CITY OF KAMLOOPS

What is in the air we breathe?

Background Report: Air Quality and the Airshed Management Plan

Kamloops
Canada's Tournament Capital

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Introduction

Air quality is an increasingly important topic among Canadian scientists, policy-makers, and the public as new knowledge emerges about air pollution and its impacts on human health and the environment.

As an essential life sustaining substance, air provides us with oxygen and enables the removal of carbon dioxide (CO_2) absorbed by plants through the process of photosynthesis. It is an integral part of the biosphere and it is our responsibility to protect and improve it wherever possible.

When the air we breathe is compromised by pollutants, there are a variety of adverse impacts. Poor air quality can lead to increased health risks, it can degrade visibility, and it can negatively affect our economy by potentially limiting opportunities for local, regional or national economic development.

The Sustainable Kamloops Plan, a framework for achieving a balance of economic prosperity, social well-being and environmental stewardship, identifies "air" as a prominent sustainability component.

In order to maintain a level of air quality that supports optimal human and environmental health, it is important to take a closer look at Kamloops' physical and climatic features along with local and regional, natural and man-made sources of pollution.

This document provides information on air quality, air emissions and monitoring, contributors and the effects of climate and weather, an overview of airshed planning in British Columbia as well as background information and issues considered for the City of Kamloops Airshed Management Plan.

The goals of this document:

1. Provide a review of existing data and research relative to air quality.
2. Guide development of the Airshed Management Plan by focusing on issues and challenges.
3. Compliment the Airshed Management Plan for those looking for substance behind the plan.
4. Include information not covered in-depth in the Airshed Management Plan.
5. Generate discussion on Kamloops air quality.

SECTION 1: AIR QUALITY BACKGROUND

A. Air Quality in British Columbia

The Province of British Columbia has a wide range of physical environments and climatic regimes such as the dry Southern Interior, wet forested coastal regions, and cold plains of the northeast. Each region has its own local sources of pollutants and differing exposures to marine and continental air masses.

Two air pollutants that pose the most serious health risks to BC residents are Particulate Matter (PM_{10} and $PM_{2.5}$) and Ground Level Ozone (GLO). They mainly affect the lowest part of the atmosphere, which includes the air we breathe. These two pollutants will be discussed in greater detail in Section 3 of this document.

PM can be a significant problem at certain times of the year in rural areas of BC, including areas of the Southern Interior, due to wood burning. Fine PM ($PM_{2.5}$) presents the highest risk to human health from air pollution in BC (Ministry of Environment [MOE], 2011). GLO, a by-product of the interactions between gases in the air, can irritate the eyes, nose, and throat. It may also irritate the lung airways, resulting in inflammation. Its ingredients are the key components of smog in our environment.

In addition to PM and GLO, other pollutants commonly found in the air include sulphur dioxide (SO_2), odorous reduced sulphur gases (ORSG), nitrogen dioxide (NO_2), and volatile organic compounds (VOCs). These pollutants are also discussed in further detail in Section 3.

Over the past 25 years, industrial permitting as a means of regulating emissions in BC has resulted in lower emissions from industrial sources. Technology and voluntary efforts by industry have also contributed to this decline. However, contributions from non-industrial (unregulated) sources are growing and may have significant detrimental effects on air quality (Ministry of Environment, 2011).

Principal contributors to air pollution in urban areas are emissions from mobile sources related to transportation - most commonly from cars, large and small trucks, and trains. Emissions from mobile sources in smaller communities are also on the rise. Recognizing this trend, the provincial government, through the *Environmental Management Act* (EMA), has put regulations and initiatives in place to further reduce emissions. Some of the initiatives include:

- **BC Air Action Plan**: Aims to improve and enhance air quality across the province and protect residents' health by focusing on three main areas, including clean transportation (such as converting public bus engines to cleaner burning technology, greening the provincial vehicle fleet, etc.), clean industry (such as eliminating beehive burners, encouraging cleaner technology, etc.), and clean communities (such as completing airshed management plans, researching air quality, etc.).
- **Act Now**: Promotes a healthier lifestyle choice such as walking and cycling to improve human health, therefore further reducing air emissions.
- **Live Smart BC**: Encourages individuals and communities to make more energy-efficient choices for their homes, businesses, and vehicles.
- **BC Scrap-It**: Provides incentives to individuals for removing their older, higher polluting vehicles from the roads, helping to reduce greenhouse gas emissions and improve air quality.
- **Wood Stove Change-out Program**: Informs residents about the negative effects of older domestic wood stoves and encourages replacement of these inefficient units with newer, low emission units.

B. Air Quality in Kamloops

Did you know? In 2003, Kamloops experienced the driest summer in 105 years. Pollution levels of particulate matter and ground-level ozone peaked due to the Strawberry Hill forest fire and other fires in the surrounding region

The KAMPLAN 1995 Background Newsletter on Environment identifies protecting air quality as the number one issue on the Mayor's Task Force on the Environment.


Strawberry Hill Forest Fire of 2003

Although it is commonly perceived that industry is a main contributor to air pollution in Kamloops, non-point sources (for example, automobiles and backyard burning) represent a greater threat to human health than more visible point-sources (Ministry of Environment, 2011).

The City of Kamloops has enacted several by-laws to reduce air pollution in the local airshed. These include:

- Fire Prevention By-law, which restricts open burning;
- Noise Control By-law, which restricts commercial vehicle idling in residential areas for more than three minutes;
- Clean Indoor Air By-law, which addresses smoking in indoor public places; and
- Prohibition of Outdoor Wood Boilers By-law, which reduces smoke emissions in the community.

In addition to these by-laws, the City has implemented several initiatives to promote air quality improvement, including:

- **Clean Air Day**: Demonstrates a wide variety of alternative methods of transit.
- **Bike to Work Week**: Promotes cycling as an active mode of transportation to reduce emissions.
- **Anti-idling Reduction Program**: Educates people on the environmental effects of idling.
- **Installation of roundabouts**: Reduces idling, engine noise, air pollution, and fuel consumption.
- **Street Tree Programs**: Promotes planting trees in neighbourhoods and providing incentives to do so.
- **Development of new bike lanes**: Supports convenience and safety of active transportation and alternative, green commuting methods.

Despite these provincial and local initiatives, the following public policies suggest that more can be done to improve air quality in the Kamloops airshed:

- The Sustainable Kamloops Plan
- KAMPLAN, the City's Official Community Plan
- The EMA

C. Air Quality Monitoring and Objectives BC and Canada

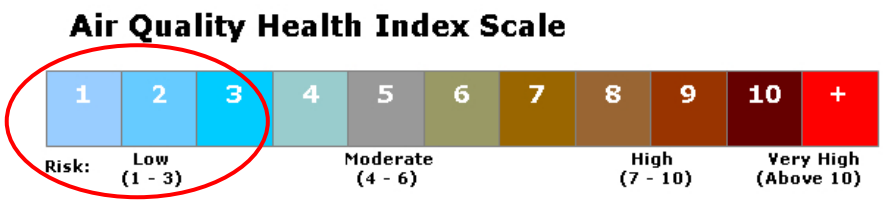
Ambient air quality refers to outdoor air that humans and other organisms live and breathe at a particular time. All living beings are exposed to the ambient air. In BC it is the responsibility of the MOE to monitor ambient air quality and real time results are provided as part of the Air Quality Health Index (AQHI) at http://www.bcairquality.ca/readings/index.html.

Air quality objectives are developed by environmental and health authorities at both the provincial and federal levels to provide guidance for environmental protection decisions. Objectives are based on scientific studies that consider the effects of the contaminant on humans, wildlife, and vegetation, as well as aesthetic qualities such as visibility.

Air quality criteria are established by the Canadian Council of Ministers of the Environment and the MOE.

MOE objectives are categorized into Levels A, B, and C, roughly corresponding to the federal "maximum tolerable", "maximum acceptable", and "maximum desirable" levels. The maximum desirable objectives are long-term goals for air quality in Canada.

The AQHI is a tool designed to help you understand what the air quality around you means to your health. The Index - a scale from 1 to 10 - is intended to help you make decisions to protect your health by limiting exposure to air pollution and adjusting your activity levels during high pollution days. In Kamloops, air quality is typically in the low risk range of 1 to 3, which is ideal air quality for outdoor activities.



Source: Environment Canada

Air Quality Benchmarks

Ambient air quality is typically measured through elevated monitoring stations such as the Brocklehurst and downtown stations in Kamloops or through portable monitoring stations that are moved frequently throughout the City.

The Kamloops Airshed Management Plan pertains to ambient or outdoor air quality.

There are two types of air quality as defined by good air quality and poor air quality.

Good air quality refers to clean, clear air. Clean air is essential to maintaining the delicate balance of life on this planet - not just for humans, but wildlife, vegetation, water, and soil.

Poor air quality is a result of a number of factors, including emissions from various sources, both natural and human-caused. Poor air quality occurs when pollutants reach high enough concentrations to endanger human health and/or the environment. The federal and provincial governments have developed guidelines for pollutant concentrations. Everyday choices, such as driving cars and burning wood, can impact the air quality.

SECTION 2: AIR POLLUTION SOURCES AND EMISSIONS

A. Air Pollution Emission Source

- An emission is a substance released into the air from either human or natural sources.
- A pollutant is a substance in the air that can cause harm to humans and the environment.

Each day we are exposed to many different kinds of pollutants both inside and outside of our homes. Air pollution can cover large areas, such as forest fires or GLO, or it can be concentrated in smaller areas - close proximity to a wood stove or a car exhaust. Regardless of the pollution coverage, both short- and long-term exposure to air pollution can be a threat to human and environmental health.

Emissions are any kind of substance released into the air from natural or human sources. They can be in the form of gas flows, liquid droplets or solid particles. Not all emissions become air pollutants, but those that do can cause significant health and environmental problems. The amount of air pollutants in an area depends on the number and size of the emission source, along with the weather and layout of the land (topography).

