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2008 Air Quality Ozone Season Summary for the Coeur d'Alene Area



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Table of Contents

Introduction	1
Why is Ozone an Issue?	3
Ozone Season Basics	4
2008 Ozone Season Summary	5
Monitoring Network	17
Regional Air Emission Inventory	18
Source Categories	18
Using Emission Factors to Calculate Amounts of Air Pollutants	22
Air Quality Standards	23
Current Public Outreach and Potential Actions	24
Current Air Quality Forecasts	24
Potential for Issuing Ozone Alerts	24
Information Provided by the Air Quality Index	24
More About Ozone	26
General Definitions	26
More About Ozone: a Criteria Air Pollutant	26

List of Tables

Table 1. Relationship Between Parts Per Million and Parts Per Billion.....	5
Table 2. Precipitation, Historical Average Compared With 2008	8
Table 3. Meters Per Second Converted To Miles Per Hour	11
Table 4. Pollutant Monitoring Methods used at Lancaster Site in 2008 in Coeur d’Alene	17
Table 5. Meteorology Monitoring Methods used in 2008 in Coeur d’Alene	17
Table 6. Monitoring Methods used by WSU for Ozone Precursor Study	17
Table 7. Idaho 2005 Estimated Criteria Air Pollutant Emission Inventory, Summary for Kootenai County	19
Table 8. Idaho 2005 Estimated Criteria Air Pollutant Emission Inventory, Summary for Spokane Area	20
Table 9. Air Quality Standard for Ozone.....	23
Table 10. Calculation and Breakpoints for the Air Quality Index (AQI)	25



List of Graphs and Maps

Figure 1. Map of Coeur d’Alene and surrounding areas, and ozone monitoring locations	2
Figure 2. Lancaster site ozone monitoring design values vs. ozone standard	6
Figure 3. Ten highest 8-hour averages of ozone concentration in 2008.....	6
Figure 4. Ten highest 8-hour averages of ozone concentration in 2008, as a percentage of the ozone standard.....	7
Figure 5. 2008 monthly average temperatures at the Lancaster site versus historical averages.....	8
Figure 6. Hourly ozone concentration compared with temperature	9
Figure 7. Hourly ozone concentration, temperature, and solar radiation compared.....	10
Figure 8. Ozone concentrations compared with nitrogen oxides.....	11
Figure 9. Wind rose for the 2008 ozone season.....	12
Figure 10. Wind rose for July 2008	13
Figure 11. Pollution rose for ozone, August 2008	14
Figure 12. Map of the Coeur d’Alene area, with wind directions indicated during periods of highest (orange) and lowest (blue) ozone concentrations.....	15
Figure 13. Ozone at Lancaster, Idaho compared with ozone at Greenbluff, Washington for four select days.....	16
Figure 14. Ozone at Lancaster, Idaho compared with ozone at Greenbluff, Washington for July 2008.....	16
Figure 15. Sources of NO _x in Kootenai County.....	21
Figure 16. Sources of volatile organic chemicals in Kootenai County.....	22



Introduction

The objective of this report is to summarize the results of ozone monitoring in the greater Coeur d'Alene, Idaho area for the 2008 ozone season. For the purpose of this report the Coeur d'Alene area is defined as an estimated Coeur d'Alene airshed. This airshed is essentially the Rathdrum Prairie including Coeur d'Alene, Hayden, Rathdrum, and Post Falls. This summary will present monitoring data collected during the ozone season of 2008 at the Lancaster Road multi-pollutant monitoring site (Lancaster site), and compare the monitoring results to the National Ambient Air Quality Standards (NAAQS). During 2008 Idaho Code 39-116B was enacted establishing provisions for ozone and ozone precursor emissions control strategies if specific thresholds are met. One threshold for action is if ambient concentrations of ozone reach greater than 85% of the NAAQS. This report will also present concentrations of ozone in Kootenai County as compared to “trigger” levels established in the same legislation.

