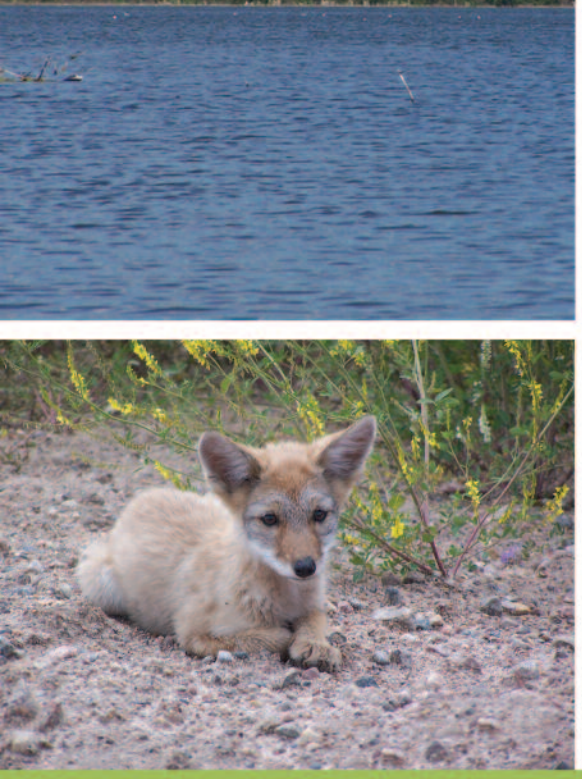
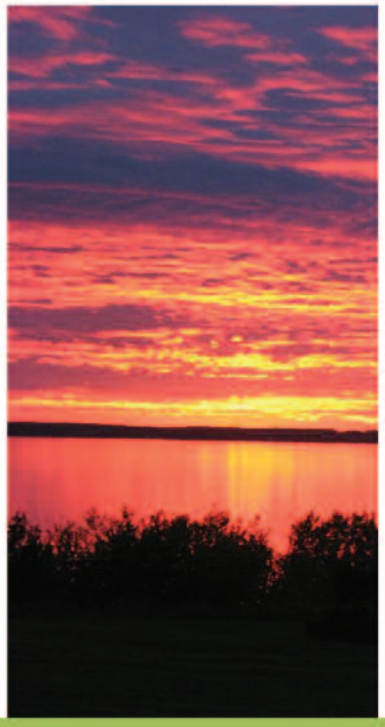
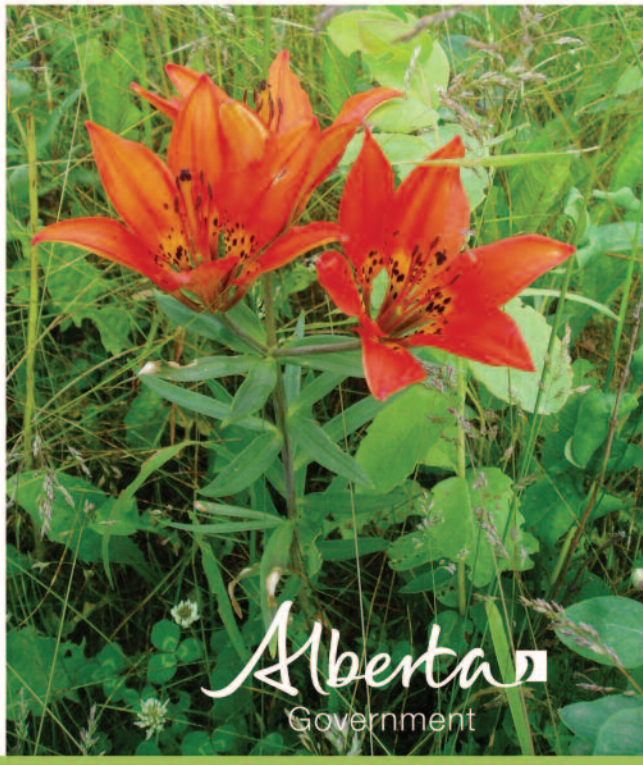
Lower Athabasca Region
Air Quality Management Framework

For Nitrogen Dioxide (NO_2) and Sulphur Dioxide (SO_2)

environmental • social • economic
Land-use Framework



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1.0 Introduction

Alberta Environment and Sustainable Resource Development's three Lower Athabasca Region management frameworks were developed using input from different stakeholders within the Lower Athabasca Region including industry, First Nations and Métis peoples, and non-governmental organizations. As part of a series developed by the department for the Government of Alberta's *Lower Athabasca Regional Plan*, these frameworks are designed to maintain flexibility and to proactively manage cumulative effects to air quality, surface water quality and groundwater quality and quantity within the Lower Athabasca Region. The frameworks provide context for development and related regulatory processes and facilitate sustainable resource management. They are intended to add to and complement, not replace, existing policies, legislation, regulations and management tools.

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

The **Air Quality Management Framework** provides an additional component for the region in the overall air quality management system. This includes setting ambient air quality triggers and limits for nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) with guidance for long-term decision making and management.

The **Surface Water Quality Management Framework** focuses on the Lower Athabasca River downstream of the Grand Rapids to the Athabasca River Delta. It sets surface water quality triggers and limits for 39 indicators measured at the Old Fort monitoring station.

The goal of the **Groundwater Management Framework** is to enhance the existing system to manage non-saline groundwater resources across the Lower Athabasca Region including management of potential cumulative effects on these resources. It establishes indicators of groundwater quality and quantity and the method for developing triggers and limits. This document forms the basis for more technical, detailed documents that have been prepared for each of the groundwater management areas in the region. These are *Groundwater Management Framework* supporting documents for the:

- North Athabasca Oil Sands (NAOS) Area
- South Athabasca Oil Sands (SAOS) Area
- Cold Lake - Beaver River (CLBR) Area

Please note that in May 2012, the Government of Alberta brought together the ministries of Environment and Water and Sustainable Resource Development to create one ministry called Alberta Environment and Sustainable Resource Development.

2.0 Purpose

The framework described in this document is part of the shift to cumulative effects management. It seeks to balance anticipated development with environmental protection. The use of indicators of air quality with triggers and limits helps to clearly define the management of cumulative effects of development and contributes to the achievement of desired regional objectives for air quality.

This *Air Quality Management Framework* was prepared by Alberta Environment and Sustainable Resource Development for the *Lower Athabasca Regional Plan*, one of seven regional plans being advanced under the *Alberta Land Stewardship Act* and the *Land-use Framework*.

The Lower Athabasca Region is the focus of major industrial development that is driving Alberta's and Canada's economy. Increasing population and industrial expansion is expected to continue in the coming years making management frameworks important components of the regional plan.

The *Terms of Reference for the Lower Athabasca Regional Plan* state that the proposed regional air management approach is to set regional industrial emissions caps for oxides of nitrogen (NO_x) and sulphur dioxide (SO_2). This management framework addresses this requirement by confirming that the province will continue to require industrial sources of these substances to employ pollution prevention and emission minimization principles as outlined in provincial policy. In addition, the framework sets ambient air quality triggers and limits for the indicators nitrogen dioxide (NO_2) and SO_2. It includes guidance on the management response if air quality triggers or limits are exceeded.

NO_x which includes nitrogen oxide (NO) and NO_2 are released as a product of combustion from industrial, transportation or home heating sources. The most stable and abundant oxide of nitrogen is nitrogen dioxide or NO_2. Alberta Ambient Air Quality Objectives (AAAQOs) are established for NO_2 and it is reported from most air monitoring stations in the region. This framework focuses on monitoring and responding to ambient concentrations of NO_2 as a way of managing releases of NO_x. Emissions management includes not only industrial emissions, but also other sources such as transportation and municipalities.

The main sources of SO_2 releases in the Lower Athabasca Region are from point sources at industrial facilities such as upgrading and other oil sands processing facilities. To a lesser extent, SO_2 is released through the combustion of fossil fuels.

Goals of the Framework

- Adopt cumulative effects management at the regional level to proactively maintain ambient air quality below the limits for NO_2 and SO_2.
- Develop triggers and limits for NO_2 and SO_2 and use monitoring data to determine ambient air quality in relation to those triggers and limits.

- Evaluate current management approaches for opportunities and solutions to improve air quality management, including broadening the understanding of contributing sources and seeking better technological solutions.
- Support and supplement the current pollution prevention and emission minimization principles as part of air quality and substance release management.
- Provide effective and efficient management that support the flexibility needed to address local ambient air quality within the region. Reduce prescriptive approaches in general, while assuring escalation to more prescriptive or regulatory approaches if the ambient concentrations increase.

The framework's proactive approach to managing ambient air quality will help to inform regulatory needs to ensure that development can continue while still maintaining air quality that supports a healthy human population and environment.

2.1 The Lower Athabasca Region

The Lower Athabasca Region covers a large area (93,216 square kilometres) of northeastern Alberta and encompasses agricultural lands, boreal forest and wetlands, including the Peace-Athabasca Delta, one of the largest freshwater deltas in the world. The region contains three municipal areas: the Regional Municipality of Wood Buffalo, including the city of Fort McMurray; the Municipal District of Bonnyville, including the city of Cold Lake; and Lac La Biche County. The Lower Athabasca Region is also home to a number of First Nations reserves, and Métis Settlements and communities. Please see the map on the following page for the locations of the municipal areas within the region.

The region has extensive natural resource development potential in the oil sands, natural gas and forestry sectors. Industrial development in the Lower Athabasca Region is an economic driver for Alberta and Canada and is expected to continue to increase in the coming years. As more people move to the region to develop the resources, the cumulative effects of human activity on the environment may also increase. Residents have expressed concerns about the impacts of industrial air emissions on health, the environment and overall quality of life.

Releases in the region come from oil, gas and oil sands operations; agriculture; forestry; and non-point sources such as vehicles and urban areas (e.g., home heating). Various substances in the air are associated with oil sands industrial processes and upstream oil and gas developments. These substances include oxides of nitrogen (such as NO_2), SO_2, hydrogen sulphide (H_2S) and other sulphur-containing compounds, ammonia (NH_3), hydrocarbons, fine particulate matter and ozone.

Ambient air concentrations of most substances are not uniform throughout the Lower Athabasca Region; rather they are influenced by the location, density and nature of developments in the area. The nature of certain developments, such as surface oil sands mining operations, means that the area influenced by cumulative emissions can also be large.

