inventory for area, transboundary and point sources Determine source attribution of increased ambient levels Assemble forecast emission profiles (e.g., growth, decline or steady state) to determine monitoring needs Plan for monitoring needs Analyze trends to determine urgency of management actions
1	Report and track

7.0 Implementation

This framework will be implemented and come into force when the South Saskatchewan Regional Plan has been approved by Cabinet. Environment and Sustainable Resource Development will provide leadership for the implementation of the framework, and, in keeping with the key principle of involving partnerships, will work with relevant parties to:

- Confirm roles and responsibilities of government and other parties for implementation of the framework; and
- Conduct ongoing evaluation of the framework's alignment with other policies and initiatives to ensure consistency of management intent and process. This will include evaluating the effectiveness of the framework in meeting the air quality objective for the South Saskatchewan Region and updating the framework as necessary.

7.1. Roles and Responsibilities

Environment and Sustainable Resource Development, the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA), the Alberta Energy Regulator, environmental and community groups and associations, and emitters and project proponents all have a number of responsibilities related to managing emissions and ambient air quality. These roles and responsibilities are described only briefly in the context of the framework, so should not be regarded as an exhaustive list. Roles and responsibilities will be further clarified as they continue to evolve.

7.1.1. Environment and Sustainable Resource Development

Environment and Sustainable Resource Development is responsible for ensuring the framework is implemented, but collaboration and engagement of stakeholders and aboriginal people remain key to the overall management intent. Environment and Sustainable Resource Development also:

- is responsible for initiating a management response when required based on the assessment of data and other approaches such as forecasting future development (e.g., spatial, temporal)
- identifies the role of stakeholders and aboriginal people for management planning and actions. If a multi-stakeholder process is required by the framework, the use of established multi-stakeholder groups will be considered
- assesses management actions implemented through other frameworks or initiatives to determine impacts on ambient air quality

- defines timelines and selects or recommends management approaches and tools, if required, to manage ambient air quality
- ensures management approaches are implemented
- communicates to stakeholders and aboriginal people the implementation status and selected management action
- maintains and supports collaborative partnerships.

7.1.2. Alberta Environmental Monitoring, Evaluation and Reporting Agency

Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) operates as an arm's length agency reporting and accountable to the Alberta Minister of Environment and Sustainable Resource Development. The purpose of the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) is to provide open and transparent access to scientific data and information on the condition of Alberta's environment to inform policy makers, regulators, planners, researchers, communities, industries and the public. In the context of this framework, the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) is responsible for annual review and assessment of ambient air quality data. They will also undertake additional monitoring to support the management response.

7.1.3. Collaborative Approaches

Collaborative approaches through the Clean Air Strategic Alliance (CASA) and local airshed organizations have been important in the province and the region for effective ambient air quality management. As the national Air Quality Management System continues to be implemented in Alberta, it is important to continue to support and maintain effective partnerships and collaborative approaches in the region.

7.2. Integration

This management framework is part of a series of management frameworks developed by Environment and Sustainable Resource Development in support of the Government of Alberta's South Saskatchewan Regional Plan. As the regional plan is implemented, all of its outcomes and objectives, including those for air, surface water, groundwater and biodiversity, will be considered in planning and decision-making for the region by all provincial government departments and municipal governments. This will help to drive integration across environmental media.

8.0

Abbreviations and Acronyms

Abbreviation/Acronym	Description
AAAQO	Alberta Ambient Air Quality Objective
ESRD	Alberta Environment and Sustainable Resource Development
AEMERA	Alberta Environmental Monitoring, Evaluation and Reporting Agency
ALSA	*Alberta Land Stewardship Act*
AQMF	Air Quality Management Framework
AQMS	(National) Air Quality Management System
BATEA	Best Available Technology Economically Achievable
CAAQS	Canadian Ambient Air Quality Standards
CASA	Clean Air Strategic Alliance
CCME	Canadian Council of Ministers of the Environment
CFO	Confined Feeding Operation
CO	Carbon Monoxide
CRAZ	Calgary Region Airshed Zone
CWS	Canada-wide Standard
EPEA	*Environmental Protection and Enhancement Act*
GoA	Government of Alberta
H_2S	Hydrogen Sulphide
LAR	Lower Athabasca Region
LARP	Lower Athabasca Regional Plan
LUF	Land-use Framework
NH_3	Ammonia
NO_2	Nitrogen Dioxide
NO_x	The family of nitrogen oxide compounds
O_3	Ozone
PAMZ	Parkland Airshed Management Zone
PAS	Palliser Airshed Society
PM	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter (smaller than 2.5 microns)
SO_2	Sulphur Dioxide
SSR	South Saskatchewan Region
SSRP	South Saskatchewan Regional Plan
TSP	Total Suspended Particulates
VOCs	Volatile organic compounds
ppb	Parts per billion
$\mu g/m^3$	Micrograms per cubic meter