In Idaho, monitoring for the criteria pollutants (which are defined below) occurs primarily in areas of high population where the potential for human exposure is greatest. As a first step to characterize ozone concentrations in the greater Coeur d'Alene area within Kootenai County, the Department of Environmental Quality (DEQ) installed an ozone monitor and a weather tower at the Lancaster site, north of Hayden (Figure 1) during the summer of 2005. While the Environmental Protection Agency (EPA) does not specifically require DEQ to monitor ozone based upon federal rules, DEQ initiated ozone monitoring in Kootenai County for two reasons. The first reason was because Kootenai County is generally downwind from Spokane (see Figure 1 for locations), where numerous sources of ozone precursor pollutants are located. The travel time from these precursor sources in Spokane to the Lancaster site during average wind conditions is roughly the same as the length of time it takes for the ozone forming reaction to occur. This suggests that precursors released in Spokane may cause increased ozone at the Lancaster site. The second reason for monitoring ozone in the Coeur d'Alene area is that the EPA's AIRNOW maps have shown Kootenai County to be in the “moderate” category on a number of days during each ozone season. The AIRNOW maps are found on the EPA's AIRNOW website and indicate what the current pollution levels are in airsheds across the country. Prior to 2005 the AIRNOW maps lumped Kootenai County in with Spokane County on the ozone maps because Kootenai County was not monitoring ozone.

Suitability of this site was determined through understanding of basic ozone development processes and an assumption that a majority of the sources of ozone-forming pollutants were located west, and therefore upwind, of Kootenai County. Ozone formation requires ozone-forming pollutants to be subjected to at least 3 hours of heat and intense sunlight to allow the chemical reaction that forms ozone to reach its peak. The average wind speeds and predominance of southwesterly winds at the Lancaster site during the ozone season indicated this site would likely measure the maximum ozone concentrations in Kootenai County. Site security, accessibility, and potential interference from nearby activity were also considered, as when identifying any monitoring site. DEQ relied on EPA's Guidelines on Ozone Monitoring Site Selection, EPA-454/R-98-002, to help select the



monitoring site at Lancaster. The Lancaster site is currently the only monitoring site for ozone located within Kootenai County.

Ozone is created when combustion by-products near the ground react with nitrogen oxides and other compounds to create photochemical smog. These reactions are optimized on days of intense sunlight and warm temperatures. Isoprene, one of the major constituents of biogenic emissions, is very photoreactive, and is a likely major contributor to ozone formation in Kootenai County. Data was collected in the Coeur d'Alene area for a limited ozone precursor study during the summer of 2008 by Washington State University. This study should shed some light on the contributions to the area's ozone concentrations coming from various sources, such as automobiles, industry, and biogenics. The results of this precursor study were due December 31, 2008 and will be incorporated into a report by WSU to be delivered in early 2009.



Figure 1. Map of Coeur d'Alene and surrounding areas, and ozone monitoring locations

Real-time ozone monitoring data in the state of Idaho is available May through September on the Internet at <http://www.tcsn.net/family/Idaho/index.html>. Please visit the DEQ Web site at <http://www.deq.state.id.us/> to find more extensive air quality data, educational materials, and discussions of current topics.



A major change in ozone regulation occurred in 2008. On March 12, 2008, the EPA significantly strengthened the NAAQS for ground-level ozone. The standard changed from 0.08 parts per million (ppm) to 0.075 ppm. This change will improve both public health protection and the protection of crops and other plants.

Why is Ozone an Issue?

Ozone is generally not directly emitted by pollutant sources, but can be in certain circumstances. It forms when photochemical pollutants emitted from gas stations, cars, all kinds of other combustion sources, industrial sources, and biogenic sources react with sunlight. These pollutants are called ozone precursors and include volatile organic chemicals (VOCs) and NO_x. Ozone levels are usually highest in the afternoon because of the intense sunlight and the amount of time required for ozone to form. Ozone levels are highly affected by weather.

People frequently hear of ozone in the upper atmosphere. In this context, ozone is considered beneficial because it helps to protect the earth from the sun's rays. In contrast, ozone formed at ground level is unhealthy. Elevated concentrations of ground-level ozone can cause reduced lung function and respiratory irritation, and can aggravate asthma. Ozone has also been linked to immune system effects (<http://www.epa.gov/ttn/oarpg/naaqsfm/o3health.html>). The damage ozone causes to the lungs heals within a few days, but repeated or prolonged exposure may cause permanent damage. People with respiratory conditions should limit outdoor exertion if ozone levels are high. Even healthy individuals may experience respiratory symptoms on a high-ozone day. Ground-level ozone can also damage agricultural crops and forests, interfering with their ability to produce food and grow.