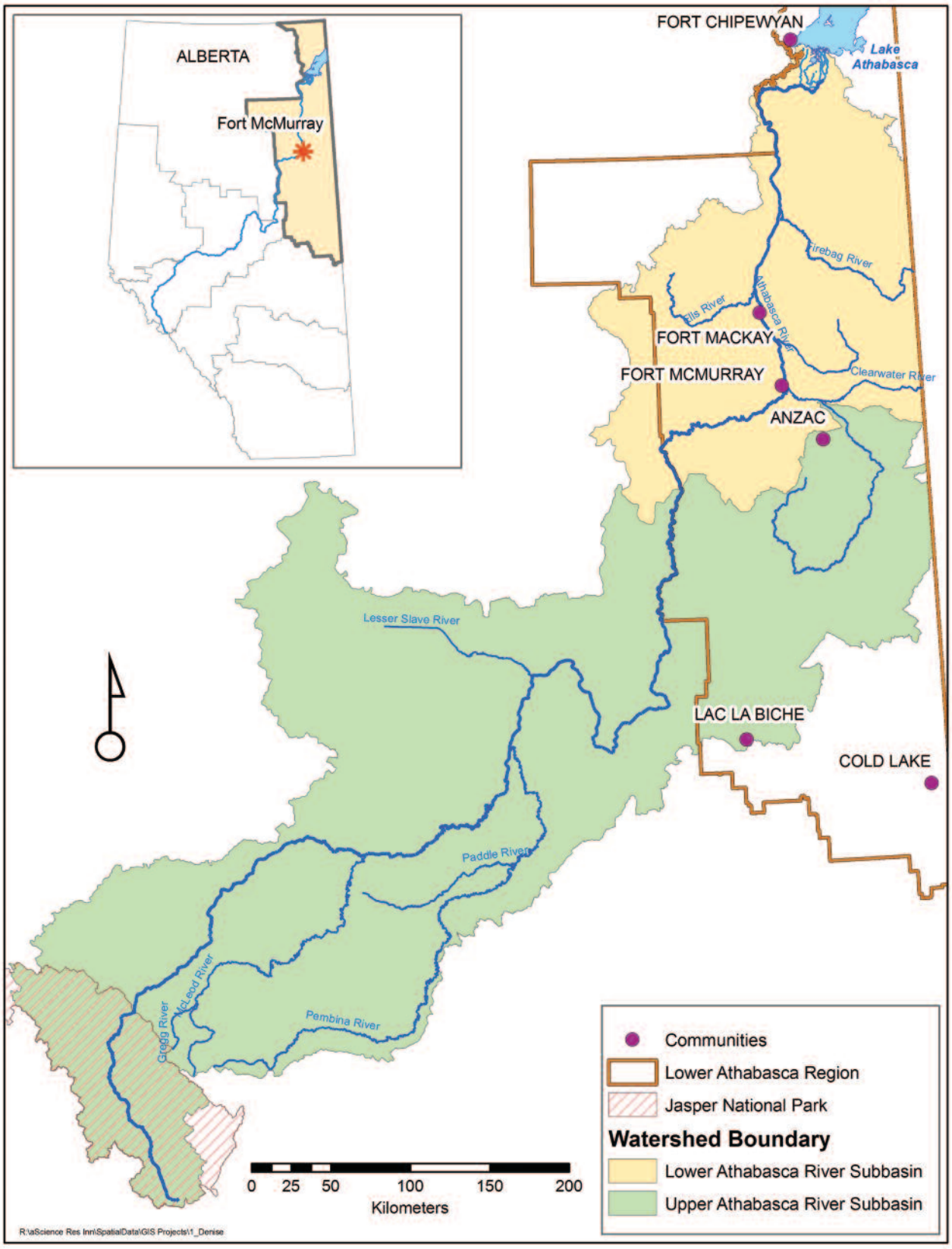

Figure 1
Map of the Athabasca River Basin and Boundary of the Lower Athabasca Region

2.2 Framework Development

The initial drafting and detailed revision of this framework relied on technical and editorial input from federal regulators, industry, multi-stakeholder organizations, non-governmental groups and First Nations and Métis peoples. An engagement process led by Alberta Environment and Sustainable Resource Development involved targeted stakeholders as well as acceptance of written feedback about the framework. At the same time, the Land Use Secretariat led a consultation process about the *Lower Athabasca Regional Plan* that involved gathering feedback on key aspects of advice provided by the Regional Advisory Council, feedback on the draft *Lower Athabasca 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 Lower Athabasca Region.

Managing air emissions through ambient air quality outcomes aligns with recommendations from the Clean Air Strategic Alliance (CASA, 2009a), with Alberta's renewed Clean Air Strategy now being developed (Government of Alberta) and with the initiatives described in the draft Comprehensive Air Management System or CAMS (CAMS Steering Committee, 2010) which has been renamed the national Air Quality Management System (AQMS currently under development).

- CASA recommended defining ambient air quality triggers based on ambient concentrations with associated management actions.
- The renewed Clean Air Strategy outlines that air quality continue to support human populations, ecosystems, as well as continued economic prosperity.
- The national AQMS (currently under development) air quality management approach calls for place-based air quality management using a similar trigger-based system, with management activities that address all contributing emissions sources.
- Adopting these approaches for the framework supports the concept of environmentally responsible clean energy production in Alberta.

3.0 Key Concepts and Principles

There are two drivers that have guided this framework. The first is the need to build on provincial environmental protection and management policies and emission minimization practices. The second is the need to adopt a cumulative effects management system in the region.

3.1 Provincial Policy Direction

One of the purposes of regional plans is to translate provincial policy to the regional scale. The *Air Quality Management Framework for the Lower Athabasca Region* facilitates this by affirming the provincial environmental principles of:

- pollution prevention through employment of best available technology economically achievable
- emission minimization through best management and control practices, and
- continuous improvement and keeping clean areas clean.

Air quality is most frequently described in relation to objectives against which the ambient concentration of the substance can be compared. This framework outlines how to address air quality with respect to the current practice of established Alberta Ambient Air Quality Objectives (AAAQOs) for NO_2 and SO_2.

3.2 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. They 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.

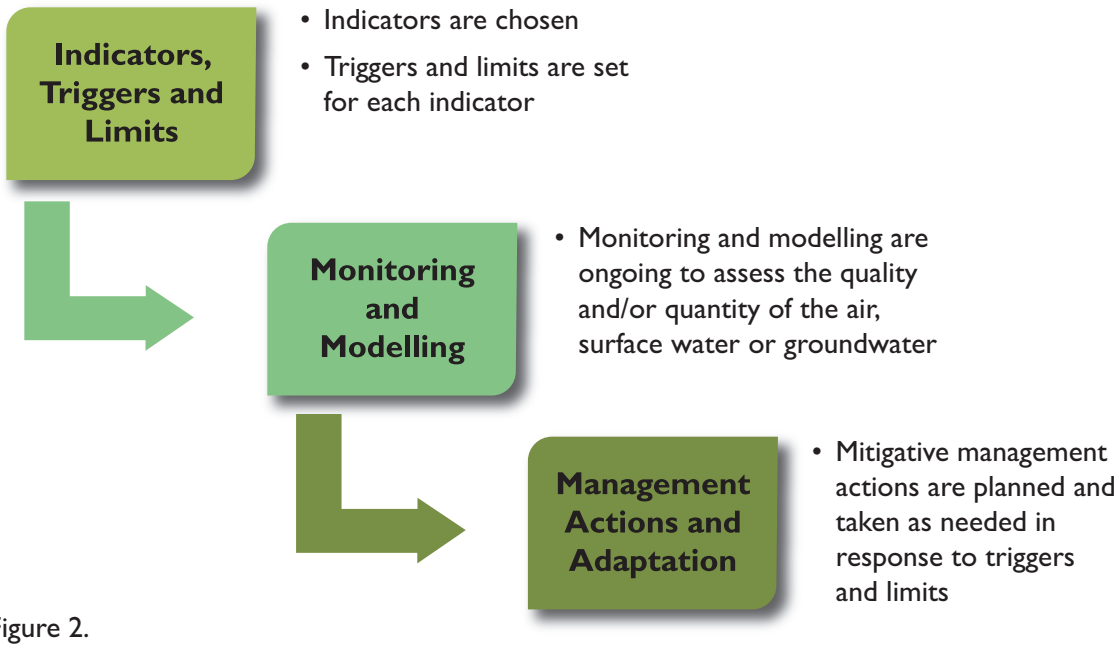

Figure 2.
Management Framework Approach

3.3 Key Principles

The following are key concepts and principles that form a foundation for the management framework.

3.3.1 Maintains Acceptable Air Quality

- The framework contributes to management of local air quality in the region by considering that:
  - ambient air concentrations of substances are influenced by the location, density and nature of developments in the area, and;
  - the nature of certain developments, such as surface oil sands mining operations, means that an area influenced by cumulative releases can be large.

3.3.2 Applies a Regional Perspective

- The framework contributes to proactively managing air quality within the region with consideration of human population and ecosystem health.
- The framework assigns and applies ambient air quality triggers and limits to NO_2 and SO_2 consistently across the region.
- As development proceeds and releases grow over time, the use of ambient air quality triggers will ensure that releases from various sources and at various scales are managed so they do not, collectively, result in unacceptable air quality.
- The framework addresses potential adverse impacts on ambient air quality from air emissions in the Lower Athabasca Region that could arise, despite the requirement for continuous improvement, from cumulative regional emissions and/or local emissions.

3.3.3 Builds on Existing Legislation, Regulations and Policies

- The framework is intended to add to and 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.
- Opportunities for continuous improvement will be considered in planning required management actions relative to capital stock turnover timelines.
- 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 ambient air quality triggers. A range of actions and potential tools are used, as required, to manage ambient air quality with respect to NO_2 and SO_2.
- 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.
- Alberta 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. It provides clarity for industry, early in their design cycle, about operating requirements for emissions management that may be necessary due to cumulative impacts.
- 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 the CASA Data Warehouse at www.casadata.org. This data is used to determine air quality levels within the Lower Athabasca Region.

3.3.6 Involves Partnerships

- Alberta Environment and Sustainable Resource Development involves stakeholders, First Nations and Métis peoples, and working groups who live and work in the area as the framework is implemented.
- Ambient air monitoring and data collection are conducted by environmental and community associations comprised of citizens, Aboriginal groups, and industry and government representatives who gather data at existing continuous air monitoring stations and store it on the CASA Data Warehouse.

4.0 The Current Management System

4.1 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 the mechanisms such as those listed in Table 1 along with applicable performance standards and modelling guidelines to identify appropriate mitigation and define allowable releases of NO_2 and SO_2 from each facility. These mechanisms along with the regulatory system will continue to be instrumental for the successful implementation of the additional components included within the *Air Quality Management Framework*.