9.0 Terminology

Air Quality
The composition of air, with respect to quantities of substances therein, and/or a measure of the health-related and visual characteristics of the air; used most frequently in connection with standards against which the contribution of the particular source can be compared.

Air Quality Objective
A numerical concentration, value or narrative statement which is intended to provide protection of the environment and human health to the extent that is technically and economically feasible, and is socially and politically acceptable. (CASA, 2009a)

Local airshed organization
Regional partnership associations that include government, industry, environmental groups and the general public. These partnerships are responsible for air quality monitoring and, in some cases, air quality management for a specific region of Alberta. Alberta presently has nine local airshed organizations. (CASA, 2009b)

Air Zone
Air zones are geographic areas identified through the national Air Quality Management System and are meant to facilitate effective air quality management at a local scale. In Alberta, the air zones align with the regional Land-use Framework boundaries.

Alberta's Ambient Air Quality Data Warehouse
Alberta's central repository for ambient air quality data collected in the province, made available online to the public. Currently known as the CASA Data Warehouse.

Ambient Air
Outside air; any portion of the atmosphere not confined by walls and a roof to which the general public has access.

Anthropogenic
Caused by human activity.

Canadian Ambient Air Quality Standards (CAAQS)
Ambient air quality standards applied across Canada that are designed to provide a uniform measure of protection for human health and the environment.

Fine Particulate Matter

Fine particulate matter refers to airborne solid or liquid particles that are 2.5 microns or less in diameter. It is either emitted directly (primary PM) or formed in the atmosphere from precursor emissions (secondary PM). Important precursors of secondary PM are nitrogen oxides, sulphur dioxide, ammonia, and volatile organic compounds. The chemical composition of articles can vary widely and depends on location, time of year, and weather.

Nitrogen Dioxide (NO_2)

Toxic pungent reddish-brown gas formed by the reaction of atmospheric ozone with the nitric oxide produced from combustion.

Nitrogen Oxides (Oxides of Nitrogen, NO_x)

A general term pertaining to compounds of NO, NO_2, and other oxides of nitrogen. Nitrogen oxides are typically created during combustion processes and are major contributors to smog formation and acid deposition.

Ozone (O_3)

Ozone is a chemical whose effect on the environment is either beneficial or detrimental depending on where it occurs. Stratospheric ozone (the layer of the earth's atmosphere above the troposphere, extending to about 50km above the earth's surface) protects us from the sun's UV light, but tropospheric ozone (the lowest region of the atmosphere, extending from the earth's surface to a height of about 6-10km), can be toxic. Ozone is a highly reactive, colourless gas that is normally present in the troposphere as a result of naturally occurring photochemical and meteorological processes. It has a sharp, clean odour that can often be detected around running electric motors, after lightning storms, and around new mown hay.

Source (of Emissions)

There are many sources of emissions, but these have generally been grouped into two categories: emissions from point and non-point sources. A point source is a stationary location or fixed facility from which substances are discharged; e.g., a smokestack. A non-point source is a pollution source that is not recognized to have a single point of origin. Common non-point emission sources are agriculture, forestry, urban, mining, construction, and city streets. (CASA, 2009a)

Sulphur Dioxide (SO_2)

A colourless gas that is formed primarily by the combustion of fossil fuels containing sulphur. Sour gas processing plants, oil sands processing plants and coal-fired power generating plants are major sources of SO_2.