Monitoring stations measuring ozone are located in both urban and rural areas, although many of the precursor compounds that react with sunlight to produce ozone are generated primarily in large metropolitan areas. Because summers in northern Idaho are normally hot and dry, the Coeur d'Alene area tends to see daily ozone levels that begin to rise in the late morning and then peak in the late afternoon and early evening. This phenomenon follows very closely with the time of day that the temperatures are the hottest and the sun is the highest in the sky.

Figure 3 (page 6) shows the ten days of 2008 with the highest ozone levels, expressed as a percentage of the federal standard. The federal standard (NAAQS) is based upon a 3-year average of the annual 4th-highest daily maximum 8-hour average. The figures on page 6 and 7 are used only to illustrate how 2008 ozone levels relate to the standard, and do not indicate determination of whether the NAAQS was exceeded. Although this report focuses on the 2008 season, a comparison between the NAAQS and the entire applicable data set will be presented. The 2008 data used for this report is considered preliminary and has not been completely quality-assured. Certification of the data will occur by June 30, 2009.



For additional information on ozone, visit <http://www.epa.gov/air/ozonepollution>. There is also additional information on ozone in question/answer format in the final section of this report.

Ozone Season Basics

Ozone monitoring in the Coeur d'Alene area occurs each summer ozone season, from May 1 to September 30. This time period is the accepted ozone season for the northern latitudes of the lower 48, and is determined to be the part of each year when ozone formation has the potential to exceed the NAAQS. Ozone formation is enhanced by the presence of temperatures near or above 30 degrees Celsius (86 degrees Fahrenheit), and intense sunlight.

While Idaho generally enjoys good air quality, our airsheds are faced with new challenges each year. In our local airsheds, these challenges are often related to economic and population growth, increased emissions due to industrial growth, and the resultant increase in use of internal combustion engines (vehicles, yard maintenance equipment, construction equipment, etc.). Over the last decade, criteria air pollutant levels in Idaho have generally decreased to levels well below the federal standards due to better control of air pollution; however, ozone levels in the Coeur d'Alene area, while not violating federal standards, are not far below the new standard.

The ozone season of 2008 was distinguished by a long cool spring and a short, cooler than average summer. These cooler temperatures are not optimal for ozone formation; therefore, ozone levels were relatively low this year. Even so, ozone concentrations reached the MODERATE range on the Air Quality Index (AQI) scale on two days. The highest 8-hour reading of the year was 0.061 ppm. The ozone NAAQS requires 3 years of data to be evaluated and compared to NAAQS limits. Data from 2006, 2007, and 2008 indicate a design value that puts Kootenai County at 86% of the ozone NAAQS. For the 2008 season alone data measured at 82% of the ozone NAAQS, indicating that 2008 was a lower than average year for ozone formation.

Ozone formation and transport are considerations when interpreting data from a measurement site. Factors such as temperature, solar radiation, and wind direction are discussed in the body of this report. Obvious correlations with temperature and solar radiation existed this season and a less obvious relationship with wind direction is possibly represented. The wind data suggests that the transport of ozone or its precursors to the site was a factor in the highest readings at the site. Study beyond the scope of this document is needed to determine if a definitive link exists.

NO_x is also a critical component of ozone formation and can be a limiting factor for ozone development. For this reason, DEQ monitors NO_x at the Lancaster site during ozone season. In this report, NO_x results will not be compared to the NAAQS for NO₂, but will illustrate the relationship between ozone formation and NO_x concentrations. This relationship is a critical step in evaluating the airshed, forecasting daily ozone



buildup, and will be used in concert with information from the ozone-precursor study discussed below.

2008 Ozone Season Summary

The biggest development this year was the adoption by the EPA of new National Ambient Air Quality Standards (NAAQS) for ozone. The previous standard was essentially 0.084 parts per million (ppm) because of rounding conventions. The new, tighter standard was set at 0.075 ppm to better protect human health and the environment. Data for this standard is not “rounded” but “truncated.” This may seem like a minor difference, but it can become a significant issue when ozone levels are near the NAAQS standard. Even with the new standard in place, Coeur d’Alene’s ozone concentrations remained below the standard for this year. A true comparison to the ozone NAAQS is made by averaging the annual 4th-highest daily maximum 8-hour average measurement over the past three years (see Figure 2). These three year averages are called the design value for that ozone season. Comparisons to the ozone NAAQS will not be completed until the 2008 ozone data for the Coeur d’Alene area is accepted by the EPA in 2009. The 2008 ozone data used for this report is considered preliminary until it is certified by DEQ on June 30, 2009.