Table 1. Regulatory and Non-regulatory Management of Air Emissions and Effects in the Lower Athabasca Region

Governance	Jurisdiction
Provincial Acts	
Environmental Protection and Enhancement Act (EPEA)	Provincial
Alberta Land Stewardship Act (ALSA)	Provincial / Regional
Regulations	
Approvals, monitoring and reporting requirements	Alberta (EPEA)
Compliance and enforcement	Alberta (EPEA)
Air Quality Management System (AQMS) in development	National
Guidelines	
Alberta Ambient Air Quality Objectives (Alberta Environment, 2009)	Alberta
Policies and Frameworks	
Land-use Framework (LUF)	Provincial / Regional
Acid Deposition Management Framework (Alberta Environment, 2008)	Alberta
Industrial Release Limits Policy (Alberta Environment, 2000)	Alberta
CEMA Acid Deposition Management Framework (CEMA, 2004)	Non-regulatory
CEMA Ozone Management Framework (CEMA, 2006)	Non-regulatory
Particulate Matter and Ozone Management Framework (CASA, 2003)	Alberta
CEMA Interim Nitrogen (Eutrophication) Management Recommendations and Work Plan (CEMA, 2008)	Non-regulatory

Governance	Jurisdiction
Strategies	
Alberta's Clean Air Strategy (in development)	Alberta
Responsible Actions: A Plan for Alberta's Oil Sands (Government of Alberta, 2009b)	Alberta
Federal Acts	
Canadian Environmental Protection Act	Canada

4.2 Current Alberta Ambient Air Quality Objectives for NO_2 and SO_2

Current AAAQOs are developed and implemented under the Alberta *Environmental Protection and Enhancement Act* to protect the environment and human health while recognizing principles of sustainability that include environmental as well as technical, social and economic considerations.

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

Ambient concentrations of NO_2 and SO_2 can affect both human and ecosystem health. Because short-term elevated concentrations of NO_2 or SO_2 may affect health, Alberta Environment and Sustainable Resource Development sets hourly and 24-hour AAAQOs for both substances. To address longer-term concerns, annual AAAQOs were established.

Table 2 shows the current annual and hourly AAAQOs for NO_2 and SO_2. For a complete list of current AAAQO values, Alberta Environment and Sustainable Resource Development's website should be referenced at www.environment.alberta.ca/01005.html.

Table 2. AAAQOs for NO_2 and SO_2

Substance	Averaging Time	Current Alberta Ambient AAAQO	Basis for Objective Value
NO_2	1 hour	300 µg/m^3 159 ppb	odour perception
	annual	45 µg/m^3 24 ppb	based on vegetation effects
SO_2	1 hour	450 µg/m^3 172 ppb	pulmonary function
	annual	20 µg/m^3 8 ppb	natural forests, lichen, protection of ecosystems adopted from European Union

4.3 Understanding Ambient Air Quality within the Region

Measuring and managing ambient air quality at a local level recognizes the variability and diversity of air quality within the region's 93,216 square kilometres. Defining air quality locally within the region helps to focus efforts to manage air quality where the problems may be occurring. Responding to local measurements is necessary to prevent ambient air quality concerns from spreading.

Ambient air quality monitoring is foundational to the implementation of this framework. Continuous air monitoring data are used to assess air quality with respect to the ambient air quality triggers and limits for NO_2 and SO_2 as specified in this framework. To effectively manage air quality, the locations of the continuous air monitoring stations are taken into consideration when assessing ambient conditions, undertaking a management response and considering the need for management actions.

This framework uses air quality data from airshed monitoring to define the ambient air quality level. The flexibility of this approach allows Alberta Environment and Sustainable Resource Development to adapt the framework when air monitoring station types or locations are changed or added within an airshed.

Existing air monitoring was designed to monitor air quality for industrial compliance as well as to monitor air quality in communities within the region. 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. For example:

- Some air monitoring stations are clustered near industrial facilities primarily to monitor compliance with respect to ambient concentrations; consequently data collected from these stations represents the air quality near those industrial facilities and not the air quality for the region as a whole. Stations located close to industrial sources provide valuable information into how the releases are dispersed locally from point sources. They supply data essential to effective management of industrial sources; therefore, they play an important role in successful implementation of this framework.
- Similarly, continuous air monitoring stations that are located in specific communities represent air quality only in those communities.
- Air monitoring stations located in more remote areas provide information about how both industrial and non-point sources (e.g. transportation) releases disperse within the region. They also provide data for understanding longer term effects of emissions within the region.

The air quality in the region cannot be described adequately by a single number. Monitoring and managing local ambient air quality as described in this framework ensures that the most effective tools are being used where they are needed. Comprehensive air quality monitoring in the region needs to monitor air quality around industrial sources as well as in communities to ensure that all sources are managed appropriately.

4.4 Current Airshed Monitoring in the Region

The Lower Athabasca Region is Alberta's most heavily monitored region for air quality. Two airshed management zones operate in, and cover most of, the region. These are the Wood Buffalo Environmental Association (WBEA) and the Lakeland Industry and Community Association (LICA), the latter of which has an airshed boundary that extends south of the Lower Athabasca Region.

WBEA's airshed zone monitors close to 70,000 square kilometres in the northern part of the region and is currently using 15 continuous and 39 passive stations. The airshed includes Fort McMurray, Fort Chipewyan, Fort McKay and Anzac as well as a number of oil sands developments. LICA's 25 passive and 3 continuous stations monitor approximately 18,000 square kilometres in the east central part of the region. Together the stations in these two associations comprise the ambient air quality monitoring stations for the Lower Athabasca Region.

WBEA and LICA's airshed zone monitoring contributes to regional air quality management by providing reliable data, identifying concerns and monitoring substances within the airsheds. The WBEA and LICA regional monitoring has evolved to meet compliance and other stakeholder needs. WBEA and LICA will continue to adapt monitoring activities and initiatives based on changing land uses and changing stakeholder interests, although Alberta Environment and Sustainable Resource Development maintains the responsibility for approving monitoring station changes.

More information on WBEA and LICA as well as the ambient air concentrations they monitor is publicly available on their websites at www.wbea.org and www.lica.ca, respectively. These two associations report annually on their monitoring results and summarize their activities and initiatives within the region. Alberta Environment and Sustainable Resource Development analyzes ambient data collected by the associations and reports on air quality through the State of the Environment reporting process, described online at www.environment.alberta.ca/02488.html.

The southeast corner of the Lower Athabasca Region is not covered by either airshed. This area is currently not regarded as being under pressure from an air quality perspective and will continue to be modeled as part of the assessment process for proposed development.

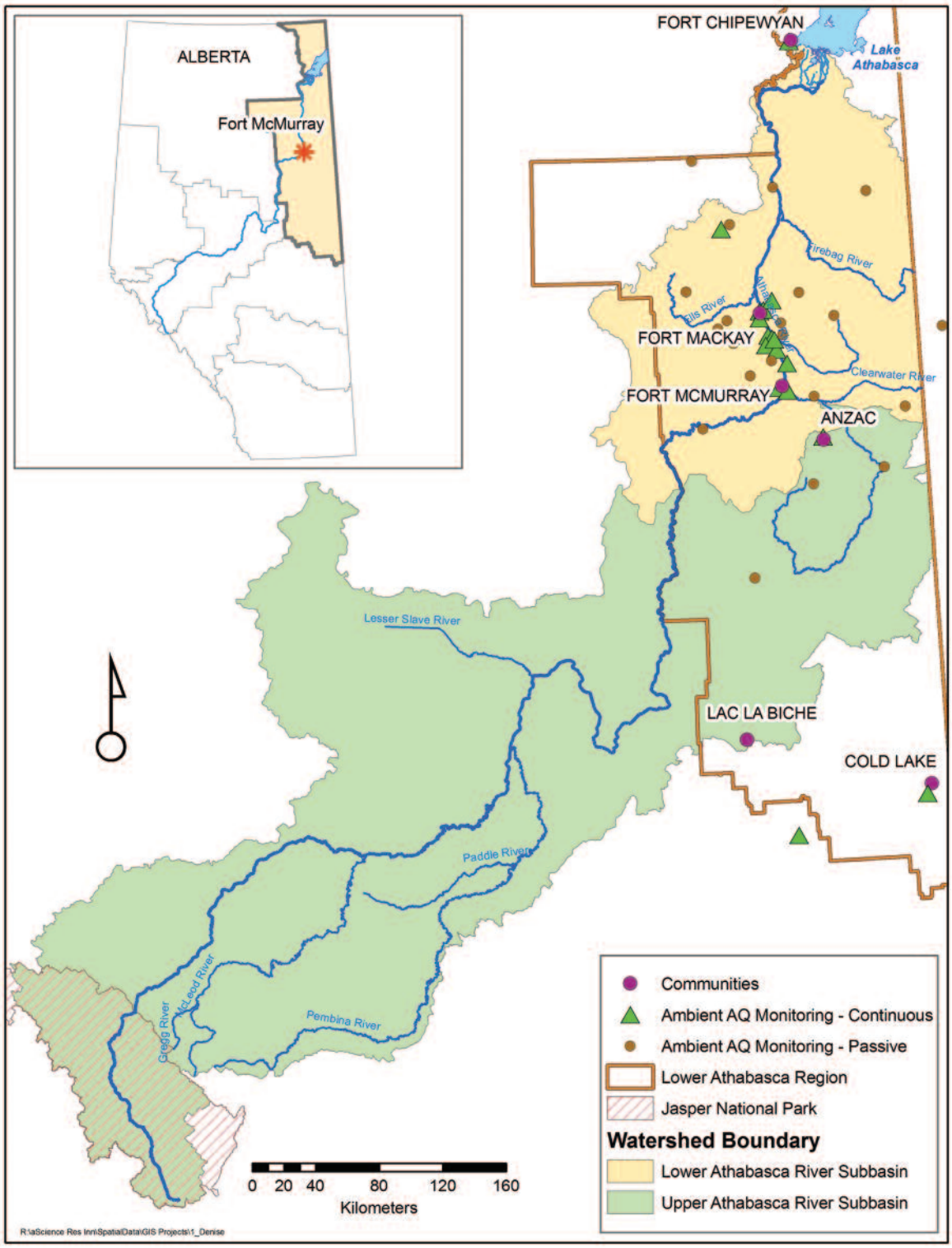

Figure 3:
Map of the Athabasca River Basin and Boundary of the Lower Athabasca Region Showing Ambient Air Quality Monitoring – Continuous and Passive

4.5 Types of Stations in the Region

Air monitoring stations operated by WBEA and LICA are situated to monitor some point sources, some populated areas and some background (undeveloped) areas. Additional monitoring to meet the needs of long-term ecological monitoring programs has also been included as required. Data collected for NO_2 and SO_2 monitoring includes continuous (hourly) and passive (monthly) measurements.

Each station, whether continuous or passive, is designed to sample and represent air quality at a specific location and for a specific purpose. Types of air monitoring stations, their intent and averaging times are shown in Table 3.

Meteorological monitoring is also important and the airsheds have a number of stations that collect representative sub-regional meteorological data.

4.5.1 Continuous Stations

Currently, hourly data collected for NO_2 and SO_2 come from industrial, community, background or meteorological monitoring stations. Continuous air monitoring stations comprise part of regional monitoring for air quality.