Transboundary (Transport)

The long-range movement of emissions and substances across political or pre-determined spatial borders. Transboundary pollution refers to substances that originate in one jurisdiction, but have adverse effects in another area/jurisdiction at such a distance that it is not generally possible to distinguish the contribution of individual emission sources or groups of sources. (CASA, 2009b)

10.0
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11.0
Appendices

Appendix A: Determination of the Interim NO_2 Triggers and Calculation of NO_2 Metrics

A.1: Determination of the Interim Upper Range of the Hourly Data Triggers for NO_2

Ambient air quality triggers for both the annual average and the upper range of the hourly data are used to initiate a more detailed review of the sources and conditions that have contributed to the ambient concentrations. The ambient air quality triggers are designed so appropriate actions can be planned and implemented to prevent the ambient air quality limits, or AAAQOs, from being exceeded. The interim upper range of the hourly data ambient air quality trigger, therefore, will be used to plan and implement actions to reduce the probability that the hourly AAAQO will be exceeded.

The upper range of data in this case is represented by the 99th percentile. The 99th percentile is often used by scientists to represent the peak value in a dataset. For ambient air quality data, the annual 99th percentile one-hour value is the concentration that is higher than 99 per cent of the one-hour concentrations recorded throughout the year. In other words, only 1 per cent of the ambient hourly concentrations observed during the year fall above the 99th percentile concentration. Scientists often find the 99th percentile concentration more useful in tracking trends than the single, maximum value because the maximum hourly value often represents outlying conditions.

To determine the upper range of the hourly data ambient air quality trigger into Level 4, a dataset with multiple hourly AAAQO exceedances could be used to understand the relationship between the AAAQO and the 99th percentile. However, exceedances of the hourly AAAQO for NO_2 have not occurred at all of the South Saskatchewan Region's air monitoring stations. In fact only three exceedances of the AAAQO occurred between 2004 and 2012, all at the Calgary East station in 2005.

Instead, the upper range of the hourly data ambient air quality triggers were determined based on the ratio between historical 99th percentile ambient concentrations of NO_2 and the maximum hourly concentrations (see equation on page 46).

$$Trigger_n = \left(\left(\frac{1}{m}\sum_{i=1}^{m}\left(\frac{\mathrm{p}}{\mathrm{Max}}\right)\right)\right) AAAQO \; x \; \frac{\mathrm{n}}{3}$$

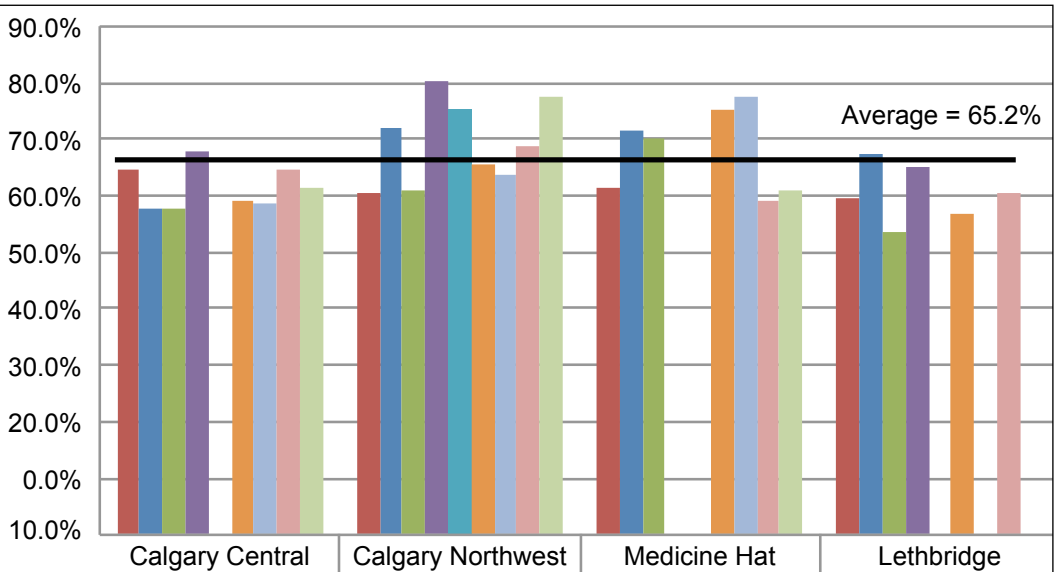
Where:
$Trigger_n$ is the nth trigger,
n ranges from 1 to 3,
p is the 99th percentile,
Max is the maximum one hour concentration,
m equals the number of years multiplied by the number of stations,
AAAQO is the one-hour average AAAQO for the contaminant being assessed.

