Central Okanagan
Air Quality Discussion Paper

Table of Contents

1.0 INTRODUCTION

1.1 Purpose of the Discussion Paper

The objectives and strategies outlined in this discussion paper will focus on the area covered by the Central Okanagan Regional District (roughly from Peachland to Lake Country). In this region, through the Regional Growth Strategy, there is commitment to work on air quality, transportation and other key issues related to changing land uses, growth and development.

The intent of the discussion paper is to focus on air quality issues; the current management systems, future requirements and various actions needed to maintain air quality in the Central Okanagan. Any action plans would be followed up through regional "Implementation Agreements" or other partnership arrangements.

It is to be noted that this document is not an air quality management plan, as it does not set specific air pollution reduction targets. This document is for the purpose of engaging decision-makers in discussion of future steps to be taken in achieving regional air quality goals and objectives.

1.2 Okanagan Air Quality

From 1996 to 1999 air quality in the Central Okanagan was rated as good 88% of the time, "fair" 11% and "poor" 1% of the time. These statistics show that the Central Okanagan has "fair" or "poor" air quality for approximately 1051 hours per year (MoELP, 2000). These fair or poor air quality hours affect a significant portion of the year. Faced with a noticeable increase in urban "smog", public complaints about smoke, coupled with increased awareness about the harmful effects of low level pollutants, and the ever present "fair" and "poor" ratings that affect every month of each year has led the region to seriously consider taking action on the issue of air quality.

Provincially, the Okanagan is identified as one of three provincial areas of concern. The combinations of local climate and topography, vehicle usage and outdoor burning have put the Okanagan at risk for deteriorating air quality in the future.

1.3 Factors influencing Okanagan Air Quality

The Okanagan Valley is susceptible to air pollution episodes due to a combination of several regional characteristics:

Topography – The Okanagan airshed is approximately defined by the natural valley boundaries to the east and west, by Enderby to the north and Osoyoos to the south. The Okanagan Valley lies perpendicular to the prevailing winds, resulting in an increased number of calms and therefore greater air stagnation (Josefowich, 1998, pers. comm.).

Weather Patterns – In summer months, higher temperatures and increased sunlight can result in greater concentrations of ground-level ozone. In winter months, thermal inversions are common in the Okanagan Valley. A thermal inversion occurs when cold air is trapped below a layer of warmer air inhibiting the dispersion of pollutants.

Population Growth –Kelowna and area population has increased from approximately 50,000 in 1970 to 150,000 in 2001. More people equate to more vehicles, there are 104,000 registered vehicles in the Central Okanagan (Knapp, 2000), which produce more emissions and can result in deteriorated air quality.

1.4 The Airshed

The Okanagan Airshed is roughly defined as the Okanagan Valley located in south-central British Columbia, or more roughly speaking, from Osoyoos to Enderby. The valley stretches over a total length of 200 kilometers, bounded on the east and southwest by high mountain systems. A chain of rivers and lakes travels throughout the valley. Human settlement occurs along the major river deltas and extends up gently sloping terraces on the east and west facing valley slopes.

The Central Okanagan began as an agricultural region, that over the last forty years has developed into a major regional economic center and one of the fastest growing population centers of the province. Now comprising the municipalities of Kelowna, Lake Country and Peachland, the region houses a population of 150,000 that is expected to grow to 250,000 in the next twenty years.

Air quality in the Central Okanagan is primarily driven by factors within the local communities and within the larger Okanagan "Airshed". Unlike well-defined watershed boundaries, however, activities and occurrences from as far south as the northwestern United States, and as far west as Asia also affect our local atmosphere, depending on airflow and ocean currents.

1.5 Health and Costs Due to Air Pollution

Outdoor air pollutants, primarily fine particles and ozone are causing health problems in our region. About 10% of the population is considered most "at risk". If conditions worsen, the entire population will be affected to some degree.

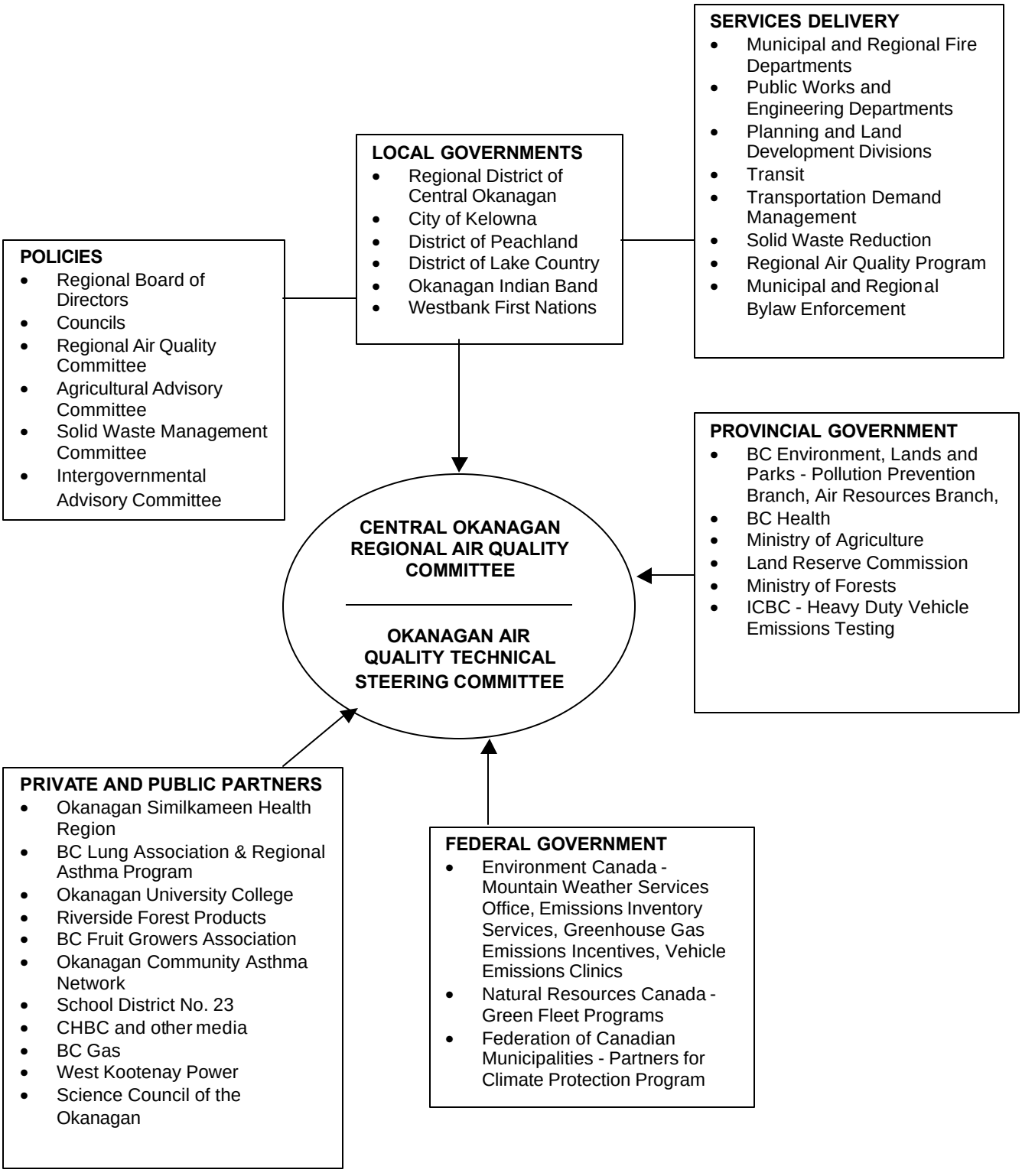
People most affected by air pollution include the very young (ages 0-5) and the elderly. People with lung conditions such as asthma, bronchitis and emphysema are particularly sensitive as well as people with heart conditions and those with sensitive eyes.

The Okanagan Similkameen Health Region estimates the Central Okanagan has:

- 15,000 people with asthma (1 in 10)
- 3,000 people with advanced bronchitis or emphysema, and
- 500 people with heart conditions

It is important to recognize a cost in terms of human suffering and loss of health and quality of life. Estimated average costs of "symptom days" due to outdoor air quality range from $1.5-7 million per year, while loss of work time is estimated at $1-1.5 million per year applicable to the Okanagan – Similkameen Health Region. There is also a small but measurable increase in premature death (due to respiratory or cardiac conditions) (Dr. Eugene Krupa, OSHR, 2001).

1.6 Central Okanagan Regional Air Quality Program - Organizational Structure and Stakeholders



1.6.1 Key Groups Involved in the Central Okanagan Regional Air Quality Program

- **Central Okanagan Regional Air Quality Committee -** In 1998, the Central Okanagan Regional Air Quality Committee was formed. Consisting of a group of elected officials from municipalities and areas of the Central Okanagan Regional District, the Committee fulfills an air quality monitoring and education/public awareness and advocacy function. Through public workshops and with provincial staff encouragement, the Committee has been "charged with the development and implementation of an Air Quality Management Plan for the Regional District of Central Okanagan subject to Regional Board approval." The AQC works in concert with the Central Okanagan Regional Transportation Committee regarding Transportation Demand Management measures. Committee members represent municipal and regional district elected officials that are responsible for land use decisions and regulations.

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- **Okanagan Air Quality Technical Steering Committee (OAQTSC) -** The OAQTSC was formed in 1995. This committee is comprised of staff and technical representatives from municipalities, Regional Districts (including North Okanagan and Okanagan Similkameen Regional Districts, provincial and federal agencies, institutions and industries in the Okanagan Airshed. Working together with the Central Okanagan Regional Air Quality Committee, the OAQTSC provides technical information and research regarding local air quality.

- **Environment Division - City of Kelowna**
  The function of the Environment group is to plan, coordinate, promote and implement programs to reduce air pollution, as a service on behalf of participating communities in the Central Okanagan Regional District. Environment staff provides an air quality education program, coordinate research studies, compile and report data and provide working support for both air quality committees. Staff also coordinate public workshops and emission clinics, hold air quality festivals and other promotional events, provide information via web site and are currently designing an Air Quality Management Plan for the Central Okanagan.

- **BC Ministry of Environment, Lands and Parks (MoELP)**
  The Ministry of Environment controls all air quality monitoring equipment in the Southern Interior, including the Central Okanagan station located at the Okanagan University College KLO Road campus. The Ministry provides air quality monitoring data, technical advice, issue air quality advisories (in cooperation with the Okanagan Similkameen Health Region) and provides the Air Quality Index to the media and the public.

  Note: at time of report writing, provincial ministries were undergoing a period of restructuring. The name "Ministry of Environment" is used throughout this report to refer to activities and functions conducted through provincial air quality programs.

- **Environment Canada**
  Environment Canada's local weather office near the Kelowna Airport collects weather data, which enables prediction of the venting index (indication of whether or not smoke and other pollutants will leave the valley), and have made this information available, along with the morning air quality index. Staff from the weather center also work on projects associated with the Central Okanagan Air Quality Program as well as offer technical advice to the Okanagan Air Quality Technical Steering Committee.

  Environment Canada has also funded the "Vehicle Emissions Clinics" held in the Central Okanagan for the past three years. This is a three-day event with a $30,000 budget.

- **Okanagan Similkameen Health Region (OSHR)**
  OSHR is concerned with the effects of air quality on the health and safety of the population. Individuals who feel the effects directly and are most at risk (young, elderly, those with respiratory and cardiac conditions) constitute about 15% of the population. Staff with the Lung Association Regional Asthma Program, supported by the Kelowna General Hospital respiratory department, Medical Health Officer and health inspectors, have contributed in several ways: public education materials and events, research in health effects and costs, media promotion, self-care instruction for people suffering due to poor air quality, development and implementation of the Air Quality Advisory (with BC Ministry of Environment), advocacy and policy development.

2.0 AIR EMISSIONS AND AIR QUALITY

2.1 Monitoring Data

Common air pollutants, such as fine particulates (PM_{10} & $PM_{2.5}$), ozone, nitrogen oxides, sulphur dioxide, and carbon monoxide are measured continuously at a state-of-the-art monitoring station at Okanagan College on KLO Road in Kelowna. A central computer in Victoria gathers this information and an hourly Air Quality Index (AQI) value is calculated.

The Air Quality Index (AQI) is not an amalgamation of all measured pollutants, but rather the value of the pollutant with the highest AQI number. Every hour, Environment Canada and the Ministry of Environment convert each pollutant concentration into an AQI number according to a methodology developed. The highest AQI number becomes that hours overall AQI value. When issuing the AQI it is common practice to note which pollutant is "driving" the AQI.

An Air Quality Index (AQI) is a way of transforming complex air quality measurements into a single number and descriptive term. The British Columbia AQI is directly comparable to AQI's issued in all major Canadian cities that follow the same Federal guidelines.

The AQI numbers are interpreted thus: **0 to 25 is GOOD, 26 to 50 is FAIR, 51 to 100 is POOR, and 100+ is VERY POOR.** An AQI in excess of 50 represents the point at which BC Environment normally becomes concerned about the level of human health impact and at which there may be damage to vegetation and property.