4.5.1.1 Industrial Stations

Industrial source stations measure ambient air concentrations as a result of industrial releases. The locations are determined through modelling that 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.

In WBEA, two monitoring stations are classified as "attribution" stations. These are located between industrial sources and Fort McKay and are used to help determine which industrial sources may be influencing air quality in Fort McKay, particularly during poor air quality events.

4.5.1.2 Community and Background 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 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. Fort McKay is an example of a regional community where air quality is largely influenced by industrial as opposed to in-community emission sources.

Background air monitoring stations are sited to measure remote ambient air concentrations and/or to complement the monitoring of ecological effects. Their purpose is to measure the concentrations of pollutants in areas far removed from direct anthropogenic influences or to detect concentrations due to transboundary influences. As a result, short-term exceedances are less likely to be found in these areas.

4.5.2 Passive Stations

With passive monitoring, 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 air pollutants 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." 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.

Table 3. Air Monitoring Station Summary

Type	Location Design and Intention	Sampling / Averaging Time
Continuous	Industry stations: • ensure release sources comply with AAAQOs • confirm proper operation of equipment (e.g., combustion, pollution abatement) • monitor for substances being released • are located between sources and local communities so that the specific operation responsible for an air quality event can be identified (attribution).	• Continuous sampling • Hourly, annual averaging
	Community stations: • are located to measure potential exposure to humans • support human health risk assessment • provide comprehensive monitoring of substances and other air quality parameters.	• Continuous sampling • Hourly, annual averaging
	Background stations: • provide information on transboundary effects or information about air quality without anthropogenic influences • provide comprehensive monitoring of substances and other air quality parameters.	• Continuous sampling • Hourly, annual averaging
Passive	Passive applications include: • pattern recognition (spatially distributed across region) • ecological monitoring (as required to support program objectives) • background (remote from emission sources) • co-location with continuous monitors (for statistical comparisons).	• Monthly cumulative sampling • Annual averaging only

4.6 Managing Local Exceedances

Alberta Environment and Sustainable Resource Development will continue to respond to local exceedances of AAAQOs after they have occurred. This includes determining the cause of the exceedance, notifying the responsible sources and affected stakeholders as well as any affected First Nations and Métis communities, and determining any requirements to prevent a re-occurrence. Hourly or daily AAAQO exceedances at compliance air monitoring stations are most likely due to upset or abnormal operating conditions at point sources. If an AAAQO (hourly, daily or annual) is exceeded, the identified source or sources 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 Objectives

In support of desired regional outcomes, this management framework establishes the following regional objective for air:

>>

Releases from various sources are managed so that they do not collectively result in unacceptable air quality.

In order to better describe what this objective means, indicators have been chosen as well as triggers and limits established for those indicators.

5.1 Indicators, Triggers and Limits

5.1.1 Identifying Key Indicators

Indicators provide information about whether or not a regional objective is being met.

At this time, the framework focuses on managing ambient air quality with respect to ambient air concentrations of NO_2 and SO_2 because these substances:

- are two of the major substances being released in the region
- are actively monitored throughout the Lower Athabasca Region
- are predicted to increase with expanding development
- 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
- 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 and limits
- can be controlled through a range of options applied to the various sources.

NO_2 and SO_2 are also precursors to particulate matter and ozone. Acid and nitrogen deposition and their long-term acidification and eutrophication impacts are other potential environmental issues associated with NO_2 and SO_2 emissions. Ecosystem and environmental effects are monitored through regional programs, and effects are managed through regional and provincial management frameworks. Management actions may be initiated by other regional or provincial management frameworks. Such management actions will be considered when undertaking the management response included in this *Air Quality Management Framework*.

Setting Triggers and Limits

Setting ambient air quality triggers and limits for key indicators is a proactive approach to managing air quality.

Provincially, ambient air is defined as outside air; any portion of the atmosphere not confined by walls and a roof, and to which the general public has access. For this management framework, ambient air quality **limits** are determined by the annual AAAQOs.

As defined by CASA, 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)

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
- identify and ensure management actions are implemented.

Table 2 shows the current AAAQOs for NO_2 and SO_2 and information about the AAAQO is always available on Alberta Environment and Sustainable Resource Development's website.

Annual average ambient air quality **triggers** are ambient concentration values set lower than the ambient air quality **limit**. Ambient air quality values based on the 99th percentile of hourly data are all established as triggers in the management framework. **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 the annual average ambient air quality triggers below the air quality limit, the framework allows sufficient time to plan and react to manage air quality so as to avoid reaching that limit.

If an ambient air quality limit or trigger is exceeded, a management response as described in this framework will be initiated. This may lead to identifying the need for management actions such as collecting more data to understand the ambient air quality, or reducing emissions to prevent ambient concentrations from reaching unacceptable concentrations. This framework focuses on ambient air quality and management approaches to maintain acceptable air quality. Other regional or provincial frameworks consider the longer-term effects on the environment (these regulatory and non-regulatory tools are described in Table 1).

6.0
The Management System

What this framework brings to the existing system are the following:

- establishment of a regional objective for air quality
- identification of key indicators for that objective
- setting of triggers and limits for those indicators
- identification of a management response that will be initiated if triggers and limits are exceeded
- alignment with the proposed national Air Quality Management System's four levels
- description of roles and responsibilities for government, monitoring associations and emitters.

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

In the management framework the annual ambient air quality limits and triggers, and the 99th percentile triggers are expressed in terms of levels of air quality conditions. These ambient air quality levels are described in Table 4 using the annual triggers and limit as an example.

Table 4. Annual Ambient Air Quality Level Descriptions

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

Note: The ambient air quality values based on the 99th Percentile of hourly data are all established as triggers in the management framework (see Section 6.4).

Implementation of the management framework requires annual assessment and evaluation of the ambient air quality conditions. Alberta Environment and Sustainable Resource Development will use data from air monitoring stations reporting to the CASA Data Warehouse within the region to calculate ambient concentrations of NO_2 and SO_2 in relation to the ambient air quality levels. Because changes could occur within the region, the framework is sufficiently adaptable to respond to, and accommodate the need for, modifications that may arise through such initiatives as the *Ambient Air Monitoring Strategy* (CASA, 2009).

6.1 Assignment of Ambient Air Quality Levels

The purpose of assigning ambient air quality levels to monitoring stations under the framework is to identify where NO_2 and SO_2 ambient concentrations are in relation to the defined ambient air quality triggers and limit. The idea is to prevent ambient air concentrations from approaching or reaching Level 4 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.

Ambient air quality levels are assigned to individual stations based on the NO_2 and SO_2 metrics. It is possible for an air monitoring station 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, the management actions will still be carried out; however the actions may be modified accordingly, as determined by Alberta 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 above the ambient air quality trigger.

6.2 What the Current Data Shows

NO_2 and SO_2 trends vary in the Lower Athabasca Region, depending on the location of the air monitoring station.

Annual average and 99th percentile of hourly data NO_2 concentrations have increased at some air monitoring stations in the Lower Athabasca Region, based on historical data going back to 1999.

Annual average SO_2 concentrations have remained quite consistent in the Lower Athabasca Region at industrial, community and background stations. Concentrations remain well below the annual AAAQO.

The upper range (represented by 99th percentile of the annual hourly data) of the ambient concentrations of NO_2 and SO_2 are indicative of the magnitude and frequency of peak concentrations. Increasing trends in peak SO_2 at some monitoring stations will require proactive management to maintain ambient air quality below level four as described by the 99th percentile trigger values.

6.3 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 an ambient air quality trigger or limit is believed to have been exceeded. Part of the management response is determining the need for management actions. Management actions become more stringent at higher air quality levels.

The management response begins with assessing whether an ambient air quality trigger or limit has been exceeded. Depending on the findings of assessment and investigation, decisions are made about contributing parties and the need for management actions. At triggers, the emphasis is on reversing trends or avoiding reaching limits. If a limit is exceeded, there is a commitment that steps will be taken to return to conditions below the limit. To confirm that desired outcomes are met, Alberta 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 stakeholders, First Nations and Métis peoples where applicable, 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.

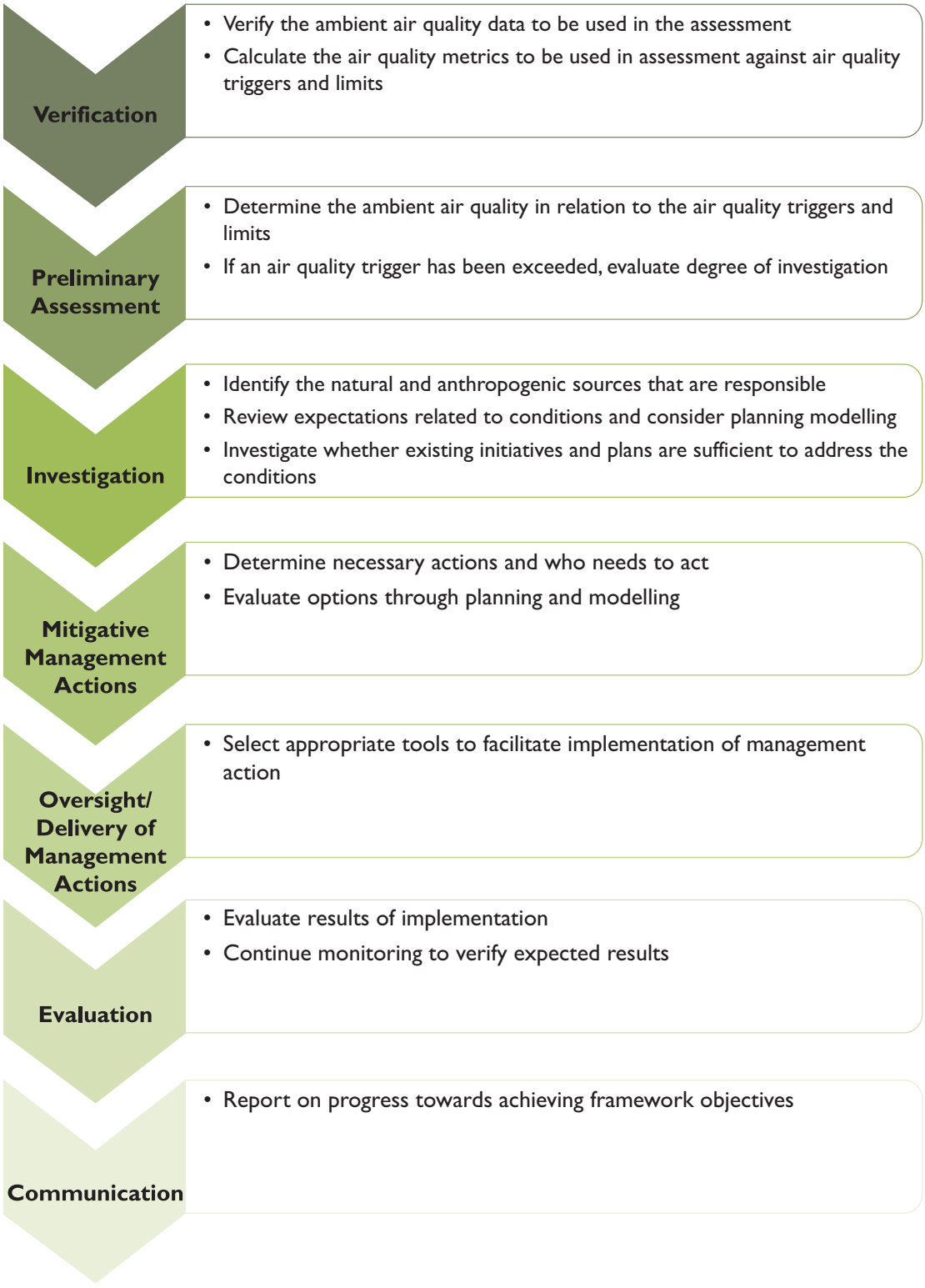

Figure 4
Management Response

6.3.1 Verification

The framework is flexible and recognizes there is no "one size fits all" management action that can effectively deal with the potential range of air quality issues. To accommodate this approach, an annual assessment of ambient air quality data gathered from ambient air monitoring stations throughout the region is conducted. The ambient air quality is described in terms of the ambient air quality levels for NO_2 and SO_2 as well as details regarding the purpose of the air monitoring station and what it is measuring.