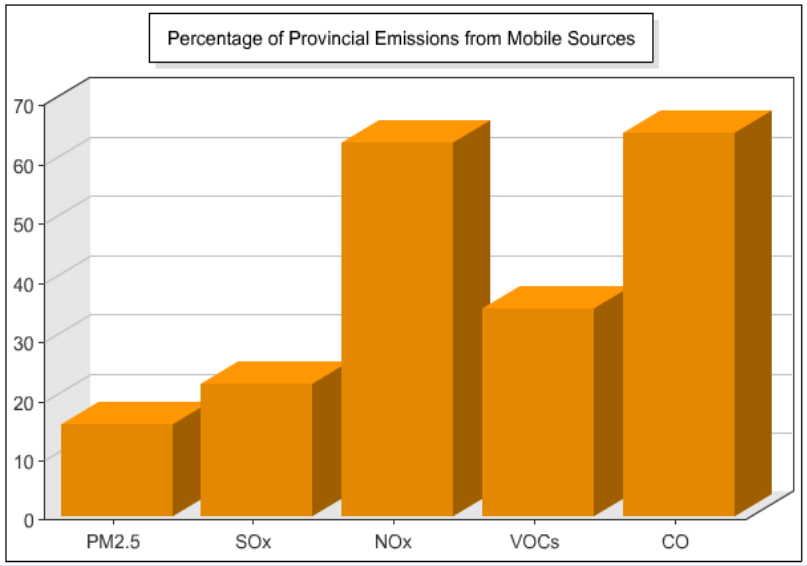


Figure 1: Vehicle Emission Statistics

Source: Vehicle Emission Statistics BC - Percentage of Emissions by Mobile Sources for the year 2000, (Environment Canada Emissions Inventory Group, 2005) http://www.env.gov.bc.ca/epd/bcairquality/topics/graph-mobile-emissions.html

Chart 1: Main Sources of BC Emissions

Source	Description	Examples
Point	• Stationary industrial facilities. • Operate under federal and provincial government authorization (a regulation, permit, approval, or code of conduct) or under an anti-discharge permit.	Pulp and paper mills and factories that burn fossil fuels
Area	• Small stationary sources acting collectively in an area. • Operate under municipal and some provincial authorization. • Emissions from most individual sources are small compared to point sources, but can be significant when considered collectively.	Prescribed burning; residential wood use; light industry; and other residential, commercial, and institutional sources.
Mobile	• Transportation related sources. • Operate under federal, provincial and municipal authorization.	Passenger cars, trucks, and motorcycles; aircraft; marine vessels; trains; off-road vehicles; and small off-road engines (agricultural, lawn/garden, construction, and recreational equipment).
Natural	• Occur in nature without the influence of human beings.	Wildfires, plants, wildlife, dust storms from exposed riverbanks and silt bluffs, etc.

B. How Humans Contribute to the Problem

Although some sources of air pollution originate from natural sources such as volcanoes, dust storms, or lightning-induced forest fires, most sources are a result of human activities.

In general, human activities can be divided into three groups including individuals, communities, and business and industry.

i) Individual Activities

As individuals we contribute to air pollution in a variety of ways depending on our activities. There are six common activities we participate in that aggravate the problem of air pollution. These include:

- Wood burning (fireplaces, woodstoves, backyard burning);
- Burning toxic substances (garbage, tires, plastics);
- Fossil fuel burning (personal vehicle uses, lawn mowers, furnaces, barbeques);
- Using household and personal products (paints, solvents, cleaning agents, hair sprays);
- Road dust from driving (driving on dirt roads); and
- Using appliances and products that release ozone depleting substances (refrigerators, air conditioners, freezers).

As individuals we can make a difference in our air quality by changing our habits and investing in cleaner technology. Simple things such as leaving our cars at home and walking, riding a bike or taking public transit can significantly improve the air quality in Kamloops airshed.

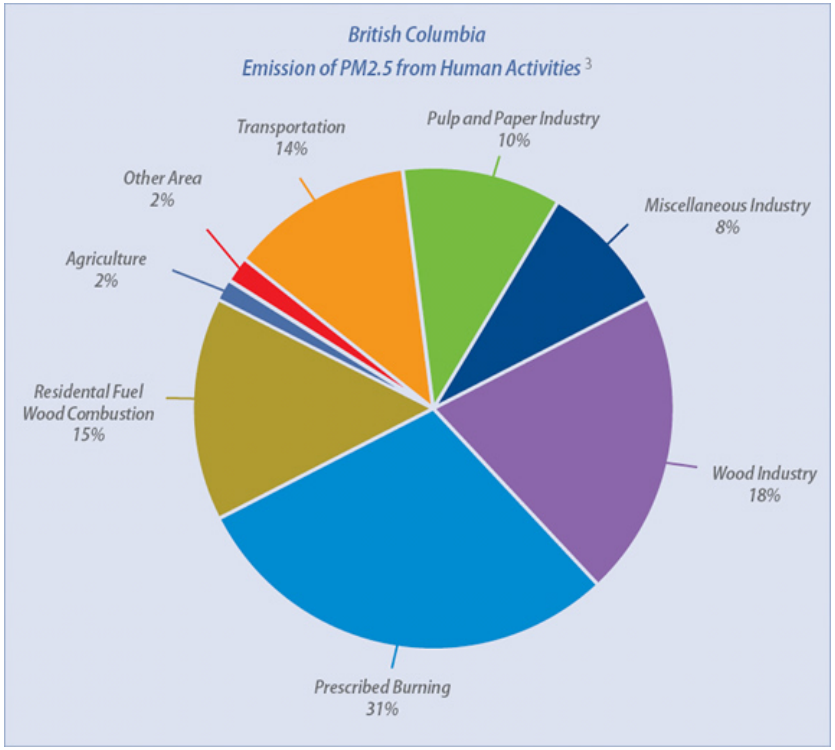


Figure 2: BC Emission of $PM_{2.5}$ from Human Activity
Source: BC Air Action Plan 2008

ii) Community Activities Resulting in Pollution

A community is made up of a number of individuals, so all of the previously mentioned air pollution sources in the Individual Activities section are inflated based on a community's population. In general, some of the common activities resulting in community air pollution include:

- Land use planning or amalgamation of communities, which typically results in an urban sprawl and greater commuting distances;
- Limited support for public transportation or alternative transportation options such as cycling, walking, or carpooling;
- No regulations for controlling open burning of materials ranging from wood to garbage;
- Absence of strong penalties for burning infractions;
- Unregulated wood stove use; and
- Few initiatives to become more energy efficient with regards to municipal offices and vehicle fleet.

The City of Kamloops has several initiatives already in place to address many of these community activities.

- Interested in your own personal/household impact on emissions? Visit http://bcemissions.ca/go/city/Kamloops.

iii) Business and Industrial Activities Resulting in Pollution

As with most communities, the City of Kamloops relies heavily on local businesses and industry for the stability of the local economy. As part of that same package, businesses and industry contribute various amounts of air pollution into the local airshed through their operations.

Within City limits, there are numerous large-, medium-, and small-scale businesses and industrial operations that are point sources of air pollution including, but not limited to:

- Pulp mill;
- Sawmills;
- Agricultural operations;
- Cement plants;
- Railway companies;
- Fuel depots;
- Paint stores;
- Data storage facilities;
- Drycleaners; and
- Automotive shops.

Despite their size differences, all contribute to local air pollution; however as technology advances, the pollution emitted from these businesses and industrial operations will often be lowered helping to improve the overall air quality in the Kamloops airshed.

C. The Effect of Topography and Weather on Air Quality

Air quality in BC is further affected by the physical geography of the province. Mountain terrain and weather patterns combine to create temporary, localized pockets of poor air quality with the potential to produce negative effects on the health and well-being of residents. Outdoor air quality is affected by the following factors that influence the length of time before pollutants disperse:

- Concentration of pollutants released into the air;
- Local topography (nearby mountains);
- Weather conditions;
- Wind speed;
- Precipitation; and
- Temperature.

Once pollutants are emitted into the air, the weather largely determines how well they disperse. Turbulence mixes pollutants into the surrounding air. For example, during a hot summer day, the air near the surface can be much warmer than the air above. Sometimes large volumes of this warm air will rise to great heights resulting in vigorous mixing.

Wind Speed

Wind speed contributes to how quickly pollutants are carried away from their original source. However, strong winds don't always disperse the pollutants. They can transport pollutants to a larger area, such as the smoke from open burning or forest fires.

In Kamloops, winds generally blow from the east or west, reflecting the east-west direction of the Thompson River valley, which steers winds. The most common winds are easterlies, when wind is blowing from east to west along the South Thompson River valley. The strongest winds, however, blow from the west. In Kamloops, wind is calm about 18% of the time.

Precipitation

Most of BC has not been affected by acid rain, due to resistant soils that can neutralize acid and easterly winds. Another factor is BC's lower level of industrialization and, therefore, the emissions that cause acid rain. Precipitation can actually alleviate smog from chemical reactions in the presence of light as the pollutants are washed out of the atmosphere with the rainfall.

Temperature

Valley temperature inversions are very common in BC, especially in mountain valleys, often forming during calm, clear nights with light winds. They can even persist throughout the day during the winter.

Valley Effect

The Thompson valley is a common example of an airshed in BC. Valley areas frequently experience temperature inversions on calm, clear nights with light winds. During these events, the air near the ground is colder than the layer of air above. This results in very stable conditions within the valley so that pollutants released near the surface are confined to the airshed. In turn, these stable conditions can lead to higher levels of air pollution.

During periods of temperature inversions, calm winds, and when vertical atmospheric motion is prevented, horizontal movement of air can be blocked by valley walls. Under such conditions, any air pollutants being released into the atmosphere will tend to accumulate, which can result in increased concentrations.

Figure 3: Temperature Inversions in a Mountain Valley
Source: BC Air Quality, www.bcairquality.ca

One measurement of poor dispersion conditions used by meteorologists is the frequency of calm winds, or the percentage of the time that the hourly windspeed is less than 1 metre per second or 3.6 kmph. In Kamloops this value varies from 15% to 20% from year to year. The values in Kelowna are very similar. On the coast, the percentage of calm winds are much lower, for instance in Ucluelet, it is about 10%. Source: Ministry of Environment, 2012.

SECTION 3: AIRSHED PLANNING AND POLLUTANTS

A. What is an Airshed?

Airsheds are affected by emissions from:

- Urban activities;
- Suburban activities;
- Marine activities;
- Agricultural processes; and
- Transformation of natural resources in the air.

The term "airshed" was coined in author Robert Avrill's Man and Environment[1] written in 1967, when he discussed the need for local regional and national air quality management programs. An airshed can be defined as a geographic area where the movement of air and thus, air pollutants can be restricted by local landforms such as mountains and weather conditions. An example of this is the mountain valley in which the City of Kamloops is situated.

From time to time, BC communities have periods of poor air quality, which can adversely affect human health, the environment and visibility. The complex terrain and weather patterns in BC naturally divide the province into a number of airsheds, such as the Lower Fraser Valley, Okanagan Valley, and Thompson Valley.

[1] Robert Avrill, Man and Environment - Crisis and the Strategy of Choice, Penguin Books, 1967

Air pollutants and their by-products can be transported between communities, or linger in mountain valleys when wind and air circulation are constrained. This means that if there is a major pollutant being emitted in a neighbouring region, the City of Kamloops may feel the effects. For that reason, maintaining and enhancing air quality can be viewed as a cooperative challenge for communities.

Airsheds have been defined for the purpose of airshed management in a number of areas in the province. In some cases, airshed boundaries have followed political boundaries, to reflect the area in which there is support and authority for air quality action. This includes individual municipalities or regional districts and multiple regional districts where there are common issues requiring solutions across a broader area.

B. Airshed Management Plans in BC

Airshed planning is a key component of the provincial government's work to improve air quality through partnerships with communities and other stakeholders in the airshed. The process recognizes that everyone has a role to play in keeping the air and our communities clean. Airshed planning is also key to meeting BC's obligations under the CWS for PM and ozone. The process recognizes that all residents, businesses and industry have a role to play in keeping our air clean.