General interpretation of Air Quality Index values relative to health effects is shown in the following table.

Air Quality Index	General Health Effects	Cautionary Statements
0-25	No measured effects are associated with air quality in this range.	No precautions are necessary for the general population.
26-50	When index values are in this range, there is adequate protection against effects on the general population.	No precautions are necessary for the general population.
51-100	Short-term exposure may result in irritation or mild aggravation of symptoms in sensitive persons.	Persons with existing heart or respiratory ailments should reduce physical exertion and outdoor activity.
101-	Significant aggravation of persons with heart and lung disease. Many people in the general population may notice symptoms.	Persons with respiratory and cardiovascular diseases should stay indoors and minimize physical activity.

The Air Quality Index has been applied nationally since 1980. It is used as a management tool in deciding whether outdoor, agricultural or forest burning is permitted, and to prompt the issuance of health advisories.

A preventive advisory to the public occurs when the Air Quality Index (AQI) reaches 25 (fair) due to airborne particles (i.e. smoke) or ozone, and forecasted weather conditions indicate that further deterioration in air quality is likely to occur. A second "action" advisory is sent out when the (AQI) reaches a reading of 50 (poor). Included in that advisory is a call to action to stop burning as well as some self-care advice.

Newer and more refined monitoring tools are now being designed federally, including the new "Reference Health Level" and the Year 2000 "Canada Wide Standards for Particulates and Ozone". These tools will enhance understanding of health impacts for some persons sensitive to health effects from prolonged exposure.

2.2 Priority Pollutants (Fine Particulates and Ozone)

Air quality monitoring in the Central Okanagan reveals that of the six air pollutants measured since 1996, only fine particulates and ozone exceeded provincial air quality objectives. Fine particulates and ground level ozone are the only pollutants to 'drive' the Air Quality Index since its inception. They are responsible for deteriorated air quality for an average 1051 hours each year.

From 1996 to 1999 monitoring data has shown that the air quality in Central Okanagan was "good" on average 88% of the time, "fair" 11% and "poor" 1% of the time. Human caused instances of "fair" or "poor" air quality are primarily due to vehicle emissions, dust attributed to vehicles and smoke from burning. Other instances of particulate exceedances were from forest fires or dust carried from outside the Okanagan Valley. The Okanagan also has naturally high levels of ozone attributed from sources other than vehicle emissions; however, more research needs to be completed before it is known how fossil fuels and natural background levels affect ozone formation in the Okanagan.

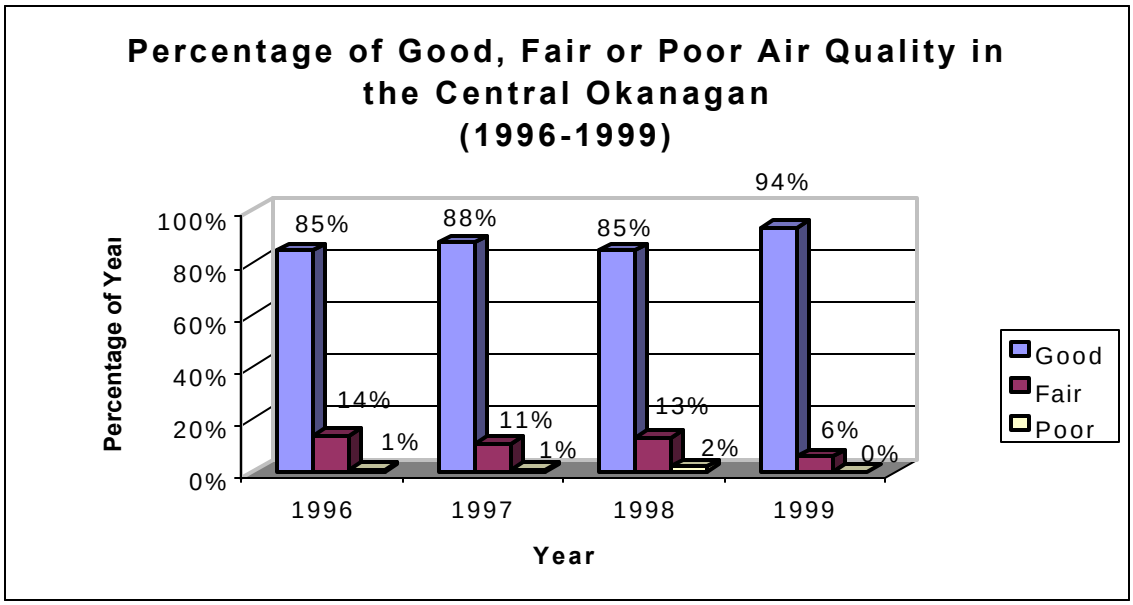

Figure 1 (Source: BC Environment, Lands and Parks)

2.3 Fine Particulates

2.3.1 What are Fine Particulates?

Particulates are tiny solid or liquid particles that come in many shapes and sizes, and from many different sources. They are also called particulate matter or PM for short. Fine particulates are roughly the same size as bacteria and like bacteria, particulate matter is invisible to the naked eye and small enough to be breathed into our lungs.

Fine particulates in the atmosphere are divided into two groups, particles with diameters from 2 to 15μm in diameter, and those with diameters less than 2μm. This separation is not arbitrary. The two kinds are distinct and do not overlap. The two groups also have different origins: the very fine group below 2μm in diameter are usually associated with combustion and are composed of small carbon particles and condensed organic and inorganic compounds, these particles are usually referred to as $PM_{2.5}$. The larger sized fraction, those with diameters above 2 μm are associated with fugitive dust and are composed of finely ground rock and clay, these particles are usually referred to as PM_{10}. The consensus of the medical community is that the finer particles ($PM_{2.5}$) formed during combustion has the greatest effect on human health.

Particles in the atmosphere reduce visibility and pose a serious threat to human health. They are commonly divided into two categories based on size.

- PM_{10} consists of particles less than 10*mm* in effective aerodynamic diameter. PM_{10} consists of coarse and fine particles. Road dust and wind blown soil are typical constituents of the coarse fraction of PM_{10}, or particle sizes between 2.5*mm* and 10*mm*. The coarse fraction of PM_{10} can stay in the atmosphere for a few hours to a few days and are removed in the upper respiratory system when inhaled. PM_{10} also consists of particles in the fine fraction range, or particle sizes between 0*mm* and 2.5*mm*. Smoke and vehicle exhaust are typical constituents of the fine fraction of PM_{10}.

- $PM_{2.5}$ refers to particles that are 2.5μm or less in diameter and stay in the atmosphere from days to weeks increasing the chance of inhalation and transport to other airsheds. These particles can penetrate deep into the lungs causing breathing difficulties or permanent lung damage. Smoke and vehicle emissions are the primary source of $PM_{2.5}$ (MoELP, 1994).

2.3.2 Fine Particulate Pollution in the Central Okanagan

Fine particulates are the most serious air pollutant the region has. The most detailed measurements of particulates are available at the KLO Road air station operated by the BC Ministry of Environment, Lands and Parks, and Environment Canada.

PM_{10} Monitoring Data

PM_{10} has been measured continuously with a tapered element oscillating microbalance (TEOM) sensor at the KLO Road air station since 1994 and an archive of hourly average data is available. PM_{10} consists of particles less than 10*mm* in effective aerodynamic diameter.

Figure 2 below illustrates the number of hours per month that PM_{10} caused air quality to degrade into the fair air quality range between 1997 to 2000. The number of exceedance hours rises in the spring due predominantly to smoke from burning and dust from road traction materials. In the fall, exceedance hours rise again due mostly to smoke from burning.

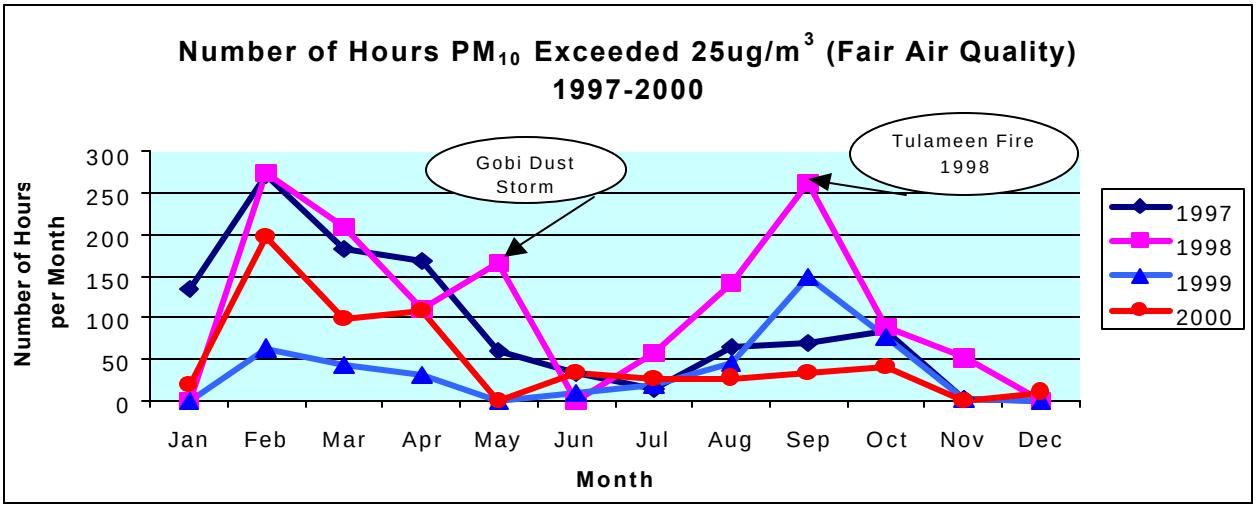

Figure 2 (Source: MoELP, 2000)

Figure 2 shows two periods of unmanageable air quality periods due to two events in 1998. The first event occurred in the last week of April and first weeks of May 1998. In this period, high levels of particulate with with a very uniform PM_{10} to $PM_{2.5}$ ratio near 0.4 were measured at the KLO Air Station. This period was due to a *Kosa* event. A dust cloud generated by a severe dust storm in the Gobi desert in China was carried across the Pacific and covered the entire Pacific North West area. The *Kosa* event affected nearly 20 days of PM_{10} data in April and May 1998 (MoELP, 2000).

The other anomalous period occurred in early September of 1998, this was the period when the Tulameen wild-fire was burning to the west of the Okanagan Valley. Based on data from the Forest Protection Branch it was determined that the Tulameen fire had affected the particulate values measured in Kelowna from August 30 to September 7th 1998 (MoELP, 2000).

The following in Figure 3 illustrates the number of hours per month that PM_{10} caused air quality to degrade into the poor range between 1997 to 2000. In 1997, the number of exceedance hours in the poor range occurs in January, February and March due mainly to smoke from burning and dust from road traction materials. In February 1998 there were 38 hours in the poor range due to smoke and dust. Other poor air quality episodes in 1998 were caused predominantly by unmanageable sources such as the Gobi Desert dust storm and the Tulameen forest fire. There were no poor air quality exceedances due to PM_{10} in 1999 or 2000 (MoELP, 2000)

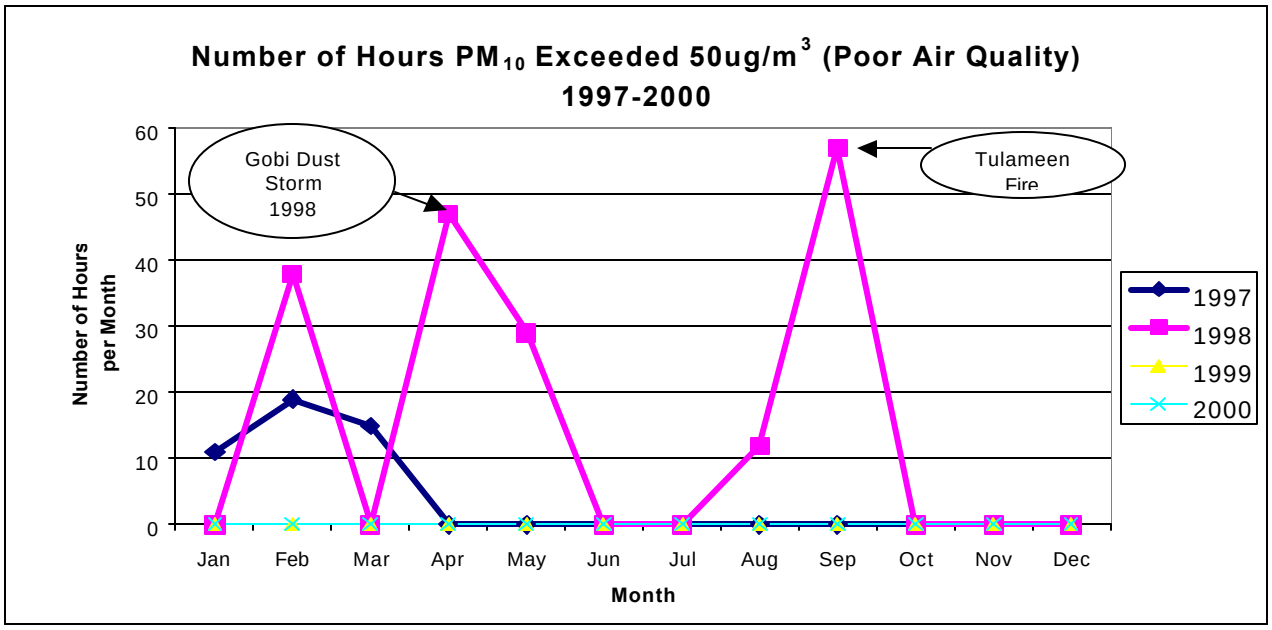

Figure 3 (Source: MoELP, 2000)

$PM_{2.5}$ Monitoring Data

$PM_{2.5}$ has been measured continuously with a tapered element oscillating microbalance (TEOM) sensor at the KLO Road Air Station since 1997 and an archive of hourly average data is available. $PM_{2.5}$ consists of particles less than 2.5μm in effective aerodynamic diameter. $PM_{2.5}$ particles stay in the atmosphere from days to weeks increasing the chance of inhalation and transport to other airsheds. These particles can penetrate deep into the lungs causing breathing difficulties or permanent lung damage. Smoke and vehicle emissions are the primary source of $PM_{2.5}$

Figure 4 indicates exceedances of the Reference Health Level (RHL) for $PM_{2.5}$ of 15$\mu g m^3$. The RHL is defined in the scientific assessment documents for the Canada Wide Standards Agreement as the lowest level of $PM_{2.5}$ at which it can be demonstrated that negative health effects occur in humans. As the RHL has had considerable scientific review, and is based on the best available epidemiological studies, it could also be used as an objective for airshed planning (MoELP, 2001).