Alberta Environment and Sustainable Resource Development analyzes the ambient NO_2 and SO_2 data collected from the airshed monitoring stations, calculates the annual average and 99^{th} percentile of the hourly data metrics to determine how stations fall into the ambient air quality levels outlined in the framework. The quality controlled monitoring data is used to determine whether the corresponding ambient air quality triggers or limits were exceeded. Ambient air quality levels are assigned to individual monitoring stations following the annual assessment. This assessment is based on data retrieved from the CASA Data Warehouse (www.casadata.org).

Hourly NO_2 or SO_2 episodes that contribute to ambient air quality concentrations reaching an ambient air quality trigger or limit are analyzed individually to interpret the primary influence. A particular episode, or several episodes occurring over a certain period or area, may require modelling and emissions inventory data to demonstrate what the primary influence is (or influences are) to ambient air quality levels.

6.3.1.1 Analyzing the Data

The ambient air quality data are analyzed with respect to the annual average. The data are also analyzed by assessing the peak values or the upper range of the hourly data. The upper range of the data is represented by the annual 99^{th} percentile of the hourly data. By using the two types of data, management actions can be tailored to prevent reaching either the annual average or hourly air quality AAAQO's.

The ambient air quality triggers and limits are consistent across the region, but management actions and tools are place-based to deal with specific circumstances.

Annual Average

Analysis of the annual average ambient concentrations occurs after the yearly data have been gathered. To provide time to plan and implement management actions to prevent the ambient concentrations from reaching the limits, the ambient air quality triggers for Levels 2 and 3 are set at 1/3 and 2/3 of the annual ambient air quality limit, respectively. If AAAQOs are revised, the annual ambient air quality limit will become the revised AAAQO for the substances covered by the framework. The associated annual ambient air quality triggers will then be assessed to ensure they are appropriate and that there is sufficient time to respond with management actions.

The annual ambient air quality triggers and limits are shown in Table 5. The annual ambient air quality limits are based on the current AAAQOs for NO_2 and SO_2.

Table 5. Annual Ambient Air Quality Triggers and Limits for NO_2 and SO_2

Description	NO_2	SO_2
Limit[1]	45 µg/m³ (24 ppb)[1]	20 µg/m³ (8 ppb)[1]
Trigger for Level 3	30 µg/m³ (16 ppb)	13 µg/m³ (5 ppb)
Trigger for Level 2	15 µg/m³ (8 ppb)	8 µg/m³ (3 ppb)

Triggers and limits apply at continuous air monitoring stations as reported through the Clean Air Strategic Alliance Data Warehouse.

[1]Annual air quality limits are based upon Alberta Ambient Air Quality Objectives

99th Percentile of the Hourly Data

Exceedances found based on monitoring data are currently, and will continue to be, addressed through the regulatory compliance system. Whenever the hourly AAAQO is exceeded, Alberta Environment and Sustainable Resource Development assesses the source and cause of the exceedance. Under the current regulatory system, if corrective action is required, Alberta Environment and Sustainable Resource Development ensures this compliance function takes place. This regulatory tool will continue to be used when the framework is in effect.

What the framework adds to the evaluation of hourly data is the use of the 99th percentile as a statistical measure that indicates the upper range or peak of the data. The framework analyzes the upper range of the hourly data to identify actions that can be taken to reduce the likelihood of reaching the hourly AAAQO.

The 99th percentile of hourly data is compared against the 99th percentile ambient air quality triggers for NO_2 and SO_2. This analysis indicates the trend in the upper range of the hourly data as well as the frequency of peaks in the data, as opposed to the analysis of the annual average which "smoothes out" the data. The metric allows some of the peak values to be removed to account for rare operating and meteorological circumstances.

Increases in the annual 99th percentile of the hourly data beyond the 99th percentile ambient air quality triggers can provide early warning that exceedances of the hourly AAAQO are more likely to occur. This trend analysis can help in selecting management actions to prevent reaching the hourly AAAQOs.

If the hourly AAAQO is exceeded, the existing regulatory compliance mechanism will come into play as described above, but one hourly exceedance will not put an air monitoring station into Level 4.

The 99th percentile ambient air quality triggers were calculated in relation to the hourly AAAQO for NO_2 and SO_2 and the values are presented in Table 6 below. (See Appendix A for calculation details.) A relationship was determined between the maximum and 99th percentile of the hourly data for both NO_2 and SO_2 and this relationship was then used to calculate the 99th percentile ambient air quality trigger values.

Table 6. Ambient Air Quality Triggers Based on 99th Percentile of the Hourly Data Over a Year

Trigger	NO_2	SO_2
Trigger for Level 4	176 µg/m³ (92 ppb)	94 µg/m³ (36 ppb)
Trigger for Level 3	118 µg/m³ (62 ppb)	63 µg/m³ (24 ppb)
Trigger for Level 2	57 µg/m³ (30 ppb)	31 µg/m³ (12 ppb)

Triggers apply at continuous air monitoring stations as reported through the Clean Air Strategic Alliance Data Warehouse.

6.3.2 Preliminary Assessment

Once the ambient air monitoring data are verified, the annual average and 99th percentiles are assessed against the 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.

The assessment of NO_2 and SO_2 data in the Lower Athabasca Region will be performed by Alberta Environment and Sustainable Resource Development on an annual basis. Data are normally available from the CASA Data Warehouse in March of each year, for data from the previous year. The assessment is completed each year by the end of the calendar year.

The assessment procedure is based on the one described in the CASA *Particulate Matter and Ozone Management Framework*, which has been performed and refined by Alberta Environment and Sustainable Resource Development since 2004. Data completeness criteria and rounding conventions from the *Canada-Wide Standards for Particulate Matter and Ozone* and the CASA *Particulate Matter and Ozone Management Framework* have been adopted here.

Alberta Environment and Sustainable Resource Development determines and assigns the ambient air quality levels at ambient air monitoring stations. The ambient air quality levels are described in terms of the type of air monitoring station, and whether the level is based on the annual average triggers and limits or the 99th percentile of hourly data triggers. This is an important factor in selecting the appropriate management action, should it be required.

The framework specifies that if any station in the planning region exceeds an ambient air quality trigger or limit a management response will be initiated. The degree of investigation, analysis and action associated with the management response is tailored to:

- the type and location of air monitoring station
- the averaging time (hourly or annual)
- the ambient air quality trigger or limit
- trend analysis (rate of increase or variability of the parameter)
- the substance being detected.

6.3.3 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 and SO_2. 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 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.

Investigations of industry stations that exceed ambient air quality triggers (annual average or 99^{th} percentile of hourly data) could involve the identified facilities and might involve forecasting trends and understanding future operational and development plans. Where such stations are on First Nations or Métis traditional lands, the appropriate communities would also be notified.

When community monitoring stations are influenced by industrial sources or if industrial stations are influenced by municipal or transboundary sources, attributing the contributions to ambient concentrations becomes more challenging. Some stations may be influenced by urban, transportation and industrial emissions. In such cases, all relevant stakeholders, and First Nations and Métis peoples would be involved. Siting of transboundary stations provides an indication of the ambient air quality entering and exiting (depending on wind direction) an airshed or, on a larger scale, entering and/or exiting the province.

Ambient air quality characterization and source attribution are more challenging at background stations, as these may be more influenced by transboundary concentrations or natural sources. Background stations reflect the ambient air quality in the area where the wind originates. In the Lower Athabasca Region, due to the extensive nature of development, some background stations may detect the cumulative impact of regional emissions. If longer-term trends lead to ambient air quality triggers being exceeded, a wide range of stakeholders, and First Nations and Métis peoples would likely be involved and regional initiatives would be needed to address the increasing ambient concentrations.

If sited correctly, background air monitoring stations should detect minimal increases in ambient concentrations resulting from regional anthropogenic sources.

6.3.4 Mitigative Management Actions

Once ambient air quality levels have been assigned and the primary sources and spatial extent have been defined, the need for management action is determined and appropriate management actions chosen by Alberta Environment and Sustainable Resource Development from Table 7 in this framework. Prior to determining the need for a management action, Alberta Environment and Sustainable Resource Development reviews whether other management frameworks or initiatives have already prompted management actions. Any already identified management actions are analyzed to understand their influences before additional actions are selected. Appropriate stakeholders may be invited to collaborate on 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.

The framework defines four ambient air quality levels, with Level 1 being the lowest and Level 4 the highest. Management actions associated with the lower levels are intended to provide time to address ambient concentrations to avoid reaching the ambient air quality limit. The stringency of management actions, compliance tools, and associated implementation timelines will increase if the ambient concentrations pass into a new level.

LEVEL 1

6.3.4.1 Level 1

- Continue to manage ambient air quality using existing management approaches, applying policies such as pollution prevention, continuous improvement and use of best available technology.
- Avoid or minimize degradation wherever reasonable or possible in accordance with the principles of emission minimization through employing appropriate technology.

6.3.4.2 Level 2

- If management actions are deemed necessary, steps would be taken as outlined in Table 7. Alberta Environment and Sustainable Resource Development will define implementation timelines, tools and parties including First Nations and Métis peoples 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.