The relationship between the 99th percentile ambient air concentration and the maximum hourly concentration varies from location to location and from year to year. This is due to the variation in emission sources by location and throughout time. The ratio between the 99th percentile and the maximum hourly concentration was examined for each station in the region to develop the regional upper range of the hourly data triggers. An average of the ratio of the 99th percentile and the maximum hourly concentration was taken across all stations in the region and all years of record (2004-2012). This average relationship was then multiplied by the current hourly AAAQO for NO_2 to calculate the trigger into Level 4. To be an effective planning tool, there should be no or very few exceedances of the hourly AAAQO at the air quality trigger for Level 3. If the ambient air quality trigger is exceeded for Level 4, exceedances of the hourly AAAQO are likely to have occurred. Hourly NO_2 values, and the circumstances surrounding these values, will be reviewed during the annual assessment if Level 3 or 4 is triggered.

Figure A1 shows the ratio of the annual 99th percentile to the maximum one hour concentrations for the continuous air monitoring stations in the South Saskatchewan Region for each year from 2004-2012. The fractions calculated for Calgary Central, Calgary Northwest, Medicine Hat and Lethbridge stations were averaged to provide a fraction to represent the South Saskatchewan Region. Note: The Calgary East monitoring station was not used in the calculation because it was decommissioned in 2011. It did not meet national siting criteria and was deemed non-representative of ambient air quality. The station has been relocated to a more representative location of ambient air quality and will begin collecting data in 2014.

The average fraction of the 99th percentile compared to the maximum hourly concentrations is 65.2 per cent. Multiplying the current NO_2 hourly AAAQO of 159 ppb by 65.2 per cent gives 104 ppb, which is used as the trigger into Level 4. Levels 3 and 2 are then calculated as 2/3 and 1/3 of the trigger into Level 4, respectively. The trigger into Level 2 is 35 ppb and the trigger into Level 3 is 69 ppb.

The trigger levels resulting from this method were reviewed to ensure that the triggers met the intent of the framework. Levels that would be assigned to each monitoring station based on analysis of historical data align with the current understanding of air quality at each respective station. For example, stations with hourly concentrations well below the AAAQO fell in Level 2 or Level 1.



	Calgary Central	Calgary Northwest	Medicine Hat	Lethbridge
2004	64.8%	60.5%	61.4%	59.6%
2005	57.7%	71.9%	71.7%	67.4%
2006	57.5%	60.8%	70.3%	53.7%
2007	67.9%	80.4%	*	65.2%
2008	*	75.0%	*	*
2009	59.0%	65.5%	75.1%	56.6%
2010	58.5%	63.9%	77.6%	*
2011	64.5%	68.7%	59.3%	60.7%
2012	61.5%	77.4%	60.9%	*

*Dataset did not meet completeness requirements

Figure A1: Ratio of the Annual 99th Percentile and the Maximum Hourly NO_2 Concentrations for the years 2004-2012 for continuous stations in the South Saskatchewan Region

A.2: Calculation of NO_2 Metrics

The methodology for annual assessment against NO_2 triggers for the South Saskatchewan Region is similar to that used for the Lower Athabasca Region Air Quality Management Framework. The two metrics used to analyze the ambient air quality data for NO_2 are described below.

Calculation of Metrics for Assessing the Average of the Annual Hourly Data

The annual metrics are calculated by first downloading hourly NO_2 data from Alberta's Ambient Air Quality Data Warehouse. The arithmetic mean is then taken for all hourly values for the year, for each station.

The annual average is then compared to the ambient air quality triggers in Table 5 of the management framework.

Calculation of Metrics for Assessing the Upper Range of the Hourly Data

The same hourly NO_2 data that is used for calculating the annual metrics is used for calculating the upper range of the hourly data metrics.

The upper range of the hourly data is represented by the 99th percentile of the hourly data. The 99th percentile of the hourly average concentrations is calculated for each station and compared to the ambient air quality triggers in Table 6 of the management framework.

Notes on Data Handling

Ambient air quality monitoring stations occasionally have disruptions in data acquisition due to planned maintenance, power outages or equipment failures. In addition, monitoring requirements may change over time and result in monitoring stations being decommissioned, moved or added to the network. Due to these circumstances, the ambient air quality data set may not be 100 per cent complete for any given calendar year of operation at a single monitoring site.