Analysis of the data from 1998 to 2000 in Figure 4 reveal that from October to April wood smoke accounted for most exceedances of the Reference Health Level for $PM_{2.5}$. Particulate Matter <2.5 μm includes human sources such as smoke from agricultural burning, land clearing burning, wood stoves, exhaust from vehicles, incineration processes and natural sources such as forest fires. Smoke from forest fires and stubble burning can contribute to $PM_{2.5}$ levels in the warmer months of the year.

Monitoring data in Figure 4 clearly indicates levels of human caused smoke in the Central Okanagan occurs predominantly between October and April each year when outdoor burning is allowed under local bylaws. In May 1998 most exceedance hours of the Reference Health Level were due to very fine particles from the Gobi Desert Dust storm in China and in September 1998 the number of hours with high concentrations of smoke were mostly the result of the forest fire at Tulameen, BC (MoELP, 2000).

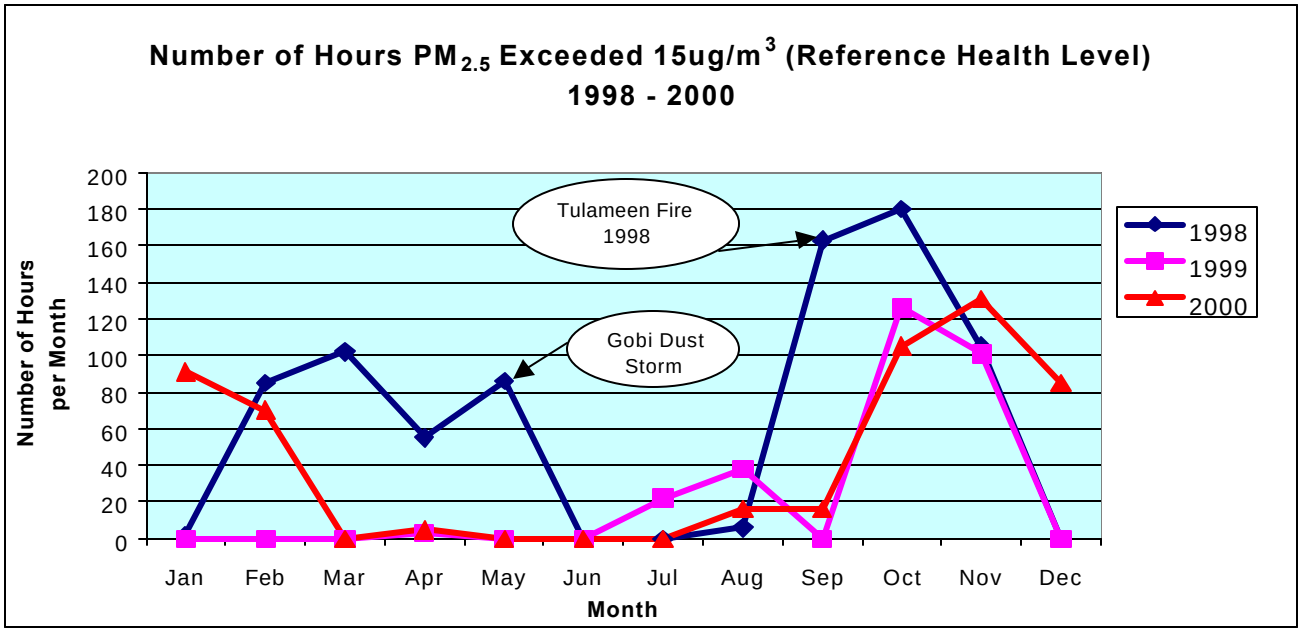

Figure 4 (Source: MoELP, 2000)

2.3.3 Health Effects from Fine Particulates

Wood smoke is much like cigarette smoke, containing a mixture of tiny particles (called "fine particulates") and gases. Particulate Matter <2.5 μm are small enough to be breathed into the deepest reaches of our lungs. They are associated with all sorts of health problems — from a runny nose and coughing, to bronchitis, asthma, emphysema, pneumonia, and even death. Fine particulates also tend to pick up other hazardous pollutants, giving them a free ride into the lungs.

The Okanagan Similkameen Health Region's 1998 Air Quality Report states:
"Most of the evidence shows increasing mortality due to particles starting above a PM_{10} concentration of 20μg/m³. Medical studies indicate that each 10 microgram per cubic meter (10μg/m³) increase in ambient PM_{10} concentrations is associated with a

- *1.0% increase in total mortality*
- *3.4% increase in mortality from respiratory causes*
- *1.4% increase in mortality from cardiovascular causes*
- *1.0% increase in emergency room visits for respiratory conditions, and*
- *3.4% increase in emergency room visits for asthma"*

A 1995 study by Dr. Sverre Vedal of UBC's Department of Medicine estimates that, each year in our province, fine particulate pollution causes 82 deaths, 146 hospitalizations and 354 emergency room visits. There are many more cases of milder respiratory symptoms, and time lost from work and school. Meanwhile, new research in the US links fine particulates with tens of thousands of deaths annually in that country.

Numbers cited by Dr. Eugene Krupa of the Okanagan Similkameen Health Region show that 10% of the Central Okanagan population with existing heart and respiratory ailments experience symptoms such as coughing, wheezing, breathlessness when the Air Quality Index measures in the "Fair" category.

Although we are concerned primarily with fine particulates there are various harmful gases in smoke - such as carbon monoxide, nitrogen oxides, dioxins, furans, benzo-a-pyrene, phenanthrene and acrolein - can trigger respiratory illnesses, angina, headaches and eye irritation. Some are known to cause cancer.

2.4 Ground Level Ozone

2.4.1 What is Ground Level Ozone?

Ozone is formed by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NOx) in the presence of sunlight and warm temperatures. It should be noted that VOCs, NOx, and ozone occur naturally in the lower atmosphere. However, human activities—fossil fuel use, in particular—may increase the presence of these pollutants. The ideal conditions for ozone buildup in the Central Okanagan occurs from late spring to early fall.

In basic terms, Hydrocarbons + Nitrogen Oxides + Sunlight = Ozone

VOCs (also called hydrocarbons) are constituents of trees, oil and natural gas. The major human-made source of VOC emissions is motor vehicles. Evaporation of adhesives, gasoline, solvents, some aerosol propellants, oil-based paints, and hydrocarbons from the petrochemical industry are also significant sources.

Like VOCs, NOx are mainly produced by oil and gas, but in this case it's burning the fuel that does it. The exhaust from fossil fuel combustion in our motor vehicles is the primary source, followed by fuel burning in homes, businesses, factories, and power plants.

Ground level ozone is a concern in the Central Okanagan due to its effects on**:**

1) *Human Health* - Low concentrations of ground-level ozone can irritate the lungs, eyes, nose, and throat. As levels increase, more serious health problems are:

- particularly asthma, bronchitis, coughing and chest pain
- increased susceptibility to respiratory infections
- decreased lung function and physical performance.

Prolonged exposure can eventually damage lung tissue, cause premature aging of the lungs and contribute to chronic lung disease. Children, the elderly, and people with impaired lung function are considered to be most at risk.

2) *Vegetation and Materials* - Sensitive crops, trees and other vegetation are harmed at lower ozone concentrations than is human health. Ground-level ozone can damage leaves, and reduce growth, productivity and reproduction. It can cause vulnerability to insects and disease, and even death. Smog can also accelerate the deterioration of rubber, fibers, plastics, paints, and dyes.

3) *The Enhanced Greenhouse Effect and Acid Rain* - The pollutants we spew into our atmosphere are implicated in more than one environmental problem. Ozone, for example, is not only a major component of smog; it also contributes to the enhanced greenhouse effect,

which is predicted to lead to global climate change. Similarly, NOx - one of the building blocks of ground-level ozone - plays a major role in creating acid rain.

2.4.2 Ground Level Ozone in the Central Okanagan

In the Central Okanagan, the ideal conditions for ground level ozone to form is from late spring to early fall. During the summer months, an abundance of intense sunlight hours and low wind speeds are normal. With the addition of ozone precursor emissions (NOx, volatile organic compounds, etc.) into the atmosphere, elevated concentrations of ozone result. In 1997 the Ministry of Environment, Lands and Parks (MoELP) compared hourly mean, 95th percentile and maximum concentrations of ozone at various sites in the Province. Based on this combination of parameters, the highest concentrations were reported for sites in Kelowna and Kamloops. This finding suggests that ozone is an issue in our area (MoELP, 1998).

MoELP also did a comparison study of eight-hour average concentrations of ozone data for the 1987-year. Standards or objectives based on an 8-hour average are believed to provide better protection against longer exposure periods. For comparison purposes, 8-hour average concentrations were evaluated against the United Kingdom standard of 50ppb (approximately 100 µg/m3). This level was exceeded 253 times in Kelowna in 1987.

The following Figure 5 illustrates how ozone levels become more dominant than particulate matter levels throughout the summer months in the Central Okanagan.

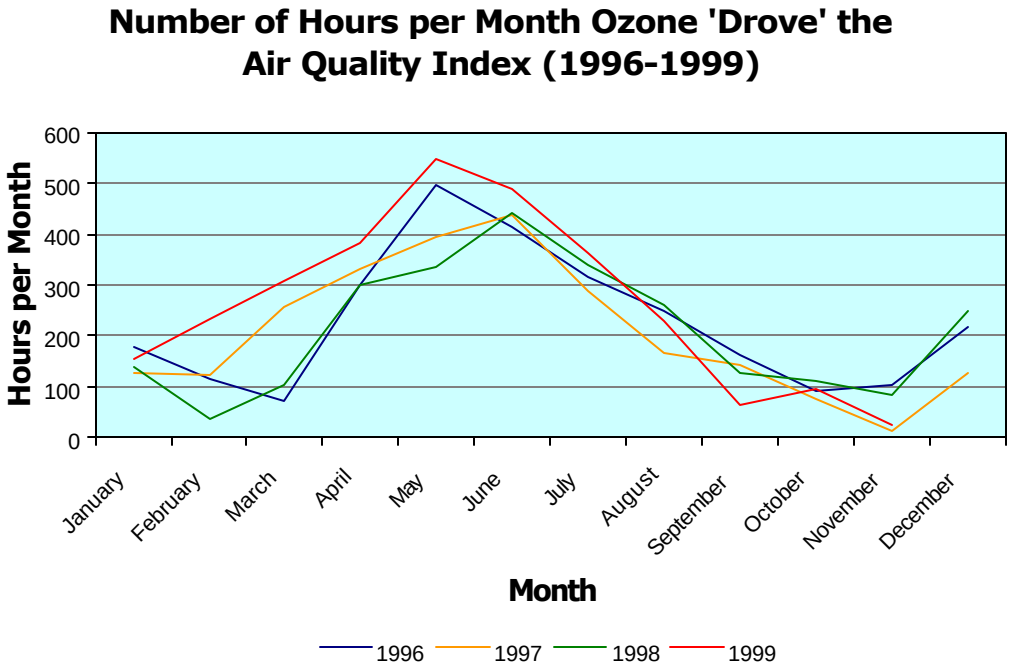

Figure 5 (Source: MoELP, 2000)

The issue of ground level ozone levels in the Central Okanagan is complex and difficult to explain in simple terms. The Central Okanagan has naturally occurring high concentrations of ozone throughout the year and periods of elevated ozone concentrations during the warm, sunny summer months. There is little evidence of a trend showing increased concentrations of ozone due to human activities since the 1984-monitoring year. If current ozone levels were being influenced by current anthropogenic emissions (human emission sources), the large increase in emissions over this period should be reflected in the measured values; however, this

is not the case. Similar levels of ozone have been measured in Kamloops and Merritt; both of these communities have far less traffic and traffic congestion than the Central Okanagan. MoELP and the Meteorological Service of Canada (MSC) are working to determine what proportion of the observed ozone levels are due to anthropogenic emissions of ozone precursors.