LEVEL 2

LEVEL 3

6.3.4.3 Level 3

- Within the response protocol, appropriate management actions for Level 3 are required to ensure that the annual average air quality limit is not exceeded, or that conditions do not move into Level 4 for the 99th percentile of the hourly data. Flexibility in the framework is achieved by providing an array of tools to address the situation after it has been assessed. Depending on the tool selected, stakeholder involvement and implementation will be identified by Alberta Environment and Sustainable Resource Development. Roles and responsibilities for Alberta Environment and Sustainable Resource Development and other parties are described in section 7.

LEVEL 4

6.3.4.4 Level 4

- In Level 4 for the annual ambient air quality triggers and limits, the acceptable ambient air quality limit has been exceeded, and mandatory actions are required so the air quality limit is no longer exceeded. There may be circumstances that do result in ambient air quality levels reaching Level 4 (e.g., adoption of lower AAAQOs).
- In Level 4 for the 99th percentile of the hourly data triggers and limits, the highest trigger has been exceeded. Appropriate management actions are required to reduce the likelihood that the hourly AAAQO is not exceeded.
- As described in Table 7, Alberta Environment and Sustainable Resource Development retains the responsibility to implement an emissions-reduction plan for the affected area. This will include identifying the parties including First Nations and Métis peoples to be involved in the plan as well as the timelines required to achieve the reductions necessary to get below the air quality limits. Potential tools for achieving the emissions reductions are listed in Table 8. Enforcement of the plans and communication of progress are required as part of implementation.

Table 8 includes a list of potential actions and tools that could be used to manage air quality as part of the management framework. The list is not exhaustive, but rather it can be used as a range of options for selection to manage air quality as appropriate. The table starts with the more restrictive tools that would typically be used at the higher air quality levels, but depending on the specific situation, Alberta 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.

Table 7. Mitigative Management Actions for Each Ambient Air Quality Level

Level	Potential Management Actions
4	Emission Reduction Plan and other Measures - Identify parties including First Nations and Métis peoples roles in management action - Define timelines for achieving reductions - In this level, emissions reductions are required if the ambient air quality limit has been exceeded
	Enforce Plan Communicate progress to public, stakeholders, First Nations and Métis peoples
3	Identify Pressures and Measures Required to Prevent Reaching Air Quality Limits - Identify stakeholders, First Nations and Métis roles and inclusion - Identify urgency of and need for measures - Identify, if required, measures and appropriate tools for managing ambient air quality - Implement identified action - Communicate to the public, stakeholders, First Nations and Métis peoples
2	Surveillance - Determine need for and placement of additional monitoring - Analyze monitoring data for trends - Communicate with stakeholders, and First Nations and Métis peoples (e.g., status of action and forecasts)
1	Verify Ambient Air Monitoring - Track and trend available data - No management actions beyond base regulatory systems - Communicate with stakeholders, and First Nations and Métis peoples (e.g., status of action)

Table 8. List of Potential Measures and Tools for Air Quality Management

Potential Measures and Tools to Enable Management Actions
- Restrictions on further emission sources
- Emission reduction requirements to allow for new sources
- Director-initiated approval amendments (in accordance with authority under EPEA)
- More stringent performance standards or regulations
- Emission caps including mechanisms for management
- Regional planning regulated under ALSA: mechanisms for managing non-regulated sources
- Approval conditions or restrictions
- Enforcement Orders and fines
- Environmental Protection Order
- Remedy
- Revise policies, performance standards for new or existing sources
- Codes of practice
- Economic instruments
- Memorandum of understanding
- Municipal bylaws, First Nations bylaws
- Ambient air quality management plan
- Air modelling
- Approval conditions to participate in airsheds, regional initiatives
- Additional regional monitoring is optional (assessed collaboratively by the environmental and community associations and Alberta Environment and Sustainable Resource Development)
- Education and awareness

6.3.4.5 Range of Mitigative Management Actions Available

Following the annual assessment, the main influences on ambient levels at each station are determined. This information will be used to identify the appropriate management actions and which parties would be most appropriate to engage.

Actions become more stringent as the ambient air quality level increases. Management actions include a range of measures and tools with varying degrees of rigour and are meant to be flexible to consider either more or less stringent action depending on the concentration trends and the magnitude above an ambient air quality trigger. If trends are downward, or the concentration level is just above an ambient air quality trigger, 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, actions taken may be more significant.

6.3.5 Oversight/Delivery of Management Actions

As noted above, the appropriate parties to be involved in the development and implementation of management actions will be identified. There will be shared responsibility amongst these parties to make sure the actions are taken. Alberta Environment and Sustainable Resource Development will have two roles. This includes ensuring that any changes in regulatory or management changes that are needed are undertaken, and serving in an oversight role for actions being taken by other parties.

In addition to the measures described in Table 7 and 8, the framework recognizes that analysis of future plans for development is required to address the need for and urgency of management actions. A key tool for this type of analysis is air dispersion modelling. While monitoring data are used to compare ambient concentrations to ambient air quality triggers and limits, modelling can be used to understand the relative impact of future plans on, and trends in, ambient concentrations.

Monitoring data are used to determine the ambient levels of the substance managed within the framework. Monitoring data are also used for trend analysis, assessment and attribution of ambient concentrations.

Modelling: A Tool for Assessment and Planning

Dispersion modelling is undertaken by proponents and operators when conducting Environmental Impact Assessments 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 Alberta 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 and the need to manage releases. Assessment of the reliability of the model predictions and investigation of proactive measures that can be used to minimize impacts to air quality will remain part of the planning process by proponents and Alberta Environment and Sustainable Resource Development.

While the modelling results will not be used to determine into which ambient air quality level a given area or station falls, it will be used for investigation and planning. Table 9 outlines the uses for modelling.

Table 9. Use of Modelling Results for Assessment and Planning

Level	Use by Alberta Environment and Sustainable Resource Development	Use by Emitters or Proponents
4	- Modelling to be used as planning tool as in Level 2, but also: - Understand relative influences for reduction plans and other measures.	- Provide emissions profiles and plans as requested by Alberta Environment and Sustainable Resource Development
3	- As in Level 2, but also: - Determine source attribution for increasing trend, forecast future trends	- Modelling required for proposed projects - Provide emissions profiles and plans as requested by Alberta Environment and Sustainable Resource Development
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	- Model new projects as required per existing regulations - Provide emissions profiles and plans as requested by Alberta Environment and Sustainable Resource Development
1	- Modelling (or update of existing models) initiated by Alberta Environment and Sustainable Resource Development - Report and track	- Model new projects as required per existing regulations

6.3.6 Evaluation

The current practice of annual reporting by WBEA and LICA will continue as will Alberta Environment and Sustainable Resource Development's analysis of ambient data collected through the airsheds' air monitoring stations. The results will continue to be available through the State of the Environment reporting process, described online at www.environment.alberta.ca/02488.html

Alberta Environment and Sustainable Resource Development will also use the annual assessments under this framework and other means to assess over time if any management actions that have been required are achieving the results that were anticipated. This is described in more detail below.

6.3.7 Communication

Communication is an important component of the framework. Although ambient air quality data present information about current ambient air quality, providing details of management actions taken in response to ambient air quality concentrations demonstrates to the public, stakeholders, and First Nations and Métis peoples that efforts are underway to effectively manage ambient air quality. Consultation with stakeholders, communities, and First Nations and Métis peoples on the appropriate follow-up management strategies will take place as required.

State of the Environment reporting will communicate the status of the ambient air quality and any management actions initiated under the framework or other initiatives or management frameworks. Communication will also include posting a report on the Government of Alberta's website.

Annual assessment results (i.e., ambient air quality levels assigned) as well as details on the influencing source(s) and which management actions have been chosen in response will be communicated regularly to the public, stakeholder, and First Nations and Métis peoples.

The preliminary assessment procedure outlined in step 2 will take place on an annual basis. A summary report of the assessment results will be completed annually.

This report will include episode analysis and assignment of ambient air quality levels to monitoring stations in the Lower Athabasca Region. Reporting will also include data from available continuous ambient monitors in the region that meet the data completeness criteria described in Appendix B. If management actions have been chosen by Alberta Environment and Sustainable Resource Development, these will also be described in the report; however, it is more likely that management actions will be chosen upon collaboration with relevant stakeholders and First Nations and Métis peoples.

Reports will be developed and issued with consideration for consistency with reporting done for other management frameworks within the region. The details of the contents and requirements are to be included in the implementation phase of the *Air Quality Management Framework*. Opportunities for integrated reporting on regional air quality and initiatives will be explored through the implementation of the frameworks.

7.0 Implementation

Implementation details, including timelines and resource allocation, will be determined when Cabinet has approved the *Lower Athabasca Regional Plan* and this framework is considered final.

Implementation planning will include:

- An inventory of tasks to meet the requirements of the framework including, at a minimum, identification and development of system components such as monitoring, evaluation and reporting mechanisms; protocols for assessment of conditions relative to objectives; management response expectations; and reporting processes and communication plans for ambient air quality and management actions activated by the framework.
- Confirmation of roles and responsibilities of various groups (Alberta Environment and Sustainable Resource Development, stakeholders, First Nations and Métis peoples, and others) for implementation of the framework and an assessment of resources needed to fulfill the tasks and commitments of the framework, including human resources and any missing data requirements.
- Ongoing evaluation of the framework's alignment with other policies and initiatives (national programs, provincial policies, by-laws) to ensure consistency of management intent.
- A timeline for implementation including key milestones and target dates for completion.

7.1 Roles and Responsibilities

Alberta Environment and Sustainable Resource Development, environmental and community 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.

7.1.1 Alberta Environment and Sustainable Resource Development

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

- is responsible for annual review and assessment of ambient air quality data to determine ambient air quality levels at each air monitoring station
- 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 stakeholders, First Nations and Métis roles for management planning and actions. If a multi-stakeholder process is required by the framework, the use of established multi-stakeholder groups (such as CEMA) 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
- communicates to stakeholders the implementation status and selected management action.

7.1.2 Environmental Monitoring Associations

The main role of the environmental monitoring associations, such as airshed groups, will be data gathering and management for input into the ambient air quality assessment. More specifically, this includes:

- data gathering and analysis
- quality assurance and control
- air monitoring station design, management and reporting of air quality data.

7.1.3 Emitters and Proponents

Emitters and proponents include industrial sources and sources of emissions in communities and municipalities as well. As a result, there may be roles for all levels of government and government agencies within air quality management. Roles and responsibilities for emitters and proponents with respect to the framework include:

- participating in airshed groups and other regional initiatives for ambient air monitoring
- modelling and assessing how current and planned operations influence local ambient air quality
- providing emissions data to Alberta Environment and Sustainable Resource Development, as required
- participating in ambient air quality management actions, if identified (e.g., development of plans or implementation of reductions)
- reporting on progress of implementation of management actions, as required.