Airshed planning is an important stakeholder-driven process used by local and regional governments to address activities affecting air quality within an airshed. It provides stakeholders with a clear understanding of community air quality priorities and how future growth may be accommodated. In addition, an airshed management plan ensures the air quality goals of various levels of government are met.

Currently, airshed management plans are under development or being implemented in the following areas of BC:

Municipalities

Kamloops, Merritt, Prince George, Quesnel, Whistler, Williams Lake, and Grand Forks.

Regional Districts

Fraser Valley Regional District, Metro Vancouver (formerly the Greater Vancouver Regional District), Regional District of Okanagan-Similkameen, and Regional District of Central Okanagan.

Multiple Regional Districts

Bulkley Valley-Lakes District (Kitwanga to Endako) and Sea-to-Sky Corridor (Bowen Island to just north of Pemberton).

Why Develop an Airshed Management Plan for Kamloops?

The City of Kamloops has been growing in population steadily and will continue to grow to meet new demands. With growth come new businesses, industries, more vehicles, and more residential dwellings, all of which can impact local air quality.

In order to support responsible, sustainable growth within the City, air quality must be addressed. The Airshed Management Plan is the means to address this issue.

Ambient Targets for the Kamloops Airshed Management Plan

To protect air quality in the Kamloops airshed, a target for ambient air quality is essential. As part of the planning process, air quality targets will be determined by the Airshed Management Plan Technical Committee with input from the Airshed Advisory Committee and ultimately adopted by Kamloops City Council.

An airshed management plan provides a blueprint to help communities manage development and control air contaminant sources.

C. The Kamloops Airshed

The Kamloops airshed extends along the North and South Thompson River valleys and surrounding lands. It contains the mass of air contained in the City of Kamloops and immediate surrounding communities of the Thompson-Nicola Regional District, Tk'emlúps Indian Band and, particularly, the air mass contained and affected by the natural topographical features at the confluence of the Thompson valleys. Kamloops airshed boundaries were identified by MOE officials.

The Kamloops airshed is approximately 942 km^2 in area and is mainly confined to the local valley bottoms, walls, and some portion of the plateau.

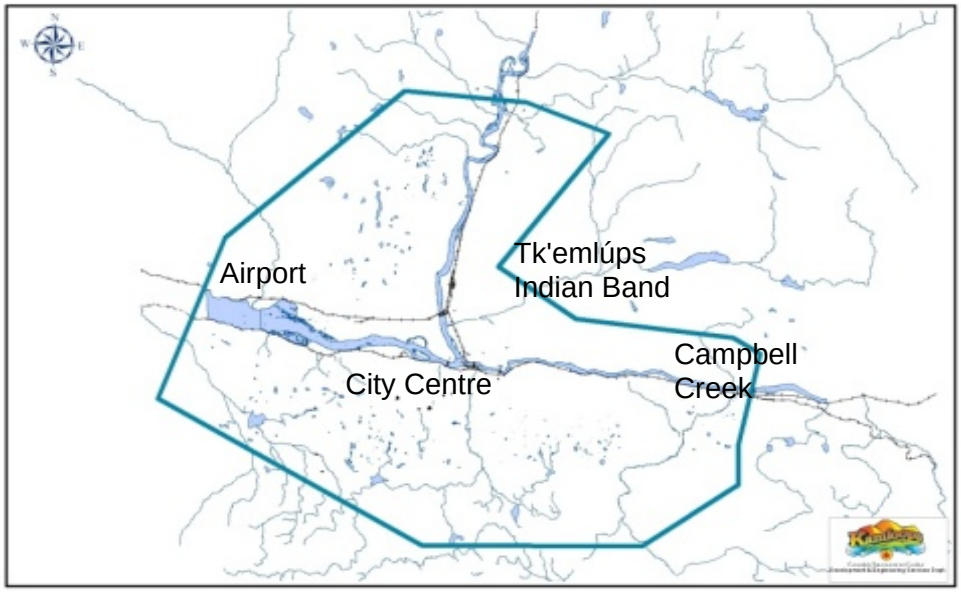


Figure 4: Kamloops Airshed Boundary Map,
Source: Ralph Adams, Ministry of Environment

Airshed Geography

Kamloops is located at the confluence of the North and South Thompson Rivers at 345 metres above sea level. The Thompson River valley is a broad, deep valley that bisects the Thompson Plateau. It contains two main river valleys - the South Thompson and the North Thompson River valleys. The Thompson River valley in the region of Kamloops has a distinct semi-desert climate, and thus a landscape distinct from that of the plateau.

This zone occupies the driest and hottest regions of the Southern Interior in BC. It is predominated by grasslands, while the forest cover is restricted to wet sites such as near lakes and river shores. The upper elevations range from 700-1,000 metres. Douglas-fir and Ponderosa Pine sparsely occur on dry rocky outcrops and in open grasslands.

Airshed Climate

The airshed is situated in the rain shadow of the Coast and Cascade mountains. Summer temperatures range from warm to hot, and winters are moderately cold. Peak periods of precipitation occur in early winter and again in mid-summer, but, overall, precipitation is low. Peak snowpack is seldom greater than 50 cm, and many sites are without snow for most of the winter, especially on southern aspects and wind-exposed sites.

The Environment Canada 1971-2000 climate normals at the Kamloops Airport reveal temperatures hover below freezing in winter, and can exceed 28° C in summer.

Daily Mean Temperature: January: -4.2° C; July: 21.0° C
Average Annual Precipitation: 279 mm (27% is in the form of snow)
Monthly Average Precipitation: 11.7 mm - 35.2 mm (heaviest in July and August)
Bright Sunshine: 2,075 hours
Fog: 60 or more days/year

Kamloops is biogeographically connected to similar semi-desert and desert areas in the Okanagan region and the central parts of Washington and Oregon State as well as intermontane areas of Nevada in the US.

D. State of the Air in Kamloops

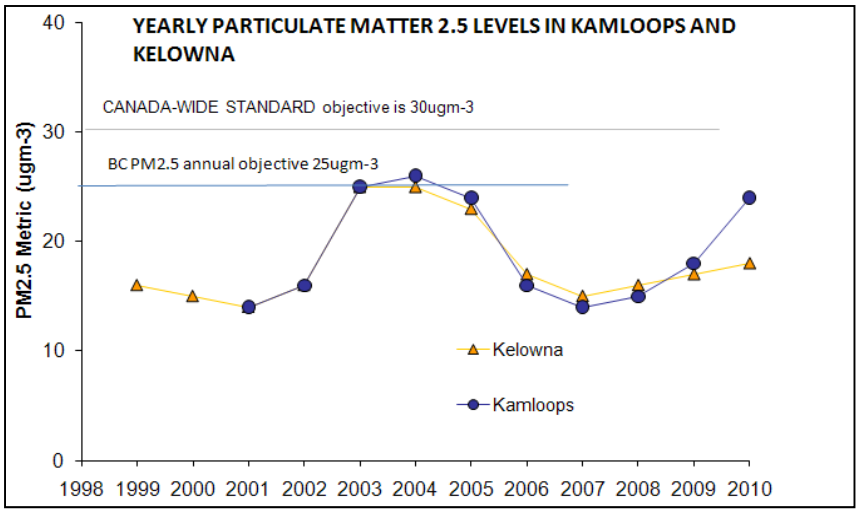
Where We Are

Kamloops air pollution levels fall well below the provincial and Canada-wide standards. We are fortunate to enjoy good air quality compared to some other BC communities and other areas of the country. The high quality of air we enjoy is a result of existing community-wide efforts and activities that favour good air quality. We all have a role to play in keeping our air clean and improving it where we can. Only through a collaborative effort amongst government, industry, business and residents, can we continue to maintain our high standard of air quality for the future sustainability of the Kamloops Airshed.

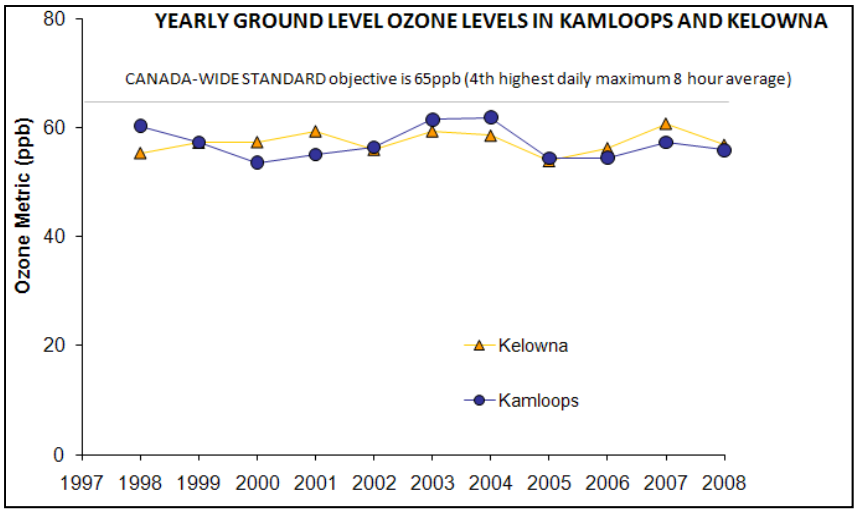
Where We Are Going

"Imagine . . . in 2050, Kamloops, Canada's Tournament Capital, is an innovative, vibrant, and diverse community. Social, economic, and environmental challenges are welcomed as opportunities to further enhance its beautifully unique landscape. It is known for its bold ecological and healthy living initiatives that shape one of the most inviting and livable cities in Canada. It continues to minimize its corporate and community footprint and leads by example when making sustainable choices for future generations.

Kamloops is a place where blue skies, clean air, and fresh water complement the strong sense of belonging, where residents feel safe and secure, where community input is valued and encouraged, and where all citizens have abundant opportunities to live, learn, work and play" (Sustainable Kamloops Plan, 2010).