Figure 6 illustrates the annual number of days the Central Okanagan has measured ground level ozone exceeding the recommended levels.

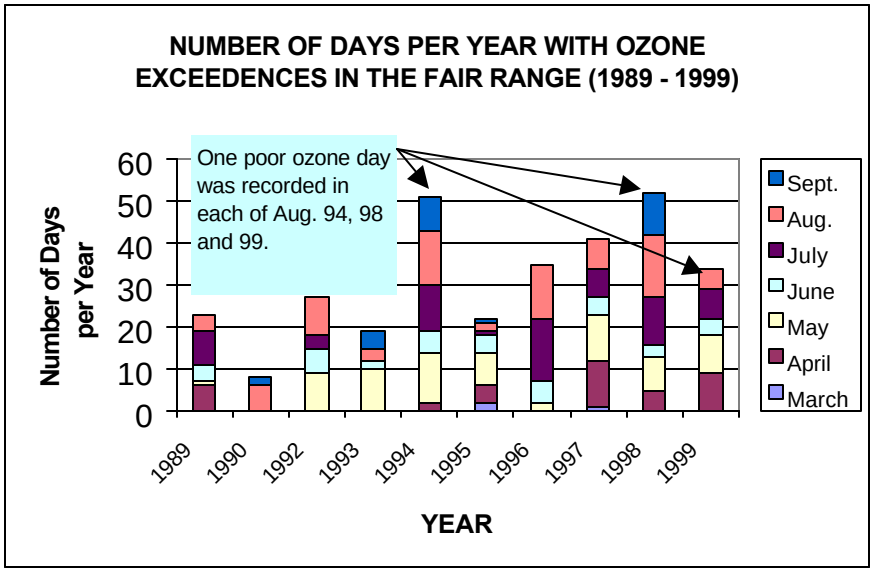

Figure 6 (Source: MoELP, 2000)

2.4.3 Health Effects from Ozone Pollution

Ozone is particularly harmful to people with respiratory conditions such as asthma, chronic bronchitis and emphysema. Studies have linked increases in ozone levels with increases in cardio-respiratory diseases. Increased risks for non-accidental mortality, respiratory hospitalization and Emergency Department visits respectively are estimated at 0.4%, 1-2% and 6-8.6%, for every 10 ppb increase in ozone (Ozone Science Assessment Document, 1999).

Low concentrations of ground-level ozone can irritate the lungs, eyes, nose, and throat. As levels increase, more serious health problems are:

- particularly asthma, bronchitis, coughing and chest pain
- increased susceptibility to respiratory infections
- decreased lung function and physical performance.

Prolonged exposure can eventually damage lung tissue, cause premature aging of the lungs and contribute to chronic lung disease. Children, the elderly, and people with impaired lung function are considered to be most at risk.

The Okanagan Similkameen Health Region's 1998 Air Quality Report states:
"Ozone, used to kill bacteria, destroys cell membranes. Health effects include exacerbation of respiratory symptoms and impaired lung function."

Monitoring data from 1994 to 1996 (Figure 7) indicates that the Central Okanagan ranks as the fifth worst urban area in Canada for health risks due to ozone.

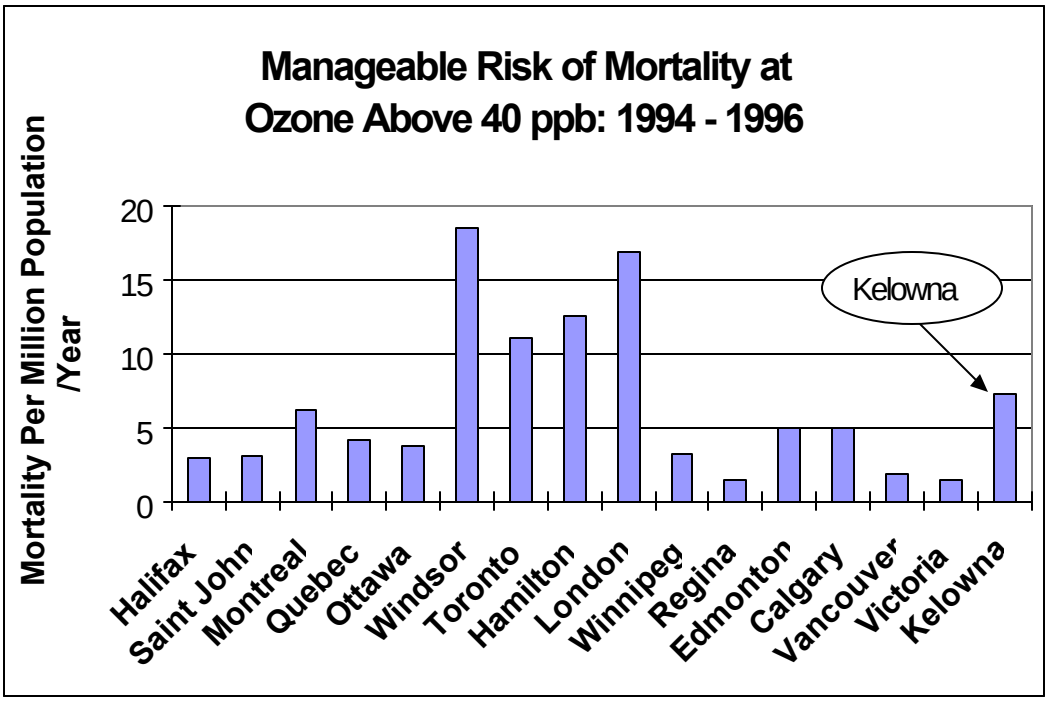

Figure 7 (Source: MoELP, 1999)

Based on the 1999 Ozone Science Assessment Document released by Health Canada and Environment Canada, there is sufficient evidence to conclude an association exists between ambient levels of ozone and human mortality, respiratory hospitalizations and several other health endpoints.

The 1999 Ozone Science Assessment Document was a Federal-Provincial consensus document, which recommended Reference Levels for ozone. A Reference Level is defined as a level or levels, above which there are demonstrated effects on human health and/or the environment. This study recommended that the daily one-hour maximum Reference Level be set at 20 ppb, a level exceeded regularly in the Central Okanagan. However, the recommended management objective adopted for the Canada Wide Standards (CWS) Agreement for ozone is based on the 4th highest annual measurement of 65ppb averaged over three consecutive years. Figure 8 shows that the Central Okanagan currently meets this CWS objective.

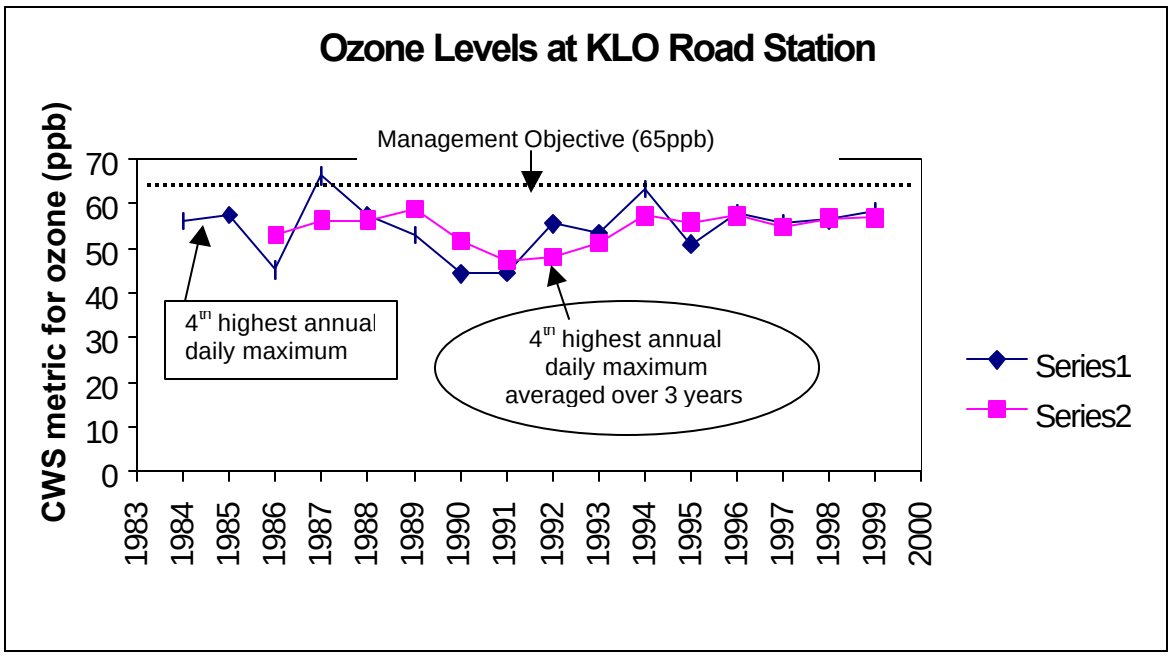

Figure 8 (Source: MoELP, 1999)

Figure 8 illustrates ozone measurements from the KLO Road Air Station in Kelowna compared to the new Canada Wide Standard (CWS) for ozone. Series 1 shows the 4th highest annual daily maximum 8-hour average. The CWS system uses the three-year running average of the 4th highest annual daily maximum 8-hour average shown in series 2.

2.5 Priority Air Pollution Sources and Contaminants

Selection of priority contaminants for management should be based on one or more or the following factors:

- Contaminants currently exceeding ambient air quality objectives;
- The relative seriousness of human health or other effects expected to result from exceedance of ambient air quality objectives;
- Contaminants with potential to cause human health or other effects in combination with other contaminants at measured ambient levels;
- Contaminants predicted to be significantly increased in the airshed without future intervention;
- Contaminants with objectives being considered for revision to lower levels; and
- Concerns expressed by the public.

The summary of current ambient air quality presented in this report identifies PM_{10}, $PM_{2.5}$ and ozone as the contaminants with significant "Reference Health Level" exceedance frequencies. When the seriousness of effects is considered, PM_{10} and $PM_{2.5}$ emerge as the top airshed management concern because many epidemiological studies point to a relationship between fine particulates and health effects ranging from premature death to subtle changes to lung function.

Levels of ozone in the Central Okanagan are a concern; however, there is little evidence of a trend showing increased concentrations of ozone due to human activities since the 1984-

monitoring year (refer to Section 2.4.2). The effects of ground level ozone on human and environmental health is a concern that has resulted in new research activities being conducted by Environment Canada. The results of this research will aid in identifying the link between ozone and human activities in the Central Okanagan region.

Selection of the sources of contaminants that should receive the highest priority for management should be based on the following factors:

- Sources contributing most significantly to exceedances of ambient air quality objectives (combination of location, size and source elevation, etc.);
- Sources contributing the greatest mass loading of priority contaminants (source size);
- Sources offering the best opportunity for reduction (available technology, cost effectiveness, availability of alternate locations).

A source inventory will provide a preliminary basis on which to classify sources for reduction of priority contaminants. The relative contributions from permitted and non-permitted sources provide an indication of the mechanisms that will be required to achieve any emission reductions.

A source inventory has not been completed within the Okanagan Airshed to determine accurate emission amounts from all sources. The inventory is used to develop emission reduction targets and to monitor strategy effectiveness. Inventory data is needed to conduct emission modelling of the airshed (scientific estimate of pollution concentrations in the airshed given a predicted change in emissions). Without a complete emissions inventory we will be unable to predict how increased emissions from various sources will impact our air quality in the future.

The following needs to be completed or updated to gather a baseline inventory on all emissions for the Okanagan (expanding beyond the Central Okanagan has a scientific basis for truly assessing the airshed):

- Motor Vehicle Emissions (light duty, heavy duty, and other mobile sources). This study would have to be re-visited so that motor vehicle emissions from the entire Okanagan Airshed (Central, North and South Okanagan Regional Districts) are collected. The effects of traffic congestion would be included in the assessment, and findings would be cross referenced in the analysis of regional transportation options and plans.
- Point Source Emissions (Permitted Industry)
- Area Source Emissions (Outdoor Burning, Wood Stoves, Lawnmowers etc.)

Listed below are activities that contribute to many of the fair air quality days and some poor air quality days in the Central Okanagan. Data was derived from various local and national government studies as well as monitoring data (stack testing) from BC Environment.

2.5.1 Dust Stirred up by Vehicle Traffic

Dust from vehicular traffic is estimated to be the largest source of particulate matter (PM_{10}) emitted into the atmosphere in the Central Okanagan; however, this estimate needs to be confirmed through an updated transportation emissions study and an overall emissions inventory. This dust is particularly concentrated during February, March and April of each year due to dry conditions and a significant amount of sand left on the roads from winter sanding.

Figure 9 illustrates the significant increase in PM_{10} exceedances starting in February due in large part by vehicular traffic stirring up roadway traction material.