8.0 Integration

This management framework is part of a series of management frameworks developed by Alberta Environment and Sustainable Resource Development in support of the Government of Alberta's *Lower Athabasca Regional Plan*. As the regional plan is implemented, all of the outcomes and objectives in it, including those for air, surface water and groundwater, 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.

8.1 Identification of Substances to Manage

While NO_2 and SO_2 provide a starting point for the development of the framework, other substances are also of concern from an ambient air quality perspective. A process is required to identify substances that require active management in the Lower Athabasca Region. The objectives of existing associations (WBEA and LICA), the Regional Municipality of Wood Buffalo (RMWB), and the Cumulative Environmental Management Association (CEMA) include identifying substances of concern for their areas. Alberta Environment and Sustainable Resource Development, working with the associations, will assess whether the substances identified could be incorporated into (or included in) the framework. This would work well for substances that have established AAAQOs and are monitored in the area.

Substances for which no AAAQOs have been established, or for which regional limits are considered desirable or appropriate, the process proposed through the *Air Contaminants Management Framework* (CEMA, 2009) is recommended to identify, prioritize and address these substances.

9.0
Abbreviations and Acronyms

Abbreviation/Acronym	Description
AAAQO	Alberta Ambient Air Quality Objective
ALSA	*Alberta Land Stewardship Act*
CAMS	Comprehensive Air Management System
CASA	Clean Air Strategic Alliance
CEMA	Cumulative Environmental Management Association
EPEA	*Environmental Protection and Enhancement Act*
LICA	Lakeland Industrial Community Association
RMWB	Regional Municipality of Wood Buffalo
WBEA	Wood Buffalo Environmental Association
ppb	Parts per billion
$\mu g/m^3$	Micrograms per cubic metre

10.0 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.

Airshed ..... An airshed is a geographic area that, because of emissions, topography, climate and meteorology, typically experiences similar air quality. (CASA, 2009b)

Airshed Zone ..... Regional partnership associations that include government, industry, environmental organizations 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 airshed zones. (CASA, 2009b)

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

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 ..... 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.
(Oxides of Nitrogen, NOx)

Pattern Recognition ..... A grid of passive samples can be used to get a comprehensive picture of ambient air quality across the province. Data gathered in this way can be used to create a monthly and annual spatial map of province-wide air pollutant levels, and could be used to address long-term trends in air quality. (CASA, 2009b)

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 strong smelling, colourless gas that is formed 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 pollutants 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)

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Please note that in May 2012, the Government of Alberta brought together the ministries of Environment and Water and Sustainable Resource Development to create one ministry called Alberta Environment and Sustainable Resource Development.

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12.0 Appendices

Appendix A: Calculation of Ambient Air Quality Triggers for the Lower Athabasca Region

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 one 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.

Ambient air quality triggers (both the annual average and the 99th percentile 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 annual ambient air quality limit or AAAQOs from being exceeded. The 99th percentile ambient air quality triggers, therefore, will be used to plan and implement actions to reduce the probability that the hourly AAAQO will be exceeded.

Determining the 99th Percentile of the Hourly Data Ambient Air Quality Triggers

To determine the Level 4 ambient air quality trigger for the 99th percentile, a dataset with multiple hourly AAAQO exceedances could be used to understand the relationship between the AAAQO and the 99th percentile. Exceedances of the hourly AAAQO have not occurred at all of the Lower Athabasca Region's air monitoring stations.

The relationship between the 99th percentile ambient air concentration and the maximum hourly concentration will be characteristic of specific locations. This is due to the emission source type, magnitude and location relative to the air monitoring stations. The relationship between the 99th percentile and the maximum hourly concentration was assumed to be consistent.

The 99th percentile ambient air quality triggers were determined based on the relationship between historical 99th percentile ambient concentrations of NO_2 and SO_2 and the maximum hourly concentrations. This relationship was then used to calculate a Level 4 ambient air quality 99th percentile compared to the current hourly AAAQOs.

To be an effective planning tool, there should be no or very few exceedances of the hourly AAAQO at the 99th percentile 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. The specific circumstances of maximum hourly values will be reviewed during the annual assessment if Level 3 or 4 is triggered.

The first step was to determine the 99th percentile and maximum of the hourly concentrations for each of the continuous air monitoring stations in the Lower Athabasca Region. For each year from 2003-2009, annual 99th percentile was divided by the maximum value for that year to give the ratio of the 99th percentile to the maximum for the year. This fraction was plotted as a percentage for each year and for each air monitoring station in the Lower Athabasca Region.

The average fraction for all of the Lower Athabasca continuous monitoring stations for all of the years analyzed was determined for NO_2 and the average of community stations for all the years analyzed was determined for SO_2. These percentages were then multiplied by the AAAQO to determine the ambient air quality triggers for the 99th percentile. The calculated values were compared to the historical data to ensure that the air quality triggers met the intent of the framework. In other words, if hourly exceedances were experienced at an air monitoring station, the data should indicate a Level 4 assessment. If there were no exceedances, but there were peaks nearing the AAAQO, the assessment should indicate Level 3.

For NO_2 the average fraction of the 99th percentile compared to the maximum concentrations was 58 per cent. Multiplying the current NO_2 hourly AAAQO of 159 ppb by 58 per cent equals 92 ppb, which was used to represent the Level 4 ambient air quality trigger. This method could be used to determine new ambient air quality triggers when the AAAQOs are revised. Levels 3 and 2 were then calculated as approximately 2/3 and 1/3 of the Level 4 trigger value, respectively. Level 2 ambient air quality trigger was 30 ppb and the trigger for Level 3 was 62 ppb. The graph showing the ratios is illustrated in Figure A.

The same methodology was used to derive the SO_2 99th percentile ambient air quality triggers, but only the community stations were used. This change was made because the sources of SO_2 are point industrial sources and the intent of the framework is to be protective of human health. The average fraction of the community stations 99th percentile SO_2 values compared to the maximum concentrations was 21 per cent. Multiplying the hourly AAAQO (172ppb) by 21 per cent yielded a Level 4 ambient air quality trigger of 36 ppb. The 99th percentile of the ambient air quality trigger for Level 2 became 12 ppb, and for Level 3, it was 24 ppb. The graph showing the relationship between the 99th percentile and the maximum values is illustrated in Figure B.

Upon review of the trigger levels resulting from this method, stations seemed to fall logically into ambient trigger levels that made sense, based on the historical data. Where exceedances of the one-hour AAAQO were occurring (e.g., the Mannix station with SO_2), the stations fell in Level 4; stations with hourly concentration well below the AAAQO fell in Level 2 or Level 1. At the Mannix station, SO_2 exceedances were recorded in most years, but none were recorded in 2009.

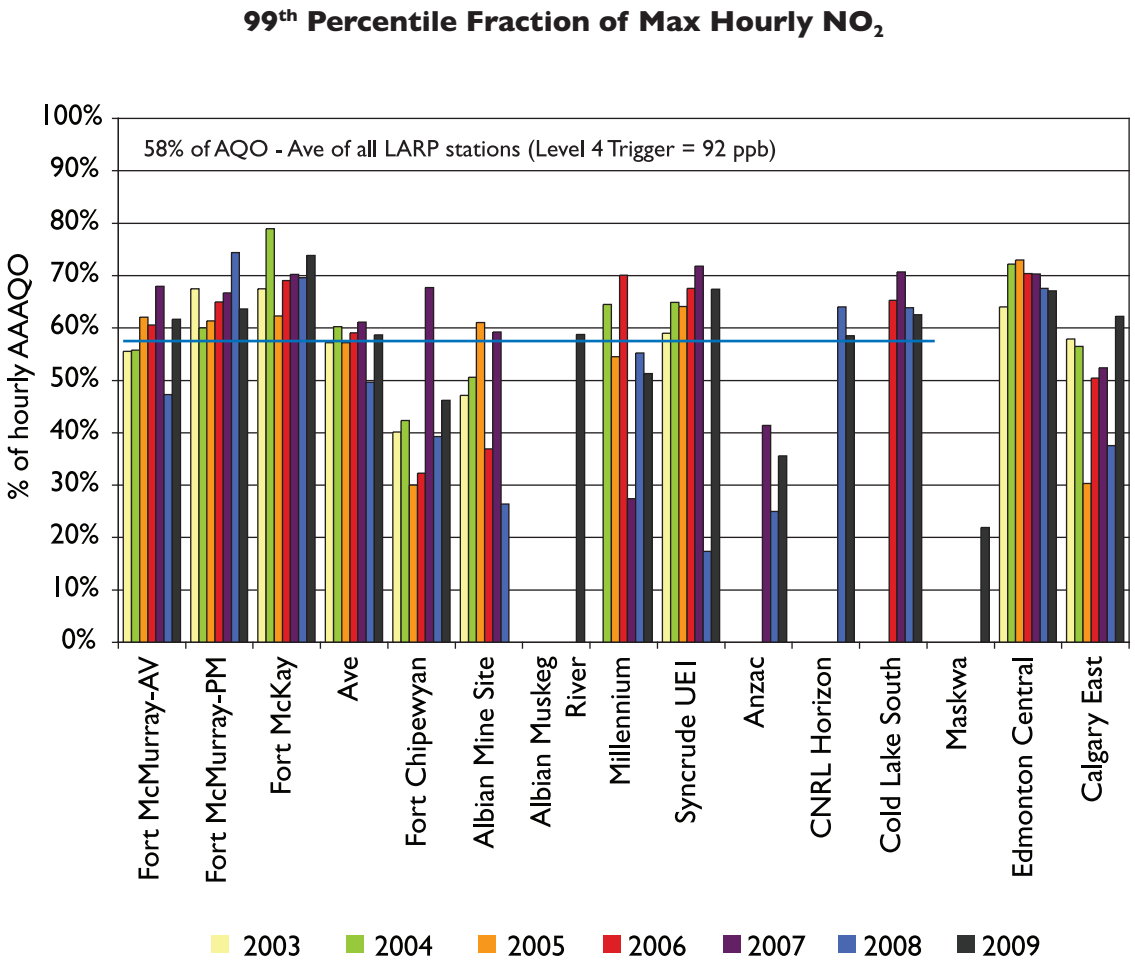

Figure A
99th Percentile of NO_2 Compared to the Maximum Hourly NO_2 Concentrations