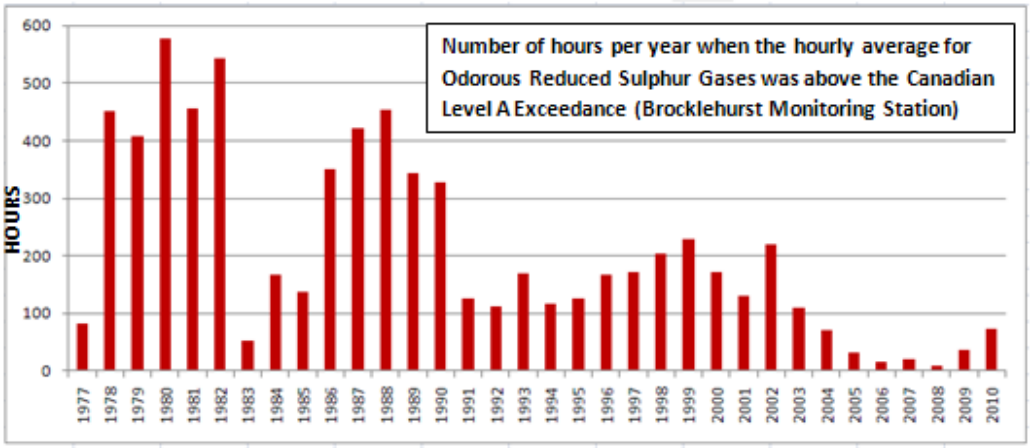


Graph 1: Particulate Matter$_{2.5}$



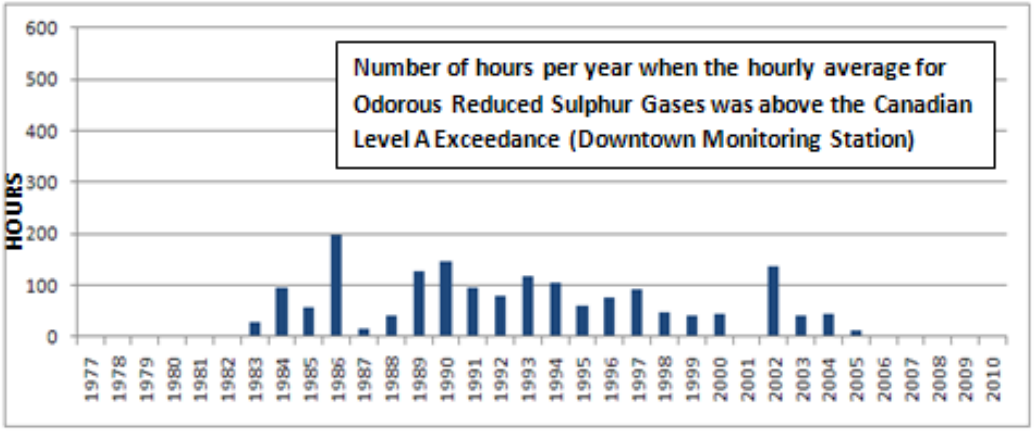
Graph 2: Ground-level Ozone

Two air pollutants that pose the most serious health risks to BC residents are PM_{10} and $PM_{2.5}$ and GLO. The graphs above depict the historical distribution of $PM_{2.5}$ and GLO in Kamloops and Kelowna in relation to CWS objectives. Both pollutant levels peaked in the early 2000s, most likely resulting from the Strawberry Hills forest fire and fires throughout the region. While GLO levels have remained fairly steady, hovering below the CWS, $PM_{2.5}$ levels have been more varied.



Graph 3: Number of Hours/Year When Hourly Average for Odorous Reduced Sulphur Gases was Above the Canadian Level A Exceedance, Brock Monitoring Station
Source: Ministry of Environment

Graph 4: Number of Hours/Year When the Hourly Average for Odorous Reduces Sulfur Gases was Above the Canadian Level A Exceedance, Downtown Monitoring Station
Source: Ministry of Environment



ORSGs don't pose a serious health risk to the population as $PM_{2.5}$ and GLO do; however, they are a nuisance pollutant. The main monitoring station for ORSG is located in Brocklehurst. A second one exists in the City Centre. The graphs above depict the number of hours ORSG was above the Canada-wide Level A Exceedance. According to the graphs, ORSG levels have declined dramatically. Monitoring at the City Centre station was disrupted over the past few years due to renovations to the site containing the monitor. Renovations are now complete and data collection has resumed.

Maximum observed yearly averages for other contaminants in Kamloops

	BROCKLEHURST								DOWNTOWN	
	Carbon Monoxide		Nitrogen Dioxide		Nitrogen Oxide		Sulphur Dioxide		Sulphur Dioxide	
	1 hr	8 hr	1 hr	24 hr.	1 hr	24 hr	1 hr	24 hr	1 hr	24 hr
Level A Objective	14300	5500	400	200	NA	NA	450	160	450	160
Year	(ugm-3)	(ugm-3)	(ugm-3)	(ugm-3)	(ugm-3)	(ugm-3)	(ugm-3)	(ugm-3)	(ugm-3)	(ugm-3)
1995	3492	2474	90	66	269	84	40	10	35	4
1996	3492	2827	117	74	286	130	64	8	35	5
1997	3500	2171	92	66	257	117	24	4	24	5
1998	2700	1563	90	59	177	136	61	11	48	11
1999	3400	1729	84	55	213	144	83	19	40	8
2000	12100	2588	90	74	311	141	56	11	40	8
2001	2300	1757	92	59	157	67	93	10	75	17
2002	2400	1529	82	66	207	108	75	18	109	14
2003	4200	3313	80	52	299	90	88	10	45	13
2004	2212	1514	78	54	206	106	48	8	53	9
2005	2212	1397	82	58	192	85	64	13	90	10
2006	2445	1630					56	9		
2007	2096	1630	80	54	153	67	77	11		
2008	1863	1281	78	56	165	67	61	14		
2009	2320		78		135		67			

Chart 2: Maximum Observed Yearly Averages for Other Contaminants in Kamloops

These pollutants have never exceeded the CWS Level A Objective and tend not to be a problem in Kamloops. While we should continue to monitor them, they do not appear to be a threat to human health in Kamloops.

The Downtown monitor was inactive due to repairs to its host building, which is why there is some missing data for certain years. The monitor itself was updated in 2011 to include the ability to monitor PM levels.

E. Pollutants to Consider Within the Kamloops Airshed Management Plan

Pollutants considered for the Airshed Management Plan are those that pose the most significant effect to human health and are relevant to the Kamloops Airshed. These pollutants are also identified by Environment Canada as Criteria Air Contaminants. Information on CAC emissions is collected every year within the National Pollutant Release Inventory (NPRI) starting in 2002. CACs are produced from a number of sources, including burning of fossil fuels, and it is because of these shared sources that CAC are grouped together.

When heating our homes with wood-burning appliances, cooking with wood stoves, using outdoor wood-fired boilers, or burning backyard waste, we release various levels of PM2.5 and PM10, VOCs and nitrogen oxides (NO_x) into the air. These are released into the air in the form of smoke. When we burn garbage, plastics, and tires, the amounts of harmful emissions are further increased in the atmosphere.

While using cars, boats, off-road vehicles, airplanes, trains, oil and gas furnaces, gas stoves and water heaters, gas-powered garden tools, barbecues, and light-industrial equipment such as generators, we are releasing PM, NOx, VOCs, SO2, and other pollutants into the air.

Using certain household products, including paints, solvents, cleaning agents, printing ink, or personal products such as hair, deodorant, and air freshener sprays, can release various levels of VOCs and PM into the air.

Driving our vehicles stirs up road dust, particularity on dirt roads or sanded, paved roads during the winter. The PM10 resulting from this can cause air pollution and human health effects.

Finally, we often don't realize that even household appliances and products that we purchase such as refrigerators, air conditioners, freezers, fire extinguishers, and some furniture foam products can release various ozone-depleting substances.

Pollutants considered for the Plan and discussed in this section include:

- PM
- GLO
- No_x
- $S0_2$
- VOCs
- ORGS

i) Particulate Matter $_{2.5}$

Kelowna and Kamloops experienced five weeks of elevated 24-hour average PM levels in 2003 as a result of the numerous forest fires occurring at the time. Maximum levels were greater in Kelowna, where increases in physician visits for respiratory diseases were observed for three weeks during the forest fire period.

What is it?

PM is a combination of microscopic solid and liquid suspended airborne particles that vary in size, origin, and chemical composition but are less than 10 micrometres in size.

- **PM_{10}** is used to refer to particles 10 micrometres and smaller (dust and dirt, unpaved roads, agriculture and smoke from open burning). It is inclusive of $PM_{2.5}$.
- **$PM_{2.5}$** is used to refer to particles 2.5 micrometres or smaller (smoke, open burning), and experts link these particles to more severe health impacts.

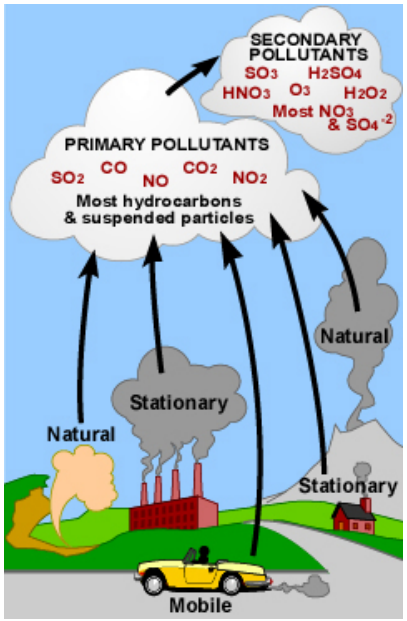


Figure 5: Primary and Secondary Pollutants

According to the Environmental Protection Agency and other regulatory bodies, PM that is less than 2.5 microns is the PM of greatest concern to human health because it can travel deep into the lungs, become lodged and can lead to chronic respiratory conditions. Fine particles that comprise $PM_{2.5}$ are also efficient at scattering light, resulting in reduced visibility.
Particles that are directly released into the atmosphere are called **primary particles**:

- Dust;
- Plant debris;
- Pollen; and
- Combustion products.

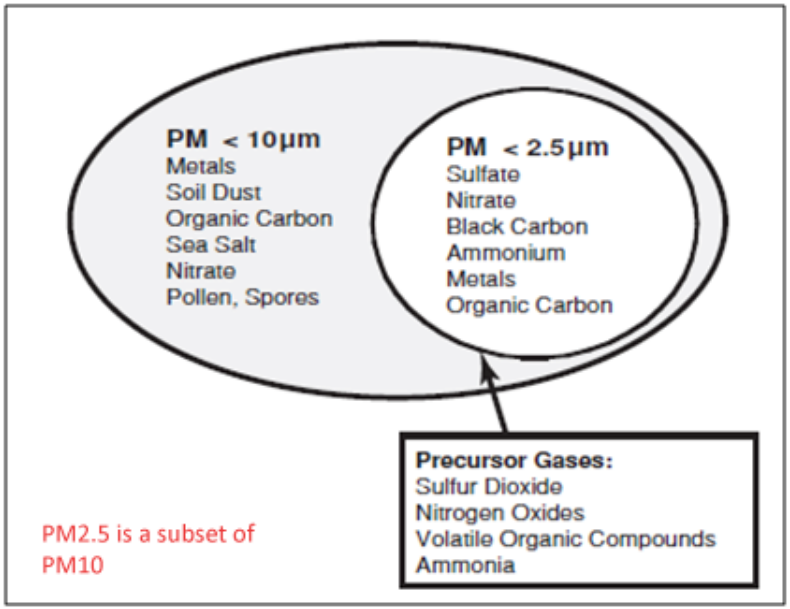
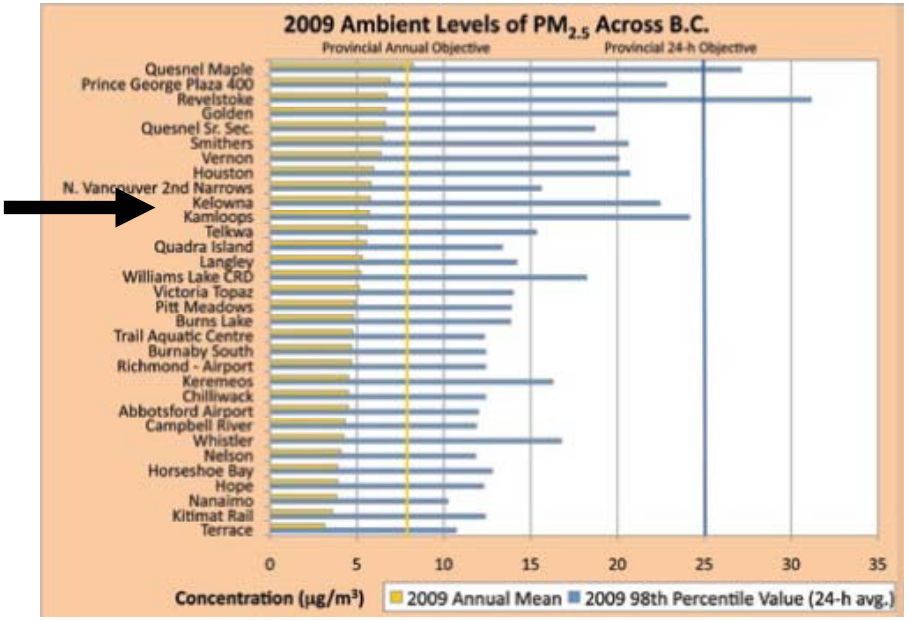