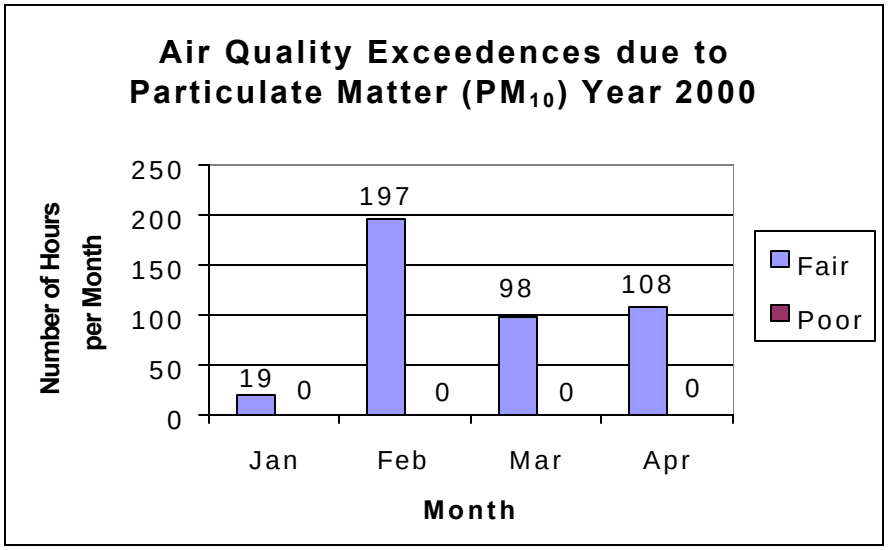

Figure 9 (Source: MoELP, 2001)

2.5.2 $PM_{2.5}$ from Vehicle Exhaust

Fine particulates emitted from vehicle exhaust is estimated to be a significant pollutant in the Central Okanagan, in fact the 1995 City of Kelowna Transportation Study estimates that 748 tonnes of fine particulates ($PM_{2.5}$) are emitted from vehicle exhaust each year.

Figure 10 illustrates the estimated increase (+137%) in vehicle exhaust particulate matter ($PM_{2.5}$) from the 1991 base year to 2013 in Kelowna. The overall impact to the air quality in the Central Okanagan cannot be determined from the 1995 City of Kelowna Transportation Study alone; however; it is likely that as emissions increase the air quality will begin to degrade. To gauge the overall impact from increased particulate pollution from Central Okanagan vehicle exhaust, all sources of emissions (a complete emissions inventory) from the entire Okanagan Airshed must be accounted for and entered into a complex computerized model. Until an overall emissions inventory is completed for the Okanagan Valley we will be unable to predict how increased emissions from various sources and under various transportation options will impact our air quality in the future.

2.5.3 Vehicle Exhaust and Ozone

The issue of tropospheric ozone levels in the Central Okanagan is complex and difficult to explain in simple terms. The Central Okanagan has naturally occurring high concentrations of ozone throughout the year and periods of elevated ozone concentrations during the warm, sunny summer months. There is little evidence of a trend showing increased concentrations of ozone due to human activities since the 1984-monitoring year. If current ozone levels were being influenced by current anthropogenic emissions (human emission sources), the large increase in emissions over this period should be reflected in the measured values; however, this is not the case. Similar levels of ozone have been measured in Kamloops and Merritt; both of these communities have far less traffic and traffic congestion than the Central Okanagan. MoELP and the Meteorological Service of Canada (MSC) are working to determine what proportion of the observed ozone levels are due to anthropogenic emissions of ozone precursors.

With vehicle numbers for the Central Okanagan expected to increase from approximately 104,000 in the year 2000 to 159,000 in the year 2020 (53% increase), there is a possibility that ozone levels could also increase. However, until an overall emissions inventory is completed for the Okanagan Valley we will be unable to predict how increased vehicle emissions will impact our air quality.

Figure 10 illustrates the estimated increase in ozone forming gases (NOx and Hydrocarbons) and fine particulate emissions caused by vehicles from 1991 to 2013 in the Central Okanagan area.

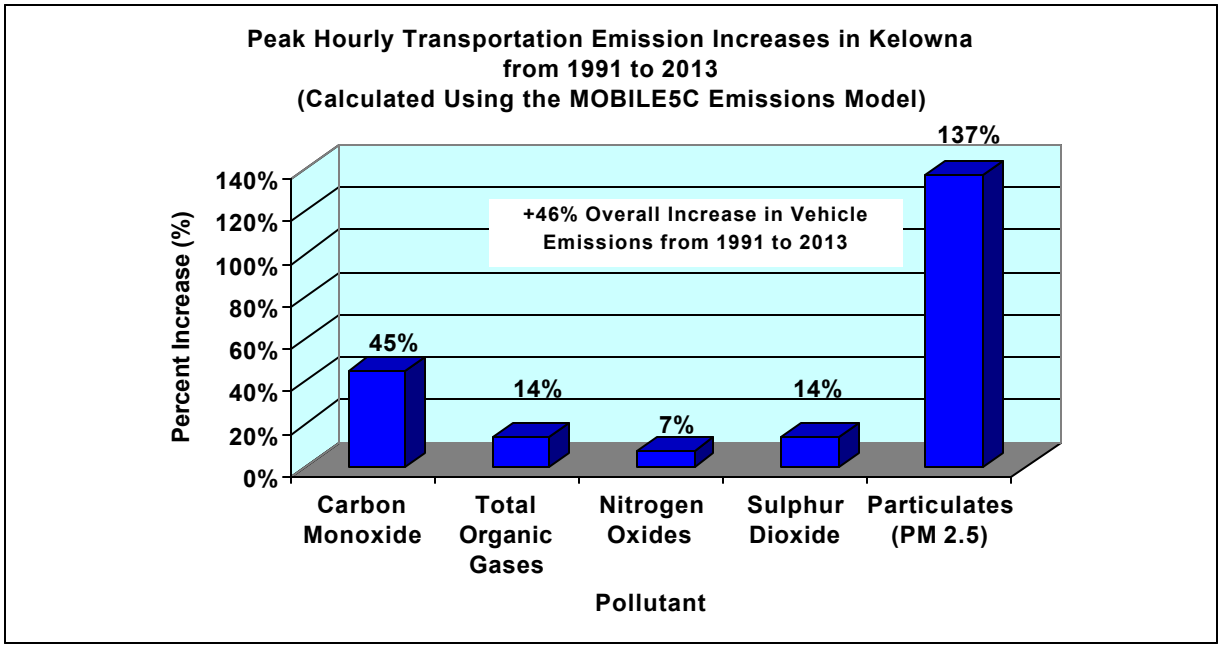

Figure 10 (Source: Kelowna Transportation Study, 1995)

2.5.4 Wood Burning Appliances

Wood burning appliance emissions account for approximately 399 tonnes of fine particulates ($PM_{2.5}$) being emitted into the Central Okanagan atmosphere every year. Information from the 1998 National Inventory of Wood Burning Appliances suggests that smoke emissions from these sources is the second largest contributor to particulate pollution in the Central Okanagan. However, an Okanagan inventory of wood burning appliances is taking place in April 2001 to obtain more accurate data on residential wood smoke emissions.

Smoke from residential wood burning mainly affects those neighbours closest to the fire and is the source of many complaints received by local government and the health region each year.

2.5.5 Outdoor Burning

Table 1 shows the number of outdoor burning permits issued by fire departments in the Central Okanagan for 1999.

BURNING PERMITS ISSUED IN THE CENTRAL OKANAGAN (1999)						
Source (Fire Districts)	**Annual Permitting**	**Types of Fire**				
		Residential	**Other**	**Land clearing for Development**	**Orchardists**	**Industrial**
Lake Country FD	500	250	0	0	250	0
Westside FD	308	99	179	4	26	
Kelowna FD	715	0	64	15	636	0
Peachland FD	300	294			6	
Ministry of Forests	70	0	3	0	58	9
Sums	**1,893**	**643**	**246**	**19**	**976**	**9**
Percentages	**100%**	**34%**	**13%**	**1%**	**52%**	**0**

Table 1 (Source: RDCO Wood Residue Study, 2000)

2.5.6 Agricultural Burning

There is a significant amount of agricultural burning in October, November, March and April of each year. It is estimated that 11.5 tonnes of fine particulates ($PM_{2.5}$) are released into the atmosphere every year from over 1000 agricultural fires. Local bylaws stipulate that burning can only take place when the venting is good enough to disperse smoke out of the valley; however, these good burning days are limited. Since there are a limited number of good burning days, there are sometimes many fires burning at one time when good burning days exist. This often creates unhealthy levels of smoke particulate in the valley, especially if the venting index is marginal (VI = 55 to 75) for that period.

2.5.7 Land Clearing Burning

There is an average 20 land clearing burns each year in the Central Okanagan. These burns are typically very large and smoky due to the fact much of the material is still wet. Even though there are only 20 fires per year of this type, it is estimated that these fires release the same amount of particulate matter that over 1000 agricultural burns release (11.3 tonnes of $PM_{2.5}$).

2.5.8 Residential Yard Burning

There are over 600 residential backyard-burning permits issued each year in the Central Okanagan. These fires release an estimated 5.8 tonnes of fine particulates ($PM_{2.5}$) into the atmosphere. These permits are issued in Lake Country, Peachland and the Westside, while Kelowna banned backyard burning in 1988. Most backyard burning occurs at the same instance that agricultural burning takes place, essentially increasing the smoke load in the valley.

Figure 11 illustrates the amount of wood that is typically burned in an average year in the Central Okanagan from selected "private land" activities.

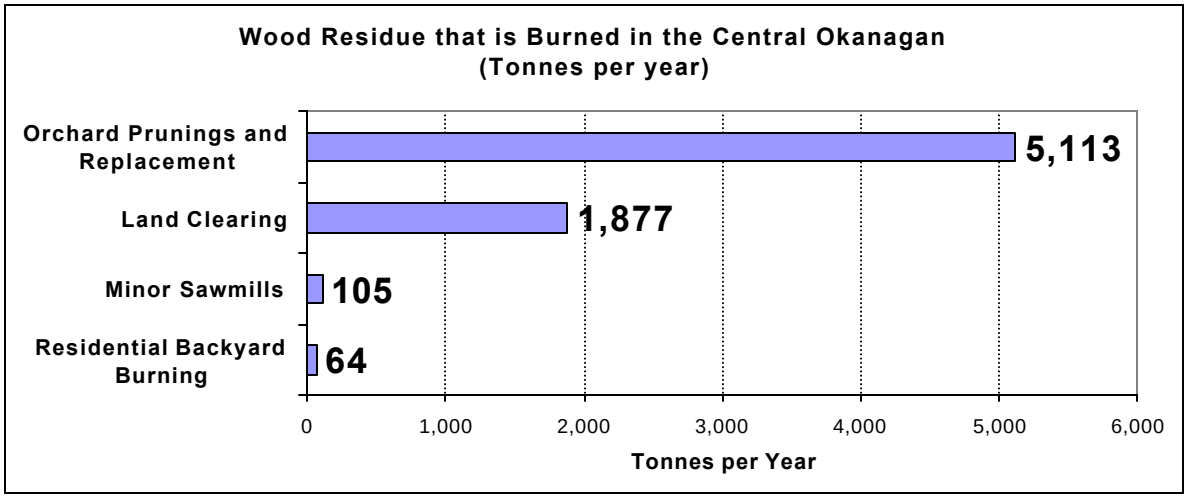

Figure 11 (Source: Regional Wood Waste Study, 2000)

2.5.9 Forestry Burning

BC Ministry of Environment, Lands and Parks does not consider smoke from burning harvesting waste piles as a significant air quality issue within the Central Okanagan. The majority of these slash burns are carried out at high altitudes when the venting is good, thus preventing smoke from reaching the inhabited lower reaches of the valley. The Ministry of Forests carefully manages slash burning so that smoke does not pose a problem to urban areas (Adams, 2001, pers. comm.).

2.6 Emissions from Industry

The BC Ministry of Environment, Lands and Parks does not consider industry to be a priority source of air pollution in the Central Okanagan. Industrial operations with large emissions under permit include (among others) Western Star Trucks, municipal and regional district landfills, the Kelowna Airport and local sawmills. The largest emitter of smoke particulate pollution originates from Riverside Forest Products (12.2 tonnes of $PM_{2.5}$ annually, calculated from stack test). This 12.2 tonnes of $PM_{2.5}$ is negligible when considered it is emitted 24 hours per day throughout 363 days per year; however, there are still occasional problems with excess soot being released from boiler cleaning processes causing excess dustfall in the adjacent Manhattan Point neighbourhood.

2.6.1 Other Sources

Various other pollutant sources of concern include dust from construction and other activities, pesticide and herbicide sprays, odor emissions, off road vehicle emissions and boat motor emissions. An emissions inventory is needed within the Okanagan Airshed to determine accurate emission amounts from these various sources.

3.0 MANAGEMENT OBJECTIVES

The following Mission Statement and Goals guide activities of the regional air quality program.

3.1 Air Quality Mission Statement

"The Central Okanagan Regional Air Quality program promotes clean air quality by working cooperatively with communities and stakeholders."