The hourly NO_2 data is checked for data completeness on an annual basis. An annual data set of one-hour average concentrations, at each individual station, is considered complete when each season contains valid hourly data at least 75 per cent of the time. If all four seasons meet this criterion, then data from that station for the particular year is considered complete. Data not meeting the data-completeness criteria are not included in the dataset. The seasons are identified as follows:

Spring: March, April and May
Summer: June, July and August
Fall: September, October and November
Winter: December, January and February

Monitoring stations can be added and removed from the network from year to year. As new stations are added, and data completeness criteria are met, they may be included in the management framework and the assessment process.

Notes on Rounding

The NO_2 levels are presented in rounded whole numbers or to one part per billion (ppb). The following procedures are used to round fractions to whole numbers:

(a) Numbers with first decimal ≥ .5 will be rounded upward

(b) Numbers with first decimal < .5 will be rounded downward

The assignment of an ambient air quality level to a station under the framework will also be based on whole numbers. This is done to be clear about assigning an action level to a station.

For example, the annual ambient air quality limit for NO_2 is 24 ppb. In order to exceed this limit, a station must have an annual average greater than 24 ppb. An annual average of the hourly values for NO_2 of 24.459 ppb would be rounded to and reported as 24 ppb and assigned to Level 3 which is below the limit. An annual average of the hourly values for NO_2 of 24.557 ppb would be rounded to and reported as 25ppb and assigned to Level 4 which is above the limit.

Appendix B: Canadian Ambient Air Quality Standards (CAAQS) for Fine Particulate Matter and Ozone

This appendix provides a summary of the determination of achievement of the fine particulate matter and ozone CAAQS, as part of the national Air Quality Management System.

In the fall of 2012, Canadian jurisdictions agreed to begin implementing a new national Air Quality Management System. As part of this system, the Canadian Ambient Air Quality Standards (CAAQS) were introduced for fine particulate matter ($PM_{2.5}$) and ground level ozone (O_3) and replace the Canada-wide Standards (CWS) for these substances. The CAAQS consist of increasingly stringent values to be achieved in 2015 and 2020, respectively, as outlined in Table B1.

Table B1: Fine Particulate Matter and Ozone CAAQS (source CCME, 2012a)

Pollutant	Averaging time	Standards (concentration)		Metric
		2015	2020	
$PM_{2.5}$	24-hour (calendar day)	28 µg/m^3	27 µg/m^3	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
$PM_{2.5}$	Annual (calendar year)	10.0 µg/m^3	8.8 µg/m^3	The 3-year average of the annual average concentrations
O_3	8-hour	63 ppb	62 ppb	The 3-year average of the annual 4th highest daily maximum 8-hour average concentrations

This framework incorporates the CAAQS as the ambient air quality triggers and limits for $PM_{2.5}$ and O_3 in the South Saskatchewan region. The 2015 values are used in this framework; however, Environment and Sustainable Resource Development will review and update the framework over time to incorporate other policies that are developed or revised at a regional, provincial or national level. This may include the use of the CAAQS established for 2020.

These standards are the indicated concentration numbers, but they have an associated time-averaging period and a statistical form that is described by the metric in Table B1 (CCME 2012a). To compare the measured concentrations of $PM_{2.5}$ and O_3 to a given standard, the concentrations have to first be transformed into the same metric as the corresponding standard. For example, for $PM_{2.5}$ there is both a 24-hour standard and an annual standard; for ozone there is only an 8-hour standard (CCME, 2012a).

The Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (CCME, 2012a) sets out the methodologies, procedures and requirements that need to be satisfied in order to determine CAAQS achievement status and ensure consistent reporting across the country. Annual assessments for the South Saskatchewan Region Air Quality Management Framework will follow the procedures outlined in this document.

The ambient $PM_{2.5}$ and O_3 concentrations measured at a monitoring station may be influenced by the local anthropogenic sources as well as sources of various other origins. Other origins include transboundary flows or exceptional events (CCME, 2012a). The CCME Guidance Document further defines these influences and the approach that is applied to account for them.

The CCME also recommends that annual reporting include a section that provides the air zone metric values (in Alberta, the air zones are equivalent to the regional plan boundaries) and achievements status for each CAAQS. All metric values will be reported based on the actual $PM_{2.5}$ and O_3 concentrations (i.e. without the removal of the transboundary flows or data influenced by exceptional events). As applicable, provinces and territories can indicate that a given standard would have been achieved if not for these influences (CCME, 2012a).