Figure 7: Composition of PM_{10} and $PM_{2.5}$
Source: McMurray, 2004



Graph 5: 2009 Ambient Levels of $PM_{2.5}$ Across BC,
Source: BC Lung Association

Particles that are emitted as a result of chemical reactions of gaseous originators (or precursors) are called **secondary particles**.

These tiny particles are dispersed in air and easily travel across large distances. Different sized particles have longer staying power and can remain in the air for weeks at a time depending on how quickly they are removed from the atmosphere through processes such as precipitation. PM does not always land near its source, causing airsheds or entire regions to suffer effects from a distant source. However, PM concentrations, are highest near points of emissions, such as major roadways and power plants.

When excluding PM loads from dust storms, forest fires, and open burning in rural areas, concentrations of $PM_{2.5}$ are generally higher in Canadian urban areas than in rural areas. Major urban centres and small industrial areas where local sources strongly influence air quality are most affected.

In BC, interior and northern communities are generally the communities with the highest levels of PM pollution due to incomplete combustion of wood and wood products (Chess, Jackson, Liston, Medd, & Noullett, 2008).

The precursor gases within PM present in various levels in the air we breathe include, but not limited to:

- SO_2,
- NO_x, and
- VOCs.

Emission inventories suggest outside of the Fraser Valley, natural sources of PM comprise approximately 25% of emissions of both $PM_{2.5}$ and PM_{10} (Suzuki & Taylor, 2003).

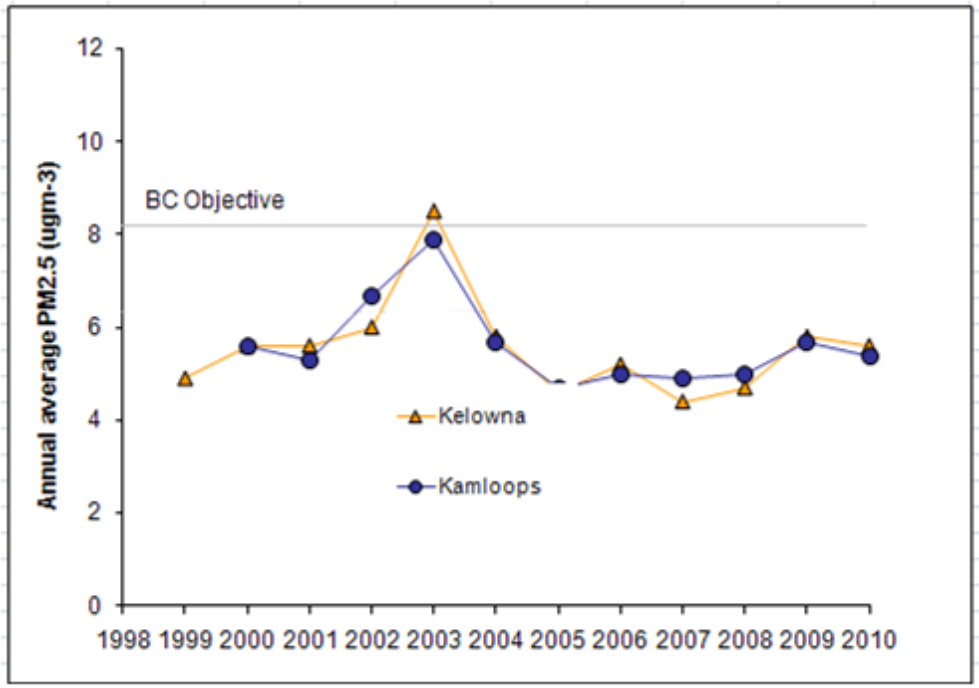
	Emissions	General Source Types
Primary	Crustal / Soil Dust / Road Dust	Paved / unpaved roads, vehicle tire and brake wear, construction, agricultural and forestry operations, and high wind events.
Primary	Salt (NaCl)	Oceans, road salt and salt pans / dry lake beds.
Primary	Biogenic material	Pollen, spores and plant waxes.
Primary	Metals	Industrial processes and transportation
Primary	Black carbon	Fossil-fuel combustion (especially diesel engines).
Primary	Semivolatile organic compounds (direct condensation of organic vapors at ambient conditions) and non-volatile organic compounds	Fossil fuel combustion, surface coatings and solvents, cooking, and industrial processes. Forest fires and biomass burning.
Secondary	Semivolatile and volatile organic compounds (forming secondary organic aerosols)	
Secondary	Sulfur dioxide (forming sulfate particles)	Electrical utilities, transportation, mining and smelting, and industrial processes.
Secondary	Ammonia (contributing to formation of ammonium sulfate and ammonium nitrate)	Agriculture and animal husbandry, with minimal contributions from transportation and industrial processes.
Secondary	Nitrogen oxides (forming ammonium nitrate with ammonia)	All types of fossil-fuel combustion, and to a minor degree microbial processes in soils.

Figure 6: Emission Inventory and Sources

Where Does it Come From?

PM, like most pollutants, is emitted from a number of human and natural sources. Specific examples of sources are identified in Chart 1: Main Sources of BC Emissions on Page 14.

These human-caused sources can result in widespread increases in airborne PM concentrations and are the main source of $PM_{2.5}$ particles. Some examples of human caused sources include industrial operations and emissions from private homes stemming from wood burning appliances and barbecues. Health experts from the World Health Organization say emissions from traffic, particularly from diesel engines, are most damaging to human health and are potential cancer causing agents.



Graph 6: Kamloops Annual Average Ambient $PM_{2.5}$ Levels in comparison to Kelowna levels
Source: Ministry of Environment

In BC, coal mining, cement and concrete production, mining and rock quarrying, and aluminum production are other important emission sources. Small businesses such as automotive shops, dry cleaners, and painting operations use various toxic substances, such as paints and solvents, cleaning agents, which also contribute to air pollution. (BC MOE, 2011)

Human Health Effects

In August 2010, more than 100 people in the Chilcotin had to be evacuated from some towns because the smoke from nearby forest fires was so bad. These people suffered from sore throats, itchy eyes, and serious difficulties breathing. Source: The Kamloops Daily News, 2010.

There is no "safe" level of PM. Studies show that health improves when the ambient concentration of PM is reduced (NARSTO, 2004).

Certain population subgroups appear to have heightened susceptibility to PM, such as those with pre-existing cardiac and respiratory disease (seen frequently in smokers), asthmatics, and the elderly. Increases in adverse health outcomes have been observed for both short- and long-term exposures to PM.

In humans, PM has been linked to cardio respiratory diseases, decreased lung function, increased respiratory stress, bronchitis, and asthma, premature death.

Environmental Health Effects

- PM can cause degradation of organic and inorganic materials, resulting in corrosion, erosion, soiling and discoloration.
- PM refracts, reflects or absorbs light, creating a regional haze, reducing visibility.
- PM is directly related to broad issues of environmental concern, such as smog, acid deposition and climate change.
- Soil particles can be significant contributors to visibility impairment in areas susceptible to windblown dust.

Economic Effects

- The difficulty in assessing the economic costs and benefits to the environment of reducing PM concentrations lies in the difficulty of assigning economic value to ecological systems, services and processes.
- Known poor air quality as a result of PM and other pollutants can potentially limit opportunities for economic growth.

ii) Ground-level Ozone

What Is It?

GLO is a secondary highly detrimental pollutant - a highly reactive and unstable form of oxygen arising from chemical reactions amongst precursor gases, principally NO_x and VOCs in the presence of sunlight.

GLO, is referred to as "bad ozone" produced in the air closest to the earth's surface and caused by human activity.

It is:

- A by-product of the interactions between common air contaminants found in PM;
- Continually created and destroyed near the earth's surface by reactions involving oxygen molecules and ultraviolet light; and
- Increased by the presence of high concentrations of NO_x and VOCs that react, with oxygen, in sunlight.

In BC, GLO typically occurs in higher levels:

- From May to September and between noon and early evening;
- Over urban areas that produce large amounts of VOCs and NO_x; and
- In rural areas because ozone can travel up to several hundred kilometres away from the source

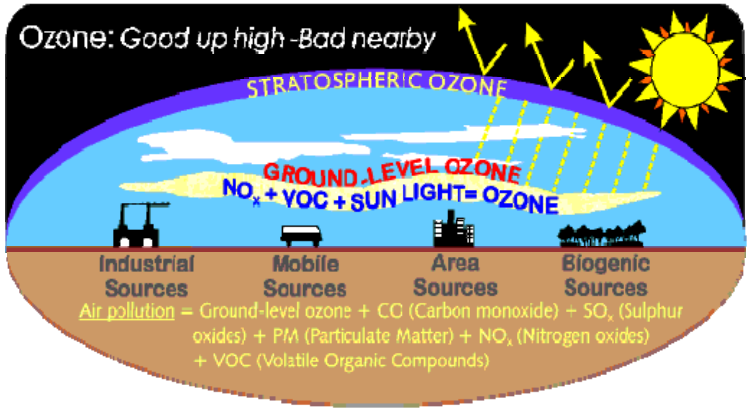


Figure 7: Ozone Good Up High

GLO levels in Kamloops have remained fairly consistent since the late 1990s, with a small peak in 2003. PM levels also peaked in 2003 in the City suggesting that a major episodic event took place leading to poorer air quality. This major event was the 2003 forest fires in Kamloops and Kelowna.

During the late 1990s:

- Highest mean concentrations of GLO were typically monitored at sites downwind and outside of the Lower Mainland including Kamloops. The highest concentrations of GLO were reported during the spring months (British Columbia Air Resources Branch, 1998).
- It was suggested, at this time, that because Kamloops exhibited a high background concentration of ozone throughout the year, and periods of elevated ozone concentrations during the summer months, that ozone may be an emerging issue in this and other growing communities. There has not been, however, an upward trend in GLO levels in the region.