3.2 Air Quality Goals

Within the Central Okanagan Region, air quality management activities are directed at achieving the following goals.

- **To ensure that citizens in the Central Okanagan have healthy air to breathe.**
- **To integrate regional air quality goals into all policies, including land use & transportation planning**
- **To educate and inform communities on air quality issues.**
- **To lead by example and bring about changes in behavior as needed to protect air quality.**
- **To ensure comprehensive monitoring of air quality.**
- **To harmonize regional air quality initiatives with the objectives of other agencies and levels of government.**

3.3 Key Management Steps

Airshed management plans from other communities across North America have been investigated by the Okanagan Air Quality Technical Steering Committee to determine successful airshed planning techniques and strategies. The Central Okanagan Regional Air Quality Committee is interested in such a review to avoid "re-inventing the wheel". By learning from the successes and failures of other communities, the Regional District can effectively construct its own management plan, based on reliable and efficient practices.

Below is a list of key management steps identified by the Okanagan Air Quality Technical Steering Committee for reducing air pollution in the Okanagan Airshed. Beside each step is a symbol indicating the progress the Central Okanagan Air Quality Program has made in that step.

¼ Partially Complete
✔ Complete
🛠 Work in Progress
✕ Not There Yet

¼ Develop an accurate emission inventory to identify all sources of air pollution (example set by Greater Vancouver Regional District "GVRD", 1994)
✕ Assess current and future air quality using population, land use, transportation, and economic activity projections and air quality modeling techniques (GVRD, 1994)
✔ Identify priority contaminants for management (example set by Prince George Airshed Technical Management Committee "PGATMC", 1996)
¼ Set priorities for emission reductions (PGATMC, 1998)
✔ Consult with the public, stakeholders and decisions-makers to establish air quality goals and priorities (GVRD, 1994)
¼ Develop emission reduction strategies and measures to achieve air quality goals (GVRD, 1994)
¼ Anticipate and take steps to prevent new air quality problems from developing (PGATMC, 1998)
✕ Take a staged approach to implementing the management actions (PGATMC, 1998)
✕ Monitor the effectiveness of the plan and research future needs (PGATMC, 1998)
🛠 Find funding to carry out the plan (PGATMC, 1998)
✕ Implement the approved Airshed Management Plan, and keep it relevant and effective through periodic assessment of achievements and deficiencies, with appropriate revisions and updates (GVRD, 1994)

The next page contains a chart detailing the air quality management process and the progress that has been made in the Central Okanagan.

Central Okanagan Air Quality Management Process

Steps in Progress

Establish air quality standards to protect public health and the environment.

- **BC Environment sets air quality objectives for each contaminant to determine good, fair, poor or very poor air quality in regards to human health.**

Conduct air quality monitoring to measure compliance with standards.

- **BC Ministry of Environment measures common air pollutants (Sulphur Dioxide, Carbon Monoxide, Nitrogen Dioxide, Ozone, Particulate Matter <10 and <2.5 micrometers)**
- **Ozone and Particulate Matter are the only contaminants monitored in the Central Okanagan that do not meet Provincial standards.**

Consult with the public and stakeholders to establish air quality goals and priorities.

- **The issues of concern determined at the Oct. 6, 1999 workshop were transportation emissions, open burning, cooperation of regulating agencies, and indoor wood burning appliances.**
- **In April 2000 a political workshop was held to discuss the possibility of an Okanagan Valley Airshed Management Plan.**
- **Oct. 2000 "Strategies for Clean Air" workshop**

Develop emission reduction strategies and measures to achieve air quality goals.

- **Determine the costs and benefits of air pollution reduction measures to address local air quality issues.**

Steps Not Completed

Develop an accurate emissions inventory to identify all sources of air pollution.

- **An emission inventory is the process of accounting for emissions from all sources of air pollution.**
- **The inventory is used to develop emission reduction targets and to monitor strategy effectiveness.**
- **Inventory data is needed to conduct emission modelling of the airshed. (scientific estimate of pollution concentrations in the airshed given a predicted change in emissions)**

Assess air quality by using computer modelling.

- **A computer program can be used to estimate pollution concentrations in the airshed given a predicted change in emissions. By using an emissions model you can estimate:**
  e.g. 1) The impact a new sawmill may have on air quality or 2) The impact increased traffic may have on air quality.

Draft Air Quality Plan for review.

- **The plan is a living document where strategies may be introduced when appropriate and funding is available. The plan must be kept relevant and effective through periodic assessment of achievements and deficiencies, with appropriate revisions and updates.**

4.0 STRATEGIES FOR CLEAN AIR

4.1 Recent Initiatives

The following are some examples of initiatives currently underway in the region aimed at improving air quality. Most projects are collaborative efforts between the Regional District of the Central Okanagan (RDCO), District of Peachland, City of Kelowna, Okanagan University College (OUC), Environment Canada, BC Environment, Okanagan Similkameen Health Region and the BC Lung Association Regional Asthma Program.

4.1.1 Education

Air Quality Advisory System (1998)
The Ministry of Environment regional office in Kamloops and the Okanagan Similkameen Health Region in Kelowna jointly issues air quality advisories during periods of deteriorated air quality. These advisories are meant to educate the public about air pollution as well as to protect the health of the general population. Air quality advisories are faxed throughout the Okanagan airshed to media outlets, hospitals, health authority, municipalities, regional districts, government agencies, fire departments, industry, agriculture and other participating organizations.

A preventive advisory occurs when the Air Quality Index (AQI) reaches 25 (fair) due to airborne particles (i.e. smoke) or ozone, and forecasted weather conditions indicate that further deterioration in air quality is likely to occur. A second "action" advisory is sent out when the (AQI) reaches a reading of 50 (poor). Included in that advisory is a call to action to stop burning as well as some self-care tips. Those with health conditions such as asthma may want to take self-care action even when a "preventive advisory" is issued.

Educational Programs in School District #23
In October 1998, the City of Kelowna Environment Division introduced an interactive air quality education program, “Gliding Through the Airshed,” for the Central Okanagan School District and the general public. The free program examines the causes of poor air quality in the Central Okanagan and provides examples of ways to reduce air pollution emissions. Over 3500 students have received presentations by City of Kelowna Environment Division staff during the 2000/2001 school year.

Light Duty Vehicle Emission Clinics
The free Vehicle Emission Inspection Clinic runs for three days each year and is sponsored and operated by Environment Canada in partnership with the Regional Air Quality Program. Over 700 vehicles have their vehicle emissions tested each year at this event.

The clinic is comprised of several steps:

1. Drivers were given general information on the impact of vehicles on the environment.
2. Information was taken on the vehicle (age, type, etc.) for Environment Canada’s national database.
3. The vehicle’s gas cap was tested under pressure to determine if it really seals properly.
4. Emission levels of carbon monoxide and hydrocarbons were tested using an analyzer.

Heavy Duty Vehicle Emissions Clinic
The primary objective for the clinic is environmental awareness in this transportation sector. This educational clinic has been held in the Central Okanagan for the last three years and is a partnership between Insurance Corporation of BC and the Regional Air Quality Program.

Vehicles that fail the emissions test will not be fined, nor will it be mandatory to have the emissions system fixed, however it is encouraged to do so in order to maintain good air quality in the Central Okanagan.

The amount of emissions is determined by measuring the opacity from the vehicle's exhaust stack (opacity is the measure of the amount of light that can penetrate the exhaust). The test takes approximately 10-15 minutes to perform.

Workshops for the public, politicians and community leaders
An integral component to the successful air quality management plans implemented in other regions across North America was the involvement of the public and stakeholders throughout the process. Other plans stress the importance of public input in determining the priority air quality issues. Incorporating public opinion into an air quality management plan not only minimizes committee conflicts over what they believe the priorities should or should not be, but also encourages public support for the plan.

A series of three public workshops was conducted in a twelve month period 1999/2000, moving sequentially from information, to consideration of actions, to analysis of strategies. Results of these workshops are contained in Section 4.2

4.1.2 Politics/Advocacy and Policy Development

Central Okanagan Regional Air Quality Committee
Local politicians focus on air quality communication, increasing public awareness and policy development.

Okanagan Air Quality Technical Steering Committee
Experts and professionals focus on the technical aspect of developing an airshed management plan.

Okanagan Similkameen Regional Health Board
Contribute a health effects dimension to the Regional District Air Quality Committee and the Technical Steering Committee.

Kelowna and Area Cycling Coalition
Promotes the use of bicycles as transportation.

Burning Bylaws - Venting Index (1996)
Environment Canada provides free information to help those who wish to conduct open burning in the Okanagan Valley. The Ventilation Index (VI) is a measure of the atmosphere's ability to disperse smoke. The higher the number, the less the risk of air pollution. The index ranges from 0 to 100. A value of 55 or greater is recommended as the minimum value at which open burning should be considered. Outdoor burning permits issued throughout the Central Okanagan require that the Venting Index must be in the good range before burning starts. The Ventilation Index (VI) service started on Clean Air Day, 1996.

The winter is dominated by strong inversions, which is typically a poor time to burn in the Central Okanagan. The worst scenario occurs when the inversion lifts, but remains below the height of the local hills. While the index may be fair or even good in this situation, smoke will not be able to disperse out of the valleys and indeed will be mixed downward significantly reducing air quality.

By knowing the frequency of good venting days one can plan burning better and thereby lessen the impact of smoke on the population. Periods of poor air quality in the region can often be correlated to the periods of poor ventilation (Source: Environment Canada, 1996).

Burning Bylaws - Burning Bans
Outdoor burning is prohibited on all properties under 2 acres in the District of Lake Country, Electoral Areas of the Regional District and the City of Kelowna. Peachland allows burning year round on all property sizes.

Regional Smoke Control Bylaw (1998)
Developed by the Central Okanagan Regional District in 1998 to reduce emissions from open burning, campfires and wood burning appliances. It is a nuisance by-law enforced through complaints only.

4.1.3 Research

Kelowna Regional Transit System Survey (Transportation Demand Management, spring 2000)
A public opinion survey of the Kelowna Regional Transit System. Information from this survey will be used in developing and improving transit in the Central Okanagan.

Wind and air movement in the Central Okanagan (1999)
In 1999, the Mountain Weather Services Office used a mesoscale model and display software to impart a deeper understanding of the low-level winds through the Okanagan Valley. This knowledge is necessary in order to explain the local transport and diffusion of pollutants in the airshed.

Time-lapse Video Study (Spring 1999)
A time-lapse video recorder is set up on the west side of Okanagan Lake overlooking the City of Kelowna. Video footage is recorded 24 hours a day, 7 days a week. Environment Canada Mountain Weather Services Office, the Regional Air Quality Committee and the Okanagan Air Quality Technical Steering Committee are particularly interested in those days that have meteorological conditions that favor bad air pollution episodes. The data is taken and used for education purposes, for scientists to confirm meteorological predictions and to analyze daily pollutant development and transport. CHBC Television News plays portions of the previous week's time-lapse film on Friday newscasts.

Time-lapse video study is beneficial because it allows the viewing time of long-term dynamic events to be reduced to a more practical time period. The videos can also be viewed at various speeds, in order to enhance the media. Time-lapse video study has been used for many applications and projects, and in other regions, has been used to study the development and transport of pollutants.

Transportation Emissions Study (1995)
In 1995, the City of Kelowna commissioned a Transportation Study on Atmospheric Emissions Modelling. Using data from the City of Kelowna Transportation Study, motor vehicle emissions of carbon monoxide, total organic gases, nitrogen oxides, sulphur dioxide and particulate matter were estimated for 1991 and 2013 (Levelton, 1995).

> An updated and complete transportation emission survey is needed for the entire Central Okanagan as the first study was limited to the area defined by the City of Kelowna boundaries.

Wood Residue Survey (1999)
A survey was conducted in the fall of 1999 identifying sources and quantifying the amount of wood residue materials within the Central Okanagan Regional District. The survey also estimated the amount of wood residue material that is burned each year in the Regional District. The overall study will assist the Regional District in developing alternative wood residue management options.

The Central Okanagan Wood Residue Survey estimates that the agriculture industry burns 5,113 tonnes/year of wood residue, land clearing for new home and commercial construction burns 1,877 tonnes/year, and minor sawmills in the area burn 105 tonnes/year. The amount of fine particulate matter ($PM_{2.5}$) that is released into the Central Okanagan atmosphere each year is approximately 34.9 tonnes.

Permitted Sources
The Ministry of Environment compiles permit fee data of point source emissions of air contaminants located within the Central Okanagan.

4.2 New Initiatives for 2001

Funding has been awarded to the Central Okanagan Regional Air Quality Program for several projects designed to increase our understanding of air pollution and its effect on the health and welfare of Okanagan citizens. Other projects being launched in 2001 involve action to reduce air pollution from those sources. These projects include:

Air Quality Health Effects and Costs Survey
The Okanagan Air Quality Technical Steering Committee recommends a study that determines the actual health effects and costs due to air pollution in this region. This study would link the severity of air pollution to the costs to individuals, provincial agencies and to society. The study is essential for tracking the effectiveness of emission reduction strategies and for predicting increases in health problems due to increased population, changes in industry, land use planning decisions, or due to lack of air quality controls. It will also enhance credibility of advocacy and provide direction to policy development.