Appendix C: Episode and Data Analysis

This appendix describes the process that could be applied as part of the management response to analyze episodes and to demonstrate what influenced an exceedance for NO_2 as part of the preliminary assessment as well as to begin the investigation stage. The Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (CCME, 2012a) describes the data analysis and defines transboundary flows and exceptional events procedures to be used for $PM_{2.5}$ and O_3.

Episode Analysis and Demonstrating the Influence

In this document, the term exceedance refers to an exceedance of an ambient air quality trigger or limit. An example of an exceedance would be an annual average NO_2 concentration greater than 24 ppb (Level 4 exceedance), or 99th percentile NO_2 concentration of greater than 104 ppb (Level 4 exceedance), after rounding. In the same way, there can be exceedances of the triggers into Level 2 and Level 3, which then require analysis.

The term episode is used to describe elevated one-hour concentrations or events that contribute to an ambient air quality trigger exceedance. Episodes can occur over a defined time frame and area, and at one or more stations over the course of a day or over consecutive days, and can include several adjacent hours. An example of such an event would be during a wintertime temperature inversion. Grouping episodes (spatially or temporally as is reasonable) is a convenient way to describe events that occur during the same timeframe and are set in motion by the same mechanism(s).

In order to demonstrate what influenced an ambient air quality trigger exceedance (be it anthropogenic emissions, a natural event or transboundary flow), hourly concentrations contributing to the exceedance are scrutinized. The following definitions are used for transboundary, background and natural influences:

Background or natural influence – concentrations observed in remote areas that are relatively unaffected by local pollution sources, or those resulting from natural events (e.g., forest fires).

Transboundary influence – evidence of air flow from a transboundary source region, so that the pollutant concentration of the transboundary air parcel, as measured at a designated upwind monitor, is within 10 per cent of, or higher than, the ambient air quality triggers.

Analysis Procedure

The episodes contributing to ambient air quality triggers exceedance are identified and analyzed to determine the source. Once an ambient air quality level is assigned to an individual monitoring station, the station is analyzed according to the ambient air quality level to which it is assigned. For example, if a station is assigned to Level 3 based on the 99th percentile, episodes would be analyzed against the upper range of data trigger into Level 3.

The detailed episode analysis procedure includes the following steps:

a) Identify hourly exceedances and gather background (meteorological) data.
   - Arrange the daily maximums (highest one-hour concentration over 24 hours) from highest to lowest and identify hourly episodes to analyze.

b) Analyze the data based on the following considerations (choosing which are appropriate):
   - time of year exceedance takes place
   - spatial and temporal extent
   - diurnal variation of substances
   - correlation with other substances
   - meteorology (temperature, insolation, wind speed and direction and weather maps)
   - back trajectories
   - forest fires.

c) Seek out auxiliary data if appropriate (modelling output, emissions data, incident reports and facility operations information).

d) Form a conclusion as to the cause of the episode (i.e. anthropogenic, natural or transboundary).

In order to simplify the analysis procedure, it is helpful to organize the daily maximum exceedances into episodes. This involves analyzing exceedances together as a unit when they occur over common time periods, in the same general area and under the same atmospheric conditions. This may not always be appropriate, depending on the episode in question, so this would be done with discretion. A good example of where this might be appropriate is during a forest fire event that spans a few days.

Environment and Sustainable Resource Development will decide how many of the top one-hour concentrations will be analyzed to determine the main influence on ambient concentrations for that year.

Data Requirements

To analyze an episode according to the detailed analysis procedure outlined above, the following information can be used:

- Back trajectories for the site and date in question (can be obtained from Environment Canada).
- Forest fire data, which is gathered from either satellite images (from the Canada Forest Service) or from provincial websites.
- Meteorological data, including hourly temperature, relative humidity, wind speed, wind direction and insolation (can be obtained from Alberta's Ambient Air Quality Data Warehouse).
- Additional information that may be of use includes concentrations of other substances.

Conclusions on the source of each episode will be based on review and analysis of this data, experience with Alberta data and conditions, and evidence from the specific circumstances surrounding each episode (including any facility operation information). Ultimately, it is up to the analyst(s) to use the evidence and circumstances surrounding the episode, along with their judgment, to ascertain the most probable source of the episode. This may or may not require the gathering of and request for additional data (which potentially includes modelling) and other expertise. The conclusion of an episode may be based on the back trajectory path of the air parcel prior to the episode, which shows how long the air parcel spent in the vicinity of the air monitoring station and/or region.