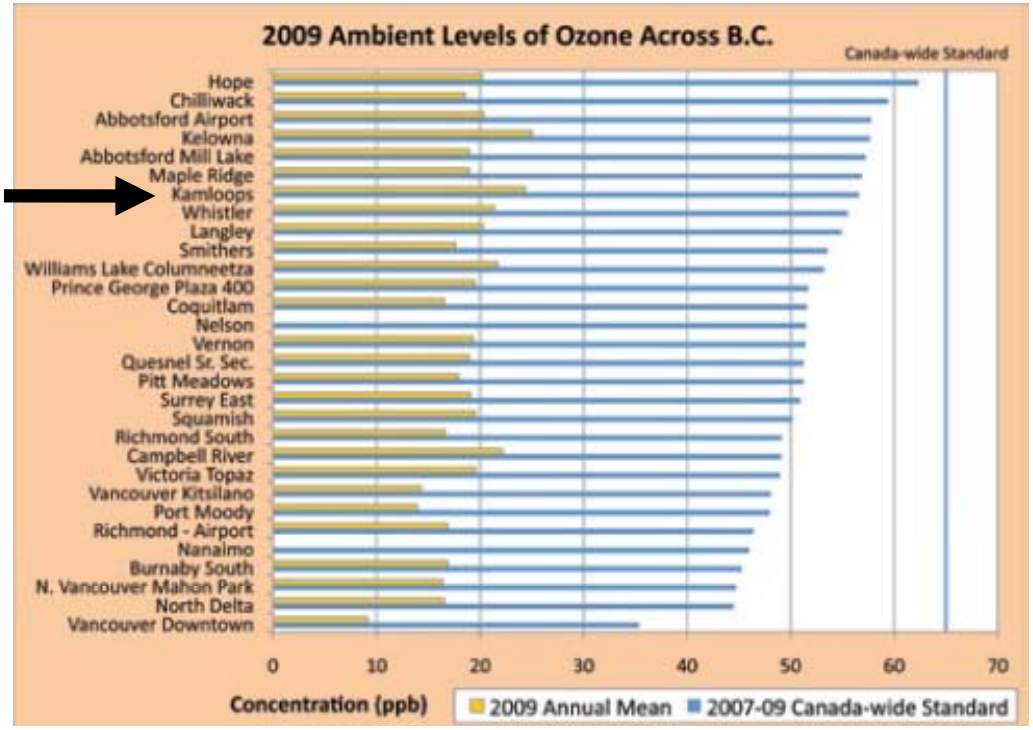
Where Does it Come From?

Ozone is formed by the reaction of two types of chemicals - VOCs and NO_x - in the presence of sunshine and warm temperatures. When the air is stagnant, ozone builds up. In Canadian cities, GLO usually occurs in the warmer months of the year.

Ozone in the troposphere (lowest major atmospheric layer) may also form as a consequence of lightning or originate from the natural intrusion of ozone from the stratosphere (where it exists in relatively high concentrations, the so-called "ozone layer").

GLO collects over urban areas that produce large amounts of VOCs and NO_x. Rural areas can be affected as well, because ozone can travel up to several hundred kilometres away when carried by the wind.

GLO levels in Kamloops have remained fairly consistent since the late 1990s with a small peak in 2003.



Graph 7: 2009 Ambient Levels of Ozone Across BC

Source: BC Lung Association

Human Health Effects

- People with lung or heart problems are most at risk, but even healthy people who are active outdoors can be affected when Os ozone levels are high;
- Children are at a higher risk because they breathe more rapidly than adults and their respiratory systems are not fully developed; and
- GLO has been linked to headaches, burning eyes, irritated sinuses, chest tightness and a variety of other maladies.

Environmental Health Effects

- It is the main ingredient of smog in our communities;
- GLO can damage vegetation and stunt growth, reduce productivity and reduce reproduction;
- It can make plants vulnerable to insects and disease;
- It reduces yields in sensitive crops;
- It increases death rates of individual trees, leading to a decline of species;
- It is linked to compromised respiratory systems of animals (e.g. lung haemorrhages in birds).

Both PM and ozone have a long history of regulation in North America. They are two of the air contaminants originally regulated in Canada as "criteria pollutants" some 30 years ago.

Although these two air pollutants have historically been regulated and air quality improvements are evident, they continue to be important indicators of air quality. The pollution concentration estimates associated with these effects are at levels that most Canadians frequently encounter. Thus there is a compelling public health commitment to manage and reduce exposures to these pollutants.

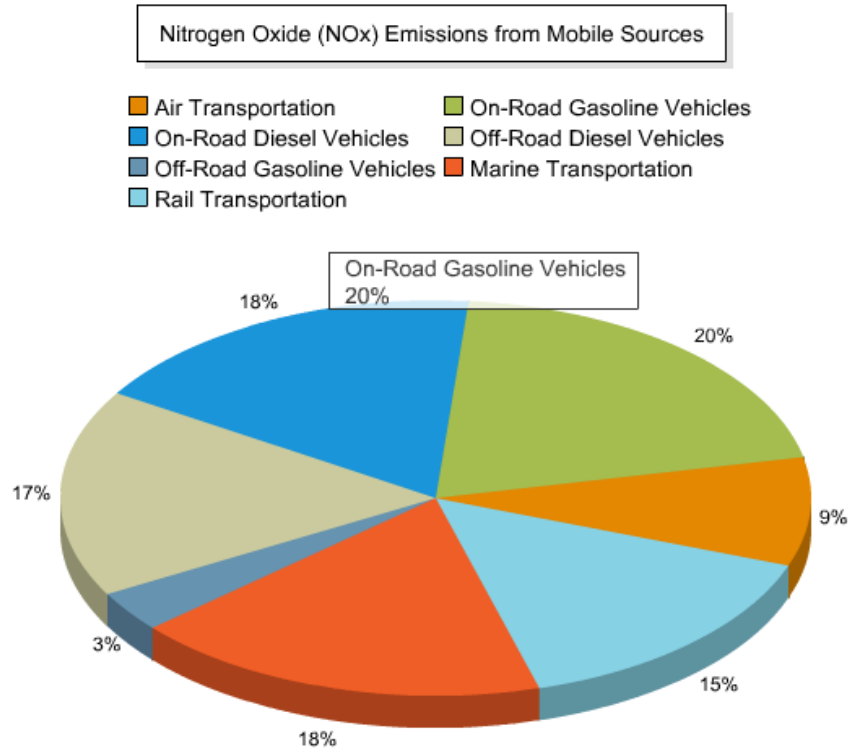
Economic Effects

- GLO has been shown to reduce agricultural yields for many economically important crops including: wheat, soybean, and sensitive fruits;
- Potential losses in sectors such as tourism and agriculture; and
- Poor air quality as a result of GLO and other pollutants can also limit opportunities for economic growth.

iii) Nitrogen Oxides

What are they?

- A group of highly reactive gases that include nitric oxide (NO), nitrous oxide (N2O), and NO2;
- Formed when nitrogen combines with oxygen;
- NO2 is odorous, brown and highly corrosive; it is the most damaging to human health;
- Gases that form when nitrogen and oxygen in the atmosphere are burned with fossil fuels at high temperatures; and
- Their lifespan in the atmosphere ranges from one to seven days for NOx and NO2 and 170 years for N_2O.



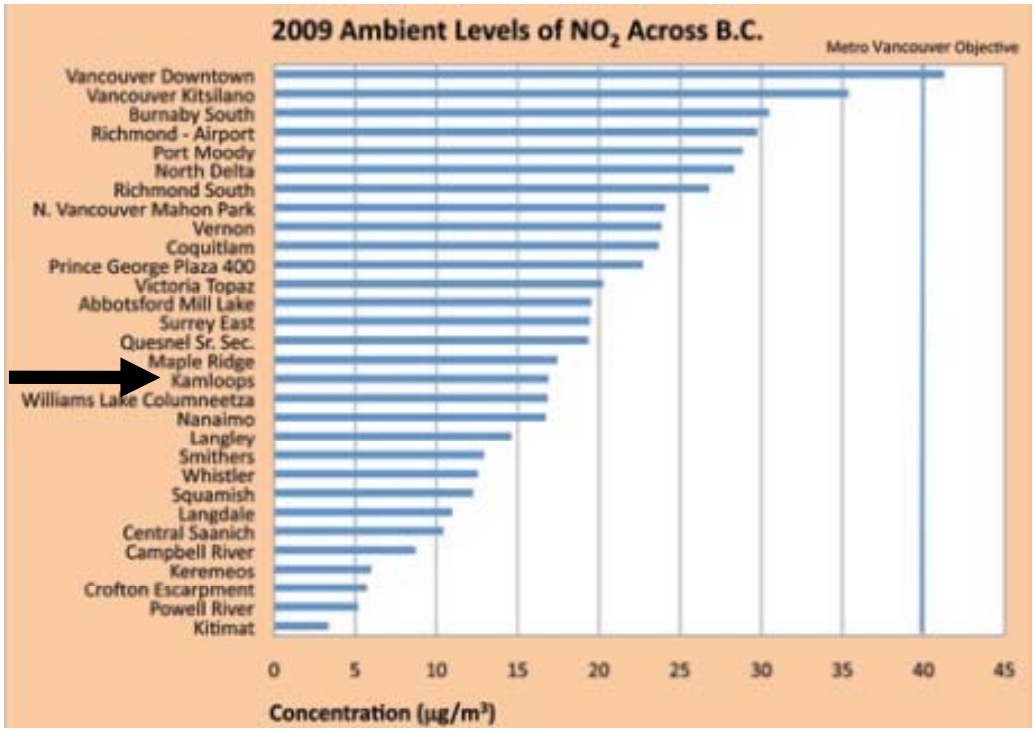
Graph 8: Nitrogen Oxide Emissions from Mobile Sources Excluding Lower Fraser Valley
Source: 2000 BC Emissions Inventory of Criteria Air Contaminants, 2005

Where do they come from?

- High-temperature combustion;
- Fossil fuel burning in motor vehicles, homes, businesses, factories and power plants;
- Animal manure management; and
- Agricultural and lawn care practices.

N_2O is produced naturally in soils. The natural emission of N_2O can be increased by a variety of agricultural practices and activities, including the use of synthetic and organic fertilizers, production of nitrogen-fixing crops, cultivation of high organic content soils, and the application of livestock manure to croplands and pasture. These practices directly add additional nitrogen to soils, which can be converted to N_2O. Indirect additions include those processes by which applied fertilizer or manure nitrogen volatilizes into NH_3 and oxides of nitrogen and then is ultimately re-deposited onto the soil in the form of particulate ammonium, nitric acid, and oxides of nitrogen.

The City of Kamloops has relatively low levels of NO_2 compared to other BC communities.