Preparation for this study will involve identifying and monitoring interested individuals for whom air quality is a trigger to health problems.

Visual Opacity (Smoking Vehicles) Assessment of Diesel Powered Heavy Duty Vehicles and Light Duty Gasoline Powered Vehicles in the Okanagan
A visual study to assess the level of emissions related to the current diesel truck, bus or light duty fleet travelling within the Okanagan Valley is needed before any type of heavy or light duty vehicle emissions inspection program could be implemented here. The study would identify trucks, buses and cars that release excess smoke. The darker the smoke the more likely it is that the vehicle is operating outside allowable limits. Stationary locations would be established throughout the Okanagan Valley where survey team members visually assess the vehicles as they drive by. Two members from ICBC are qualified in visual smoke assessment of smoke density.

Currently, BC's heavy vehicle smoke prevention program is called AirCare ON-ROAD. The program provides two mobile teams to test diesel-fueled vehicles operating on BC's Lower Mainland. Last year 794 vehicles failed the heavy-duty tests. After these vehicles were fixed, there was an average particulate reduction of 63% upon reinspection. Assuming these trucks drove an average 50,000 miles per year it is estimated that 80 tonnes of particulates were prevented from entering the atmosphere in the first year of the program.

Wood Stove and Fireplace Inventory Survey

In the Central Okanagan, smoke from wood burning appliances is a major cause of air pollution and health problems in the colder months of the year. A survey would be used to determine a more accurate extent of the problem in this area. An emissions inventory is an essential airshed management tool.

The survey would determine the type of appliance used for burning, the frequency and approximate amount and type of wood burned for each area of the Region. From this information we can calculate the approximate amount of smoke emitted into the atmosphere everyday. This is essential data for determining the extent of the problem and type of strategies that should be implemented to control this contaminant. With an inventory completed, we can determine the best strategy for removing smoke particulate from our atmosphere. The inventory would be used to predict and track the success of implemented emission reduction strategies.

The inventory would also be used for computer modelling of our airshed so that we can understand how residential wood smoke reacts in our atmosphere. This information could show which neighborhoods are being most affected by residential wood smoke and whether the problem could be become better or worse depending on land use plans or emission reduction strategies.

Great Okanagan Wood Stove Exchange Program (February 19 to March 31, 2001)

The goal of an exchange program is to reduce wood smoke pollution through raising public awareness of the importance of smoke-free burning. Old smoky wood stoves contribute to the health problems of many Central Okanagan residents each year.

This year's inaugural Great Okanagan Wood Stove Exchange Program was a terrific success. During the six-week program, which ran from February 19th until March 31st, 2001, **174** old and inefficient wood stoves were exchanged for approved clean burning appliances.

The program's success is readily apparent when the results are compared with a province-wide campaign held in 1995, which saw the exchange of 200 stoves. More importantly, the elimination of 174 "old smokers" means smoke particulate pollution in the Okanagan Valley will be reduced by thousands of kilograms each year.

This program allows consumers, with older wood stoves an opportunity to replace them with new EPA/CSA approved wood appliances, gas appliances, or pellet appliances. Cash discounts offered by participating manufacturers and distributors ranges from $100 to $500. The consumers receive a discount on their new stove, but only if they surrender their old stove, which must then be destroyed. A "tracking form" is used to record the family's name, address and phone, as well as the type of stoves, which went in and came out of the house. Signatures on a form for the dealer and the junkyard person provide tracking right to the end, and finally, an emission inventory impact analysis is done based on the mix of replacements.

Program partners of the 2001 campaign included the Central Okanagan Regional District, City of Kelowna, North Okanagan Regional District, Okanagan-Similkameen Regional District, Okanagan-Similkameen Health Region, North Okanagan Health Region, BC Lung Association and Hearth Products Association of Canada.

Agricultural Wood Waste Feasibility Study

The orchard industry in the Central Okanagan burns more than 5,113 tonnes of wood waste material each year, which translates into 11.5 tonnes of smoke particulate emitted into the atmosphere. Orchard burning and the resulting smoke pose another serious health risk to many residents each year in the Central Okanagan.

Since the "Waste Management Act" allows farmers to burn wood waste, alternatives must be found if we want to reduce agricultural burning in this region. In the October 11th, 2000 air quality workshop held for the general public a chipping program was rated as a good way to eliminate agricultural burning. Before any type of chipping program could be implemented here or throughout the valley a feasibility study must be done to attain the true costs and benefits through such a program. A pilot project to reduce wood waste through chipping, tub grinding or other means would be set up by the Okanagan Air Quality Technical Steering Committee, BC Fruit Growers Association and other partners.

Advertising Campaign to Promote the Dangers of Wood Smoke and Vehicle Emissions

An advertising campaign promoting the health implications of wood smoke and vehicle emissions is an important step for air quality management in our region. This lets people know there is a problem in our area and there are actions that we can take to reduce the problem. Many people in our region do not know that when they drive or burn in their fireplaces that they may be making someone sick. Advertising has a broad appeal and is effective in changing people's attitudes once they are informed about a problem.

Partners for Climate Protection Program

The goal of Partners for Climate Protection (PCP) program is to support Canadian municipal governments in preparing and implementing local climate change action. The PCP is a partnership between the Federation of Canadian Municipalities and the International Council for Local Environmental Initiatives (ICLEI). Program participants work to reduce greenhouse gas emissions from municipal operations by 20 per cent and at least six per cent (the Kyoto target) within the community as a whole. The preferred goal is to try and achieve these targets within 10 years.

4.3 Assessment of Potential Measures – Public and Stakeholder Feedback

An integral component to the successful air quality management plans implemented in other regions across North America was the involvement of the public and stakeholders throughout the process. Other plans stress the importance of public input in determining the priority air quality issues. Incorporating public opinion into an air quality management plan not only minimizes committee conflicts over what they believe the priorities should or should not be, but also encourages public support for the plan.

4.3.1 Air Quality Issue Prioritization (Public and Stakeholder Workshop, October 1999)

In October of 1999, the Central Okanagan Regional District held its first public workshop to gain input for a Central Okanagan Regional Air Quality Management Plan. The public and stakeholders had the opportunity to identify what they perceive as being the top air quality issues. In order of priority they were as follows:

- Vehicle exhaust / Vehicle numbers
- Agriculture / Slash / Forestry Burning
- Lack of Coordination of Enforcement Agencies such as fire department, forestry, regional districts, farm regulations, First Nations
- Wood Burning Appliances
- Dust from Human Activities
- Pesticides and Herbicide Sprays
- Road Dust
- Industrial Particulate Emissions
- Industrial Odor Emissions
- Permitted and Non-permitted industrial sources

Examining the public identified issues, finds that several of the issues can be lumped under a fine particulate category, ozone category and/or another category. Using this, we can develop priority statements:

> ***Priority 1****: (Ground Level Ozone & Fine Particulate Matter)*
> *Not currently meeting air quality objectives or current/projected impacts are significant enough to justify new emission reduction measures as soon as possible.*
>
> *The assessment shows two issues in the Priority 1 category; ground level ozone and fine particulate. Both of these issues have significant or major impacts at existing and/or projected future levels in the regional air basin, and should continue to receive the highest priority in the development and implementation of emission reduction strategies.*

4.3.2 Commitment to Cooperative Airshed Planning in the Okanagan Valley (Political and Government Agency Workshop, April 2000)

Politicians and representatives from government agencies were invited to focus on the possibility of a cooperative approach to air quality management in the Okanagan Valley. Representatives from the three Regional Districts that make up the Okanagan were in attendance. The goal of the workshop was to determine the barriers to implementing a partnership for developing a

comprehensive strategy for air quality management in the Okanagan Valley. The partnership could provide the following benefits:

- A forum for exchange of information among federal, provincial, regional and municipal governments pertaining to airshed analysis, management, and policy development.
- Increased co-operation and collaboration among federal, provincial, regional and municipal governments to achieve an integrated airshed approach to resolving air quality problems in the Okanagan Valley.
- Increased leverage when applying for provincial or federal funding.
- Expanded monitoring and research to better understand the air quality of the Okanagan Airshed.
- Common policy and program development on clean air strategies.
- More efficient and effective communications strategies to raise public awareness of air quality issues.

This workshop provided the necessary communication for several cooperative air quality improvement projects between the North, Central and Okanagan-Similkameen Regional Districts.

4.3.3 Strategies for Clean Air (Public and Stakeholder Workshop, October 2000)

In October 2000 approximately 75 individuals attended the "Strategies for Clean Air Workshop" to provide input on effective strategies to reduce air pollution. Attendees included the general public, industry leaders, agricultural leaders, politicians, environmental groups, health officials, students and government officials.

The individuals present were asked to review a number of strategies designed to manage air quality. In small groups, the participants critiqued various strategies designed to reduce air pollution from the following sources:

Burning of Wood Residue

Agricultural Burning
Backyard Burning
Wood Stoves and Fireplaces
Land Clearing Burning
Slash Burning

Transportation Issues

Reducing Vehicle Numbers
Reducing Vehicle Emissions
Dust from Roads

Participant feedback on strategies to reduce agricultural burning revealed that a "phase in" of alternative methods such as chipping or tighter burning restrictions were favoured rather than a total ban, however, participants were strongly in favour of banning backyard burning. More education and promotion about the effects of wood smoke on health from wood burning appliances were chosen as good strategies to start dealing with that problem. A wood stove exchange program and tighter wood stove burning regulations during poor venting and air quality conditions were also well accepted. Promoting viable alternatives to land clearing burning (such as chipping) was thought to be a good way to lead into a total ban on land clearing burning in the future. User fees, fines and shared funding between the three levels of government were the most popular methods chosen for funding these strategies.

The strategies presented to the workshop audience for reducing vehicle numbers from our roads were well received. Participants generally thought these strategies were good and should be combined to form an overall vehicle reduction strategy. Encouraging public transit, encouraging bicycling and encouraging forms of development that reduce the need for vehicle trips were all popular strategies among participants. A shared funding strategy between all three levels of

government was the most popular method chosen to pay for the improvement or implementation of these strategies.

The top strategy for reducing vehicle emissions was the heavy-duty diesel emissions testing program that ICBC currently operates in the Lower Mainland. Participants liked the idea that this program could be implemented quickly and could possibly target smoking light duty vehicles at no cost to local taxpayers. Participants also liked the strategy of promoting the benefits of cleaner fuels and new technology in our Region. Implementation of an AirCare program (light duty vehicle emission testing) throughout the Valley was also thought to be a good way to reduce vehicle emissions, however, the annual cost of the testing was a concern for most participants. Building more roads to reduce vehicle congestion was considered an unsatisfactory strategy that could lead to more cars being driven in the Region. User fees and fines were the most popular methods chosen for funding these strategies.

4.4 Next Steps: Potential Measures

Below is a list of possible emission reduction strategies that have been identified by the Okanagan Air Quality Technical Steering Committee and the public as having the potential for positive impact on Central Okanagan air quality. The Regional Air Quality Committee has reviewed strategies and has provided recommendations for implementation (refer to Section 5.2)

The process of identifying management options and priorities involves making judgements about the cost effectiveness and technical feasibility of alternative measures. Feasibility studies may be required to weigh the benefits and costs of these various options.

Wood Smoke Reduction Strategies - Wood smoke from various sources (wood stoves, outdoor burning, etc.) is a priority contaminant within the Central Okanagan and is considered the least expensive source of air pollution to control. For this reason, wood smoke control strategies have been the first type to be assessed through focus group sessions by the Okanagan Air Quality Technical Steering Committee, the Central Okanagan Regional Air Quality Committee and the public. The following is a draft action plan of wood smoke control strategies that have emerged from these focus group sessions:

WOOD SMOKE CONTROL DRAFT ACTION PLAN
March 28, 2001

SHORT TERM STRATEGIES (To be considered within 6-12 MONTHS)

- Prohibit outdoor burning during fair or poor air quality days
- Phase in a ban for burning arising from land clearing for development (make chipping or hauling of wood debris to landfill as part of their development costs)

MEDIUM TERM STRATEGIES (To be considered in 1-3 YEARS)

- Limit wood stove use when the Air Quality Index is in the fair or poor range.
- Wood stove/fireplace smoke opacity bylaw. This bylaw would limit the denseness of the smoke allowed to be coming from the chimney.
- Agricultural wood waste chip/grind program
- Limit the number of outdoor fires allowed per day in the Central Okanagan

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Wood Smoke Control Draft Action Plan continued….

LONG TERM STRATEGIES (+ 3 YEARS)

- Research and Monitoring (Determine effectiveness of implemented strategies)

STRATEGIES NOT TO BE CONSIDERED AT THIS TIME

- Outdoor burning permit fee (user pay)
- Extend burning season to include warmer months of the year when atmospheric venting is usually better.

Vehicle Emission Reduction Strategies - The following strategies have been found to be effective in other communities for reducing emissions from vehicle exhaust that contribute to fine particulate and ozone pollution. These strategies will be reviewed by the Okanagan Air Quality Technical Steering Committee and the Regional Air Quality Committee for consideration in this Region.