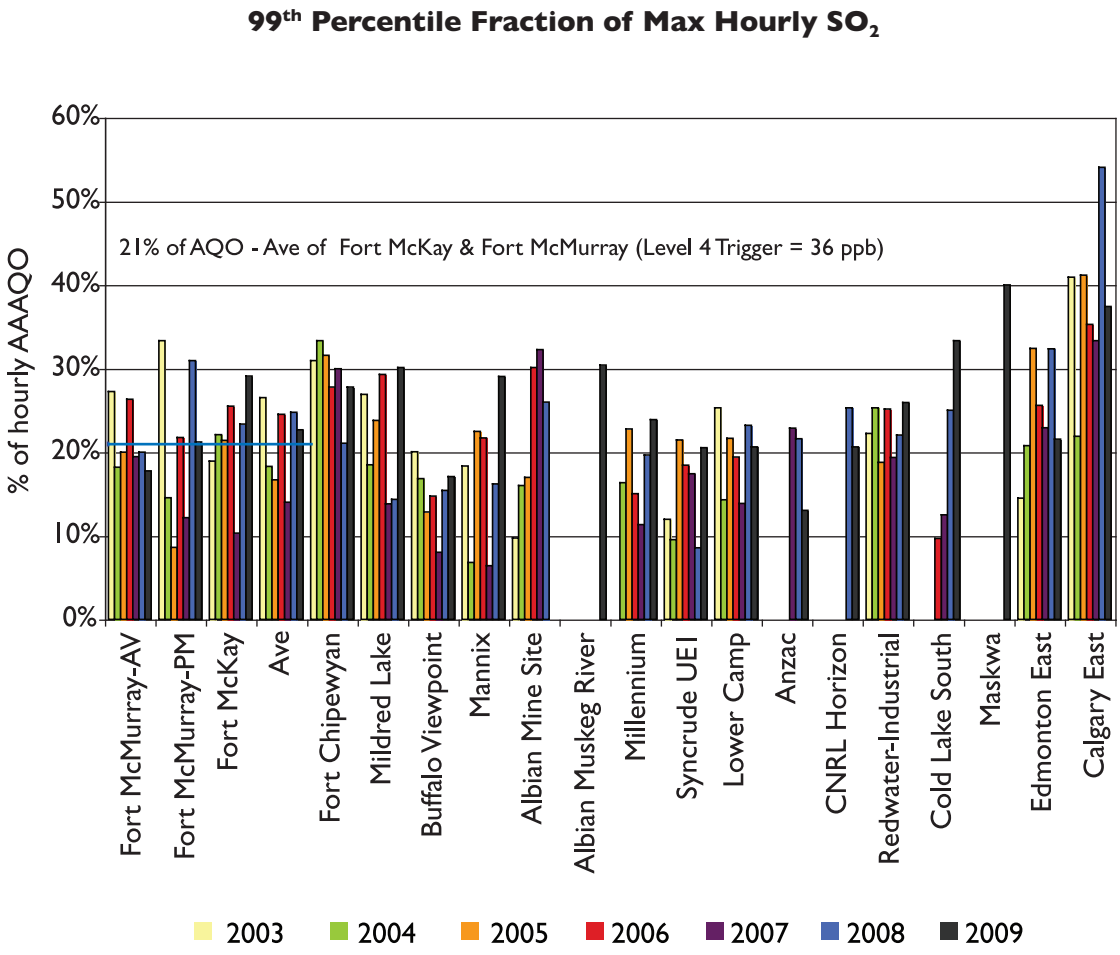

Figure B
99th Percentile of SO_2 Compared to the Maximum Hourly SO_2 Concentrations

Appendix B: Calculation of NO_2 and SO_2 Metrics

Calculation of Annual Metrics

The annual metrics are calculated by first downloading hourly NO_2 and SO_2 data from the CASA Data Warehouse at www.casadata.org. Data is downloaded using the "Download Data" report link and by requesting data from all continuous stations at once. One year is downloaded at a time and the stations within the Lower Athabasca Region can be selected. The arithmetic mean is then taken for all hourly values for the year, for each station.

The annual average is then compared to the annual ambient air quality triggers and limits.

Calculation of Hourly (99th Percentile) Metrics

The same hourly NO_2 and SO_2 data that are used for calculating the annual metrics are used for calculating the 99th percentile metrics.

The 99th percentile of the hourly concentrations is calculated for each station and compared to the 99th percentile ambient air quality triggers. The results are then tabulated and graphed for viewing trends over time. The table and graphs will be updated each year to add on the new year's data.

Notes on Data Handling

The hourly NO_2 and SO_2 data are checked for data completeness on an annual basis. The completeness criteria are modified from Alberta's *Particulate Matter and Ozone Management Framework*. At least 75 per cent data completeness is required for each year (75 per cent of hours in one year have data available). Datasets from air monitoring stations not meeting the data-completeness criteria are not included in the assessment of triggers and limits.

Rounding conventions for the NO_2 and SO_2 metrics also mirror the Canada-Wide Standards for Particulate Matter and Ozone and Alberta's *Particulate Matter and Ozone Management Framework*. The NO_2 and SO_2 levels are presented in rounded whole numbers, or to one part per billion. 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 air quality limit for NO_2 is 24 ppb. In order to exceed this limit, a station must have an annual average of 24 ppb or greater. Any value above this limit would be assigned to Level 4 (see Table 5) and anything at or below the limit would be assigned to Level 3. As such, a value of 24 ppb would be below the Level 4 trigger, while a value of 25 ppb would be above.

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

Appendix C: Investigation and Data Analysis

Episode Analysis and Demonstrating the Influence

The episode analysis procedure will follow the analysis structure from the *Particulate Matter and Ozone Management Framework*. Alberta Environment and Sustainable Resource Development will analyze individual NO_2 and SO_2 episodes on an annual basis and try to discern the source or influence of each episode. If it can be demonstrated that an ambient air quality trigger is exceeded as a result of natural or transboundary influences, management actions will be adjusted accordingly or could be deemed unnecessary.

In this document, the term **exceedance** refers to an exceedance of an ambient air quality limit or trigger; either annual or 99th percentile, as described above. 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 92 ppb after rounding (Level 4 exceedance). In the same way, there can be exceedances of the Level 3 and Level 2 ambient air quality triggers, 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. These can occur over a defined time frame and area. An example of an episode could be one-hour NO_2 concentration greater than 92 ppb (in a year that exceeds the 99th percentile Level 4 trigger). Episodes can occur at one or more stations over the course of a day or over consecutive days, and can include several adjacent hours. Grouping episodes (spatially or temporally as is reasonable) is a convenient way to describe NO_2 or SO_2 events that occur during the same time frame and are triggered by the same mechanism(s).

The suite of management actions outlined in Table 7 of the framework become increasingly more stringent as you move from Level 2 to Level 4, with Level 4 actions including mandatory emissions reductions. Management actions in Level 2 focus more on education and awareness, surveillance and possible forecasting into the future. Following the progression of management actions in Table 7, the analysis procedure for NO_2 and SO_2 episodes will be more rigorous for stations in Level 3 and 4 and less rigorous for stations in Level 2.

In order to demonstrate what influenced an ambient air quality trigger exceedance (be it anthropogenic emissions, a natural event or transboundary flow), hourly NO_2 or SO_2 concentrations contributing to the exceedance will be scrutinized. The CASA *Particulate Matter and Ozone Management Framework Guidance Document* provides the following definitions 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 trigger.

Analysis Procedure

The episodes contributing to the 99th percentile ambient air quality trigger exceedance are identified and analyzed to determine the source. If an individual year exceeds the ambient air quality trigger in question, then episodes within that year would be analyzed according to the procedure below. Years where the ambient air quality trigger in question is not exceeded are not further scrutinized.

Ambient air quality levels are assigned to individual monitoring stations. Once this is done, one station would be analyzed according to the ambient air quality level to which it is assigned. For example, if a station is assigned to Level 3, episodes would be analyzed against the Level 3 ambient air quality trigger, starting with reviewing the annual 99th percentile value for that station.

The same procedure is followed for exceedances of the annual metric. Alberta Environment and Sustainable Resource Development will make the decision on how many of the top one-hour concentrations will be analyzed to determine the main influence on ambient concentrations.

The detailed episode analysis procedure includes the following steps:

a) Identify hourly episodes and gather background (meteorological) data.
   - For an annual average or 99th percentile exceedance, arrange the daily maximums (one-hour NO_2 or SO_2 concentrations) from highest to lowest and identify hourly episodes to analyze.
   - Beginning with the highest concentration, each one-hour value in exceedance of the 99th percentile ambient air quality trigger (e.g., 92 ppb for Level 4) is analyzed to determine the source and what the main influence is (anthropogenic, natural or transboundary). For annual ambient air quality trigger exceedances, Alberta Environment and Sustainable Resource Development will decide how many hourly values will be analyzed.

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 pollutants
   - correlation with other pollutants
   - meteorology (temperature, insolation, wind speed and direction, weather maps)
   - back trajectories
   - forest fires.

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

d) Form a conclusion as to the cause of the episode.

For the 99th percentile ambient air quality triggers, this episode analysis procedure continues until a one-hour average NO_2 or SO_2 concentration falls below the trigger value in question.

As mentioned, for the annual ambient air quality triggers, Alberta 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.

Simplifying the Process

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 (consecutive days), in the same general area (airshed zone or adjacent airshed zones) 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.

Alberta Environment and Sustainable Resource Development has developed an automated tool, using Microsoft Excel, to help analyze particulate matter and ozone episodes for the *Particulate Matter and Ozone Management Framework*. This tool, called the "simplified procedure" is populated with pollutant and meteorological data for all Alberta stations each year. A date and station can be chosen by pressing a button and completing a dialogue box. Graphs of pollutant concentration and meteorology are automatically plotted for the date chosen, and wind roses are also displayed. This program already includes NO_2 and SO_2 data, so therefore can be used for the framework assessments.

The analysis of NO_2 and SO_2 concentrations falling within Level 2 should not require as detailed analysis as concentrations within Level 3 and 4. The simplified procedure tool can also be used to infer the source of episodes falling in Level 2, but likely back trajectories, modelling and emissions data will not be necessary at this level. However, these tools are available to use whenever warranted.

Data Requirements

To analyze either an NO_2 or SO_2 episode according to the detailed analysis procedure outlined above, the following information should be obtained.

- Back trajectories for the site and date in question (obtained from Environment Canada as per particulate matter and ozone assessment protocol).
- Forest fire data, which is gathered from either satellite images (from the Canada Forest Service) or from provincial websites (Alberta and B.C.). A Microsoft Excel macro has been created by Alberta Environment and Sustainable Resource Development to plot the trajectory and forest fire information on maps of Alberta and North America for visual analysis.

- Meteorological data, including hourly temperature, relative humidity, wind speed, wind direction and insolation. Not all parameters are available for all sites. Temperature, relative humidity and insolation are graphed by station on an hourly basis. Wind speed and direction are displayed using wind roses. Macros have been developed by Alberta Environment and Sustainable Resource Development to more swiftly compile and present these data as part of the "simplified procedure" tool.
- Additional information which may be of use could include concentrations of other pollutants (NO, CO, O_3, and $PM_{2.5}$). Graphs of hourly data are produced to compare the relative concentrations of these pollutants.

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 and request of additional data (which potentially includes modelling).