Graph 9: Ambient levels of NO_2 across BC
Source: BC Lung Association

FACT: The motor vehicle is a major source of NO_x and VOCs. According to Transport Canada, the transportation sector alone is responsible for more than 54% of NO_x emissions in Canada. The rail sector contributes about 9% of NO_x emissions.

Human Health Effects

- Small levels of NO_x can cause nausea, irritated eyes and/or nose, fluid forming in lungs and shortness of breath;
- Breathing in high levels of NO_x can lead to rapid, burning spasms; swelling of throat; reduced oxygen intake; a larger build-up of fluids in lungs and/or even death;
- NO_x, plus other GLO pollutants, can cause other major respiratory problems in high levels;
- NO_x can react with aerosol cans and cause respiratory problems; and
- NO_x can cause visual impairment.

Environmental Health Effects

- Contributes to acidification and nutrient enrichment of soil and surface water.
- NO by itself is non-toxic, but it is readily converted in the air to NO_x. At high concentration levels, NO_x is potentially toxic to plants, can injure leaves and reduce growth and yield. In combination with either ozone or SO_2, NO_x may cause injury at even low concentrations.
- N_2O is a greenhouse gas. As well it contributes to ozone depletion in the stratosphere.

Economic Effects

Additional health care costs for the treatment of the effects of these pollutants and other costs such as:

- Hospital admissions;
- Visits to the emergency room or doctor's office;
- Homecare service; and
- Medication such as inhalers for asthma.

Other considerations include:

- Lost productivity in the workplace;
- Lost wages due to sick time;
- Out of pocket expenses while sick; and
- Lost quality of life or life itself.

iv) Sulphur Dioxide

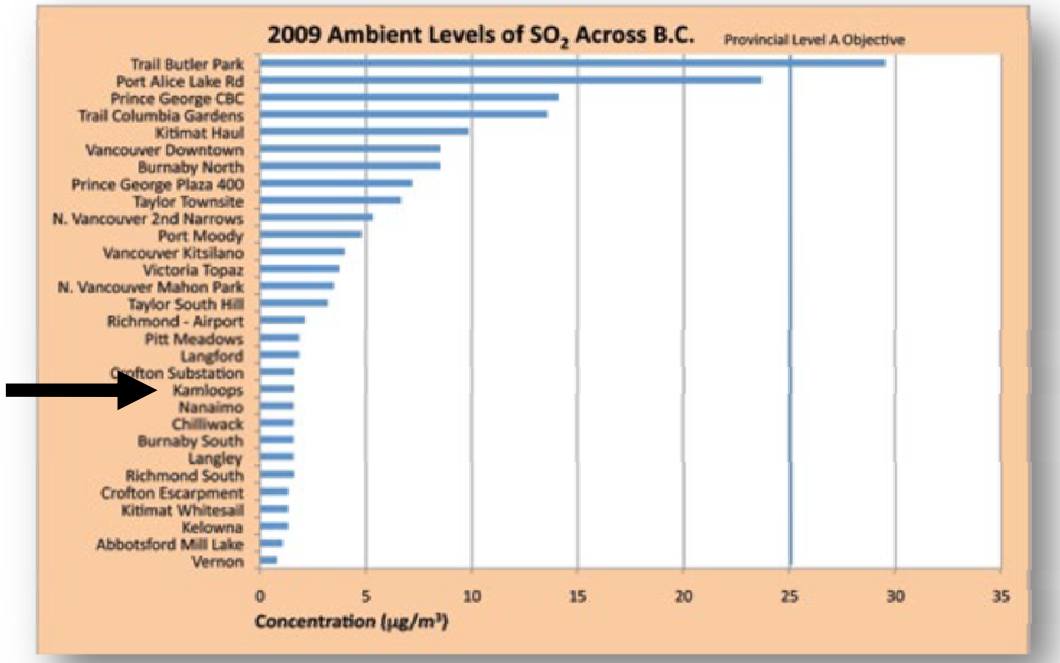
What Is It?

SO_2 is a colourless gas with pungent odour that smells like a struck match. Once released, SO_2 can react with other pollutants in the air to form fine PM.

Where does it come from?

In BC, the largest sources of SO_2 in order of contribution include:

- Oil and gas industry;
- Pipeline operations;
- Marine operations;
- Metal smelting;
- Pulp and paper production; and
- Off-road equipment (to a lesser extent).



Graph 10: 2009 Ambient levels of SO_2 across BC
Source: BC Lung Association

Human Health Effects

- Aggravation of asthma and increased respiratory symptoms;
- Contributes to PM formation with associated health and environmental effects;
- People most often exposed to SO_2 are workers in industrial facilities, where it is used or occurs as a by-product. Long-term exposure to major sources of SO_2 can affect a person's health by reducing the ability to breathe deeply or take in as much air for each breath, and aggravate or worsen existing heart disease and respiratory disease, such as emphysema and bronchitis;
- Children who have breathed SO_2 pollution may develop more breathing problems as they get older;
- At high levels, SO_2 can be life-threatening; and
- Short-term exposure to SO_2 can cause health concerns especially for people with asthma, young children, and the elderly. For these sensitive individuals, SO_2 exposure can result in increased visits to emergency departments and hospital admissions for respiratory illnesses.

Environmental Health Effects

- Emissions of SO_2 are responsible for 60-70% of the acid deposition that occurs globally;
- Increased acidity can lead to plants that have reduced growth rates, flowering ability and yields. It also makes plants more vulnerable to diseases, insects, droughts and frosts; and
- SO_2 as well as toxic metals, such as mercury and aluminum can be released into the environment through the acidification of soils. These contaminants can then end up in the drinking water, crops, and fish and then ingested by humans through consumption. If ingested in great quantities, these metals can have toxic effects on human health.

Economic Effects

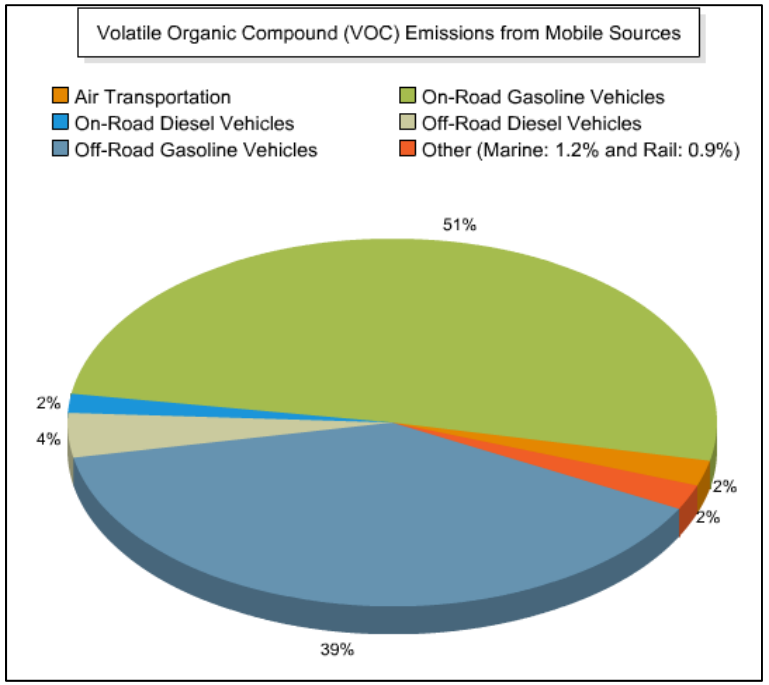
- The combined effects of SO_2, NO_x, and VOC_s can significantly decrease the natural beauty of an area; and
- Buildings and head stones that are constructed from limestone are easily attacked by acids, as are structures that are constructed of iron or steel; paint on cars can react with acid deposition causing fading.

v) Volatile Organic Compounds

What Are They?

VOCs are a family of chemical compounds that evaporate, changing from a liquid to a gas. While VOCs are typically not monitored and targeted individually, and are not considered a priority pollutant in Kamloops to date, it is important that we are aware of their impact on air quality.

- VOCs are gases given off by a number of indoor activities. Concentrations of most VOCs are higher indoors than outdoors;
- VOCs are a main component of GLO by reacting with NO_x when it is sunny and warm; and
- VOCs generally do not stick to soils at low concentrations, and readily evaporate from water and soil when the water is used for irrigation purposes.



Graph 11: Volatile Organic Compound Emissions from Mobile Sources Excluding Lower Fraser Valley
Source: 2000 BC Emissions Inventory of Criteria Air Contaminants, 2005

Where do they come from?

On-road gasoline vehicles in BC account for 51% of VOC emissions. Other contributors include:

- Air and marine transportation;
- Evaporation of gasoline in motor vehicles (gas fumes);
- Burning of fuels such as gas, wood and kerosene and tobacco;
- Oil-based paints;
- Paint thinners;
- Varnish;
- Car wax;
- Antifreeze and paint;
- Deodorant and hair spray;
- Copying and printing machines; and
- Emissions from the oil and gas industry.

Human Health Effects

- VOCs include a variety of chemicals that can cause eye, nose and throat irritation, headache, nausea, dizziness, and skin problems;
- Higher concentrations may cause irritation of the lungs, as well as damage to the liver, kidney, or central nervous system; and
- Some VOCs are suspected to cause cancer; the health effects caused by VOCs depend on the level and length of exposure.

Environmental Health Effects

- VOCs are primary precursors to the formation of GLO and PM in the atmosphere which are the main ingredients of the air pollutant "smog". Smog is known to cause harmful effects to vegetation.

Economic Effects

Increases in:

- Agricultural crop loss;
- Non-agricultural vegetation for aesthetics; and
- Material damage.

vi) Odorous Reduced Sulphur Gases

What are they?

ORSG compounds produce offensive odours similar to rotten eggs or cabbage. They are the general category of gases containing Total Reduced Sulphur Gases (TRS) and Hydrogen Sulphides (H2S). These compounds are not normally considered a health hazard. They are, however, a primary cause of nuisance odours. ORSG is a top-of-mind issue for many communities where pulp mills and other industries are located.

Where do they come from?

- Industrial sources of ORSG include the steel industry, pulp and paper mills, oil and refineries and sewage treatment facilities;
- Natural sources include swamps, bogs and marshes.

Air quality complaints to BC regulatory agencies are frequently related to odour concerns. Other odour sources include auto body shops, agriculture activities, feed manufacture, composting operations, and landfills.