Light Duty Vehicle Emission Control Strategies

- Transportation Demand Management (*currently underway*)
- Emission Inspection and Maintenance
- Land Use / Transit
- Light Duty Vehicle Fuel Efficiency
- Enhanced Diesel Fuel / Vehicle Emission Standards
- Alternative and Reformulated Fuels
- Enhanced Vehicle Emission Standards
- Zero Emission Vehicles

Heavy-Duty Vehicle Emission Control Strategies

- Heavy-Duty Vehicle Fuel Efficiency
- Enhanced Diesel Fuel / Vehicle Emission Standards
- Heavy Duty Vehicle Emission Inspection and Maintenance
- Low Emitting Fuel / Engine Technology

Fuel Marketing Emission Control Strategies

- Vapour Recovery at Service Stations

Fugitive Dust Reduction Strategies - Dust from vehicular traffic is estimated to be the largest source of particulate matter (PM_{10}) emitted into the atmosphere in the Central Okanagan; however, this estimate needs to be confirmed through an updated transportation emissions study and an overall emissions inventory. This dust is particularly concentrated during February, March and April of each year due to dry conditions and a significant amount of sand left on the roads from winter sanding. Strategies to reduce emissions from fugitive dust will be reviewed by the Okanagan Air Quality Technical Steering Committee and the Regional Air Quality Committee for consideration.

Fugitive Dust Emission Control Strategies

- Municipal and Highways contractors do more frequent sweeping of municipal and regional streets
- Municipalities and the Region examine new equipment technology for cleaning streets and sidewalks to reduce dust dispersion
- Municipalities and the Region examine the possibility of using coarser aggregate material for sanding streets

Continued on next page…

Fugitive Dust Emission Control Strategies continued….

- Municipal and Highways contractors examine the possibility of expanding the use of liquid magnesium chloride for ice control on highways and municipal streets
- Municipalities and the Region require paving or grass-scaping of all traffic areas permitted for new industrial and commercial developments and work with provincial resource officers to follow best management practices concerning dust control
- Municipalities and the Region establish sweeping standards for all paved commercial and public parking lots to mitigate the release of fine dust
- Review regulations to help control fugitive dust from construction or businesses

Educational Strategies - The following are examples of educational strategies that are currently underway within the Central Okanagan Regional District. General education and promotional activities are considered valuable in building awareness and in bringing about individual change in behaviour. The following programs have been very successful and well received by residents of the Central Okanagan.

Education

- Carry out commitments to the Federation of Canadian Municipalities' "Partners for Climate Protection Program" (primary objective is to encourage municipalities to reduce greenhouse gas emissions, benefits include networking, model plans and international recognition)
- Continue a targeted advertising/educational campaign to promote the dangers of wood smoke to health
- Continue with the successful "Great Okanagan Wood Stove Exchange Program" (174 old stoves exchanged in 2001)
- Educate the public about the Venting Index and Air Quality Index
- Continue with targeted advertising/educational campaign to promote the dangers of vehicle emissions to health and the benefits of cleaner fuels, low emission vehicles, carpooling, transit etc.
- Continue with the successful light and heavy duty emissions clinics (600 - 700 vehicles annually tested)
- Continue with school presentations (over 3500 students in 2000-2001)
- Continue with time lapse video study (shown on CHBC)
- Continue with Go Green Week, Environmental Expo and Clean Air Day promotional activities

5.0 RECOMMENDATIONS

In order to effectively meet air quality goals of the Central Okanagan region, a degree of collaboration is required from levels of government and between the program priorities of various agencies. In this section, a recommended plan of action is outlined, for the purpose of setting priorities and budgeting resources.

Many of the recommended actions coincide with those recommended by the Medical Officer of Health in a 1998 "Air Quality Report" to the Okanagan Similkameen Health Region.

5.1 Background

Recommendations for action are based on existing scientific and health data, short and long term benefits of action, and the need to plan for future growth. With respect to air quality, some of the key assumptions are:

- Central Okanagan's anticipated urban growth and development will impact air quality. The population of the Central Okanagan will increase from approximately 150,000 residents in the year 2000 to a projected 230,000 or more residents by year 2020.

- A corresponding increase is anticipated in employment activities, with a particular focus on attracting "high tech" firms and on expanding the manufacturing base, both sectors being of note in discussions of air quality.

- An increase in vehicular traffic proportional to population growth would result in an additional 55,000 vehicles registered in the Central Okanagan region.

- Public consultation programs associated with forestry, agricultural activities and community planning processes demonstrate that the region places high value on environmental quality, and that air quality is one of the highest priority concerns in the community (ranking with water quality as priorities).

- The topography of the Okanagan Valley restricts air movement, and inhibits dispersion of pollutants, such that the whole of the Okanagan operates as one airshed.

- Using monitoring data compiled by senior agencies air quality in the Central Okanagan is generally good for a high percentage of the time. However, at certain times of the year, there are periods of fair air quality and, less frequently, of poor air quality with respect to some contaminants, especially fine particulates and ground level ozone.

- Certain segments of the population are susceptible to health effects from air pollution. Within the larger Okanagan Similkameen Health Region, the current estimate is that 10% of the population is "at risk" for health problems associated with air quality. This poses and will continue to pose substantial costs to regional health care services.

- Absent from the monitoring data is the health effects associated with proximity to point source pollutants that become dispersed. Also absent, but suspected, is a general deterioration in health from exposure over time to persistent pollutants that are measurable but that rank as "good" air quality.

5.2 Key Recommendations

In looking at the projections of future growth and development, and considering the level of understanding about air quality, it is recommended that the Central Okanagan region continue its efforts to assess and to proactively manage air quality. These efforts will require, first and foremost, continued communication and collaboration between agencies.

- **Managing Air Quality** - The Central Okanagan Region should continue its efforts to assess and proactively manage air quality to protect the health of its citizens.

- **Agency Co-operation** - Governments must work together to implement air quality initiatives within the Central Okanagan region as well as the Okanagan Airshed. Co-operation between responsible agencies should continue to be fostered (e.g.: through the Technical Steering Committee and Regional Air Quality Committee) so that important issues are addressed with a minimum duplication effort.

- **Air Quality Monitoring** - The current systems of monitoring and reporting of ambient air quality conditions should be maintained and enhanced, as they are key foundations to all management strategies. The Central Okanagan region should work cooperatively with other agencies to encourage the expansion of monitoring programs to other regions of the Okanagan airshed, and to assess variations in air quality between urban and rural or between low elevation and mid elevation segments of the airshed.

- **Education** – General education and promotional activities are considered valuable in building awareness and in bringing about individual change in behaviour. The current level of educational and promotional activity should be maintained within the context of an annual and 5-year plan.

- **Fine Particulates** - Analysis of research demonstrates a link between fine particulates and health of individuals within the Central Okanagan. Efforts to and bring about changes in practices related to particulate emissions should continue as a priority action. A three-year plan to reduce fine particulates from wood smoke has been developed by the Regional Air Quality Committee (reference Section 4.3).

- **Ozone** - There is a health concern related to high levels of ozone found in the Central Okanagan. However, the cause of ozone in this region is not well understood. Research in this area is underway; however, further research needs to be identified to determine how man-made precursors to ozone affect ozone concentrations in our airshed.

- **Public Involvement** - The Central Okanagan Regional Air Quality Program should continue to include involvement of the public and stakeholders in the process of developing strategies to reduce air pollution.

- **Episode Management** - Air quality episode management procedures should be developed so that all agencies and operations “under permit” are aware of steps needed to reduce emissions when air quality advisories are issued.

- **Economic Issues** - Clean air and a healthy economy are both important. All levels of government and members of the community should seek and promote cost-effective means for improving regional air quality.

- **Greenhouse Gas Reductions** - Communities across Canada are involved in a commitment to reducing greenhouse gas emissions. This is an activity in which local governments and provincial agencies have an opportunity to "lead by example" by monitoring and changing operations as needed.

- **Energy Efficiency -** Governments should co-ordinate energy reduction and efficiency policies and programs to support regional air quality and global climate change initiatives.

Recommendations for Managing Future Growth and Development

- **Integrated Land Use Planning** – Local governments within the Central Okanagan should implement land use policies that will accommodate future growth in a manner that fulfils clean air quality goals.

- **Transportation Planning** - It is recommended that the transportation sector (regional, provincial/federal) should be engaged in planning for air quality improvement. Air quality research should be linked directly to the analysis of regional transportation options, levels of traffic and congestion, and infrastructure planning programs. Emission reduction strategies should be directed at reducing the levels of air pollutants associated with vehicle traffic, including road dust and vehicle emissions. These strategies are viewed as timely, as they correspond to regional efforts directed as transportation demand management and at expensive transportation corridor improvements.

- **Total Maximum Daily Load** - Initiate a process that links land use decisions and present practices in the Central Okanagan region to an analysis of "load levels" of various pollutants in the airshed (using the emissions inventory and dispersion models recommended below). This may require making request to provincial authorities to amend the permit process in a way that allows existing load levels to be considered in the review of applications for new permits.

Research Recommendations

Research is essential for obtaining a better understanding of current and future air quality and contaminant effects. Research gaps currently exist in our understanding of the mechanisms involved that degrade Central Okanagan air quality. In order to identify management priorities the following research components are required:

- **Emissions Inventory** - The emissions inventory needs to be enhanced and regularly updated, to determine accurate emission amounts from all sources. A detailed and accurate emissions inventory is essential for air quality management. The relative contributions from permitted and non-permitted sources provide an indication of the mechanisms that will be required to achieve any emissions reductions.

An emissions inventory would include:

- Motor Vehicle Emissions (light duty, heavy duty, and other mobile sources). This study would have to be re-visited so that motor vehicle emissions from the entire Okanagan Airshed (Central, North and South Okanagan Regional Districts) are collected.
- Point Source Emissions (Permitted Industry)
- Area Source Emissions (Outdoor Burning, Wood Stoves, Lawnmowers etc.)

Research Recommendations Continued…

- **Health Costs** - Expand local research on health related costs due to air quality conditions. This will provide improved understanding, and lay the groundwork for a long-term study that would provide a tracking mechanism for determining improvements or degradation of air quality effects on health. This will strengthen the rationale for action, and support implementation of an airshed management plan.

- **Speciation Analysis** - This study would be used to analyse the content of fine particulates captured at the KLO Air Station. This would allow the determination of where the particulates came from (source) as well as the percentage of each source in the sample (i.e.: the percentage from road dust, percentage from wood smoke, percentage from vehicle emissions, etc.).

- **Dispersion Model** - This model is used to simulate the concentration and dispersion of pollutants throughout the airshed depending on weather conditions and sources of emissions. This model can be used to estimate pollution concentrations (loading) in the airshed given a predicted change in emissions. By using an emissions model you can estimate: [e.g. 1) The impact a new sawmill may have on air quality or 2) The impact increased traffic may have on air quality, etc.]. A completed and accurate emissions inventory of the airshed is needed before modeling research can occur.

- **Ozone Research** - An emissions inventory and modeling of the local ozone-forming process needs to be completed to identify Nitrogen Oxides (NOx) and Volatile Organic Carbon (VOC) management needs. A completed and accurate emissions inventory of the airshed is needed before modeling research can occur.

- **Cost Implications** - Develop a multi-year and multi-partner budget projection so that short and long term strategies and research recommendations can be advanced.

5.3 Monitoring of Progress

It is recommended that communities of the Central Okanagan region monitor progress of regional air quality initiatives by measuring three of the five outcomes that were contained in the 1998 Health Region Report:

1. A lower average Air Quality Index (improved ratings over the course of a year)
2. A reduction of PM_{10} increments, and
3. Fewer health problems associated with airborne pollutants.

5.4 Sequence of Recommendations.

The anticipated sequence of the preceding recommendations is portrayed in the following table. This sequence is based on a logical progression from research to action as shown graphically in section 3.2. However, the sequence should remain flexible and responsive to financial partnerships, to new program opportunities, to changing public priorities, or to the results of research activities.

Next Steps: Air Quality Planning Flowchart

Annual Focus	**Focus on Particulates and Focus on Episode Management Procedures**		**Focus on Integration with Land and Energy Use**		**Focus on Greenhouse Gas and Ground Level Ozone strategies**
	• Burn/no burn message • Wood smoke regulations updated • Wood waste strategies assessed		• Economic Development Strategies • Transportation Planning • TDM Strategies		• Vehicle emissions • Fuel efficiencies.
	• Evaluate local government operations re: greenhouse gas	• Report to municipal councils & RDCO on operations.	• Implement Procedures for considering and managing "load levels"	• Focus on transportation demand management and clean emission vehicles.	• Focus on opportunity for Okanagan Airshed Management.
	Research focus on • ground level ozone, • emissions inventory, • dispersion model • health impacts		• Research focus on speciation analysis and emissions model for Central Okanagan	• Assess potential for ozone & other emission control strategies.	
Ongoing Fundamentals	Air Quality Monitoring & Reporting Clean Air Education Study Health Effects and Costs Evaluation & Monitoring of Regional Programs Monitoring & Pilot Testing of New Technologies				
Potential Timeline	*Year 2001*	*2002*	*2003*	*2004*	*Year 2005*

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