Human Health Effects

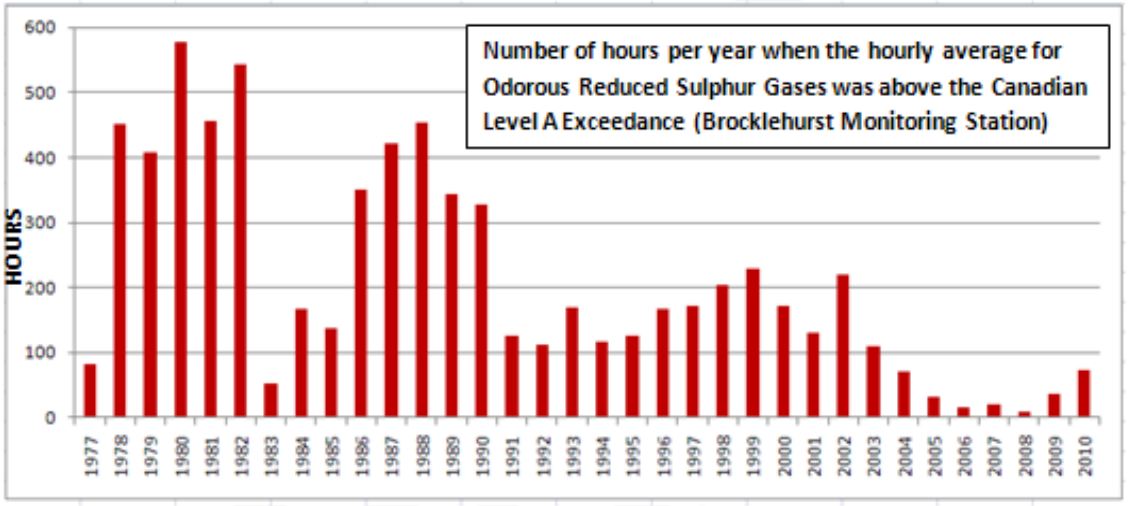
- While ORSG substances do not appear to have a significant human health impact at levels experienced in the Canadian environment and have not been proven to be carcinogenic, harmful effects have been reported from odour detection and perception;
- Symptoms from odour can include headaches, nausea, eye and throat irritation, sleep disturbances, stomach upset, breathlessness, and a decreased sense of well-being (Shusterman, 1992);
- Odours from industrial sites can increase the level of anxiety in neighbouring communities, worried about health impacts from industrial emissions (Shusterman, Lipscomb, Neutra, & Kenneth, 1991); and
- There is a general perception that the odour caused by ORSG is a human health risk.

Environmental Health Effects

- Environmental health impacts have only been studied at length for hydrogen sulphide. Since sulphur is an essential element for plant growth it can act as either a fertilizer or a toxicant depending on levels of concentration. Animals exposed to higher ambient concentrations of hydrogen sulphide may experience nasal, eye and respiratory irritation.

Economic Effects

- ORSG can negatively impact economic growth of a community through overall perception by visitors and residents; and
- ORSG are a nuisance in that they affect people's perception of the air. This may affect people's decisions whether to visit or work in certain areas where levels are higher due to proximity to sources or weather patterns.



Graph 12: Number of Hours per Year When the Hourly Average for Odorous Reduced Sulphur Gases was Above the Canadian Level A Exceedance

Source: Ministry of Environment

Glossary of Acronyms

Air Quality Health Index	AQHI
Ammonia	NH_3
Canada-wide Standards	CWS
Carbon Dioxide	CO_2
Carbon Monoxide	C0
Ground-level Ozone	GLO
Hydrogen Sulphide	H_2S
Methane	CH_4
Microgram	µg
Ministry of Environment	MOE
Nitric Oxide	NO
Nitrogen Dioxide	$N0_2$
Nitrogen Oxides	$N0_x$
Nitrous oxide	N_2O
Odorous Reduced Sulphur Gases	ORSG
Particulate Matter	PM
Particulate Matter 10	PM_{10}
Particulate Matter 2.5	$PM_{2.5}$
Parts per billion	ppb
Sulphur Dioxide	$S0_2$
Total Reduced Sulphur	TRS
Volatile Organic Compounds	VOCs

Glossary of Air Quality Terms

The following definitions explain some common terms used when discussing air quality and air quality management issues in BC

Airshed

Topography (hills and valleys) and weather conditions can interact to prevent the mixing and exchange of air from inside and outside a given area. This area is called an 'airshed'. A good example of an airshed is a valley where the surrounding mountains act as a physical barrier to air moving out of the valley when the air is still. Because weather and wind conditions change from day to day, the boundary of an airshed isn't constant; it can change with the weather.

Air Pollutants

Are any gas, liquid or solid substances that are present in the atmosphere in high enough concentrations to be considered harmful to the environment or to human health? Common examples of pollutants include: dust, wood smoke, NO_x, SO_2, GLO, and PM.

Air Emissions

Are any kind of substance released into the air from natural or human sources? An emissions inventory provides information on the amount of emissions coming from various sources in a given area within a given period of time (usually a year).

Ambient Air Quality

Refers to the air in our immediate surroundings. Ambient air quality describes the level of air pollutants in a particular region. Poor ambient air quality means pollutant levels are high enough to cause concerns. Ambient air quality is measured near ground level, away from direct sources of pollution.

Anthropogenic

Resulting from the presence or activities of humans.

Carbon Monoxide (CO_2)

One of the six criteria pollutants. A colourless, odourless, and poisonous gas produced by incomplete burning of carbon in fuels.

Concentration

The amount of a pollutant in the air at a given location, expressed as the weight of volume of pollutant per volume of air, such as parts per billion or micrograms per cubic metre of air ($\mu g/m^3$)

Criteria Air Contaminant (CAC)

There are seven air pollutants that are considered criteria air contaminants that are emitted predominantly to the air. The seven contaminants are total PM, inhalable PM (PM_{10}), fine PM ($PM_{2.5}$), CO, NO_2, SO_2, and VOCs.

Emission

The act of releasing or discharging air pollutants into the ambient air from any source.

Emission Inventory

An emission inventory is a comprehensive account of air pollutant emissions and associated data from sources.

Environmental Management Act (EMA)

A provincial act providing the legal and institutional framework for the sustainable management of the environment; impact and risk assessments, the prevention and control of pollution, waste management, environmental quality standards, public participation, compliance, and enforcement.

Exposure

A combination of the level of a pollutant and the amount of time that a person spends in the presence of a pollutant. Exposure determines the level of risk associated with different levels of pollutants.

Ground-level Ozone (GLO)

One of the six criteria pollutants. GLO is a chemical reaction with light and the major component of smog.

Hydrogen Sulfide (H_2S)

The chemical compound with the formula H_2S. It is a colorless, very poisonous, flammable gas with the characteristic foul odour of rotten eggs

Inversion

A meteorological condition in which a layer of warm air presides over a layer of cold air. Pollution can be trapped below the warm air potentially resulting in poor air quality over an area.

Kamloops Airshed

The mass of air contained in the City of Kamloops and the immediate surrounding communities of the Thompson-Nicola Regional District and the Tk'emlúps Indian Band and particularly that air mass contained and affected by the natural topographical features of the Thompson valley.

Levels A, B and C Ambient Air Quality Objectives

Level A Objectives are established to provide the basis for an anti-degradation policy for undeveloped areas with an adequate safety margin. For some contaminants, the provincial Level A Objectives are equal to the national Maximum Desirable Level which is the long-term goal for air quality and provides the basis for an anti-degradation policy for unpolluted parts of the country, and for the continuing development of control technology.

Level B Objectives are established to provide adequate protection against adverse effects on human health, animals, vegetation, soil, water, materials and visibility. Comparable to the national Maxi-mum Acceptable Level.

Level C Objectives are established to provide protection against health effects that are specific to each contaminant. No common definition is used.

Microgram (µg)

A metric unit of mass equal to 0.001 milligram (mg) or one millionth of a gram. One $\mu g/m^3$ is similar to a grain of sand suspended in a small apartment.

Microns

A unit of length equal to one millionth of a meter; the unit of measure for wavelength.

Mobile Source

Mobile emission sources normally including road and off-road sources, motor vehicles, aircraft, marine vessels, and locomotives.

Monitoring

Measurement of air pollution and related atmospheric parameters.

Nitrogen Dioxide(NO_2)

A gas consisting of one nitrogen and two oxygen atoms. It absorbs blue light and therefore has a reddish-brown colour associated with it.

Nitrogen Oxides (NO_x)

One of the six criteria pollutants. The term used to describe the sum of NO, nitric dioxide and other oxides of nitrogen, which plays a major role in the formation of ozone. NO_x poses the most serious health risk. The major sources of man-made NO_x emissions are high temperature combustion processes, such as those occurring in automobiles and power plants.

Non-point Source

A combination of a variety of pollution sources that are difficult or too small to measure on an individual basis. There are far too many cars, fireplaces and lawnmowers to track exactly how much each one is emitting by itself but they can all add up to a significant amount of total emissions. Therefore, for the purpose of developing an emission inventory, these sources are combined into categories called 'non-point sources'.

Odour Reduced Sulphur Gases (ORSG)

ORSG gas are colourless gases that are considered to be nuisance odour pollutants. They comprise Hydrogen Sulphide and Total Reduced Sulphur compounds. At detectable concentrations, ORSG is characterized by an offensive odour similar to rotten eggs or cabbage.

Particulate Matter (PM)

Material that is carried by liquid or solid aerosol particles with aerodynamic diameters less than 10 microns (PM_{10}). Road dust is an example. Fine PM is PM with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$). Smoke from wood burning and vehicle emissions are examples.

Parts per Billion (ppb)

Denotes one particle of a given substance for every 999,999,999 other particles. This is roughly equivalent to one drop of ink in a lane of a public swimming pool, or one second per 32 years.

Photochemical

A chemical reaction initiated by the absorption of energy in the form of light

Point Source

A single, stationary source of pollution that can be well defined. A vapour stack is an example of a point source; it is easy to measure and define the source of the pollutants. It is also easy to regulate using an emission permit process.

Respirable

Able to be breathed in. Fine PM ($PM_{2.5}$) that is breathed in and enters our respiratory system is 'respirable'. This is the most dangerous of PM.

Smog

A mixture of air pollutants, principally GLO, produced by chemical reactions involving smog-forming chemicals.

Sources of Air Pollution

Are normally described by the activity that caused the emission. Sources can be natural or human generated. Natural sources include wind-blown dust, volcanoes and forest fires. Human sources include the burning of fossil fuels, stirring up dust, and burning of wood or leaves.

Sulphur Dioxide (SO_2)

A gas consisting of one sulphur and two oxygen atoms. It is an air pollutant arising from the combustion of sulphur in fuels. Above certain concentrations it is a respiratory irritant; during airborne transportation it can convert into an acid precipitated as acid rain, damaging crops, forests, lakes and structures.

Total Reduced Sulphur (TRS)

Total reduced sulphur includes hydrogen sulphide, mercaptans, dimethyl sulphide, dimethyl disulphide and other sulphur compounds.TRS compounds produce offensive odours similar to rotten eggs or cabbage. TRS compounds are not normally considered a health hazard. They are, however, a primary cause of odours.

Volatile Organic Compounds (VOCs)

Refer to photochemically reactive hydrocarbons, excluding CH_4, ethane, acetone, methylene chloride, methyl chloroform, and several chlorinated organics because of their low reactivity in the atmosphere. These are gases that form when hydrocarbons are released into the atmosphere from such things as trees and grasses, decomposition of vegetative matter, combustion, industrial processes, and evaporation from liquid petroleum fuel. Natural biological sources are responsible for the majority of VOCs released; however, man-made sources may dominate in urban airsheds. Some VOCs have direct health and environmental effects while others react with other gases in the atmosphere to promote GLO formation.

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