As a point of clarification, the EPA requires ozone NAAQS design values to be submitted in parts per million (ppm). The instruments used by DEQ to measure ozone concentrations report their results in parts per billion (ppb). Some of the graphs in this report are in ppb, but references to the NAAQS are in ppm. Converting between the units is a simple function of multiplying or dividing by 1,000. The table below shows the relationship between ppm and ppb. Because of the changes to the NAAQS and the critical “truncating” data change, monitoring equipment will be modified for the 2009 ozone season to record and report concentrations in ppm.

Table 1. Relationship Between Parts Per Million and Parts Per Billion

Conversion between ppm and ppb		
	parts per million (ppm)	parts per billion (ppb)
Ozone Concentration	0.0750	75.0

Figure 2 depicts values from the Lancaster site versus the ozone NAAQS. The NAAQS line is set at 0.075 ppm and the 85% of the NAAQS line, which represents the threshold established by the Idaho Legislature in Idaho Code 39-116B, is set at 0.064 ppm. The NAAQS value is determined by taking a 3- year average of the 4th-highest daily 8-hour average concentration for each year. The 4th-highest daily 8-hour concentration is shown for each year since sampling started in 2005. The blue bars show the 3-year averages of the 4th-highest daily values. Even though this season’s value is below the 85% threshold, the 3-year average for 2006-2008 of 0.066 ppm is at 86% of the NAAQS. The 2008 figures in this report are calculated with preliminary data that will be approved by the EPA in July of 2009.

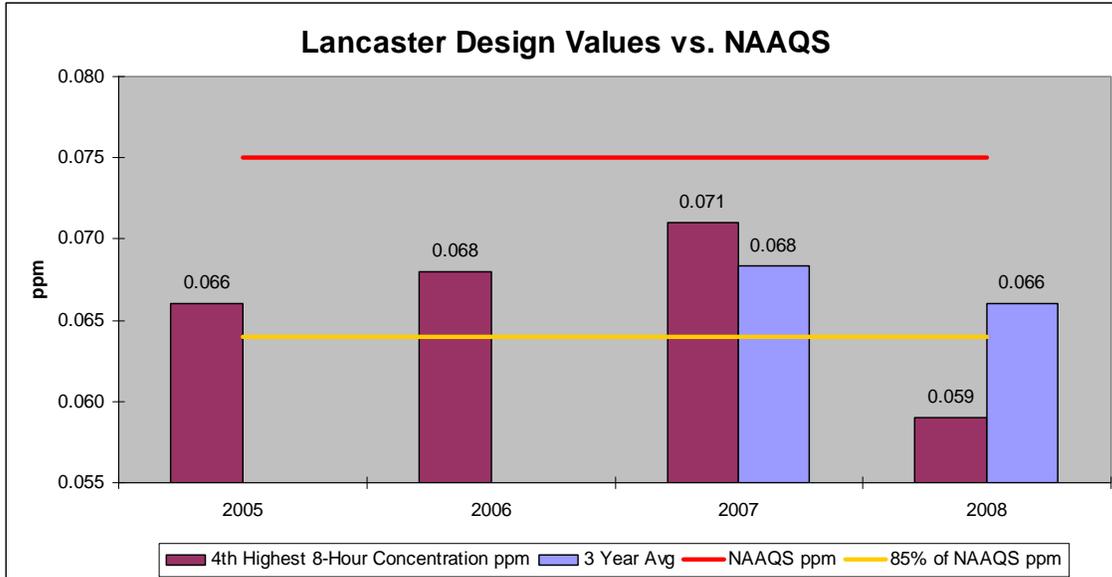


Figure 2. Lancaster site ozone monitoring design values vs. ozone standard

Figure 3 shows the ten days that had the highest 8-hour average concentrations and the time the highest average occurred. The ozone NAAQS is measured in a running 8-hour average format. The values ranged from a high of 0.061 ppm to 0.055 ppm for the highest readings on the ten highest days of the season. These values all fall well below the NAAQS of an 8-hour average of 0.075 ppm for ozone. Figure 4 shows each of these values as a percentage of the NAAQS.

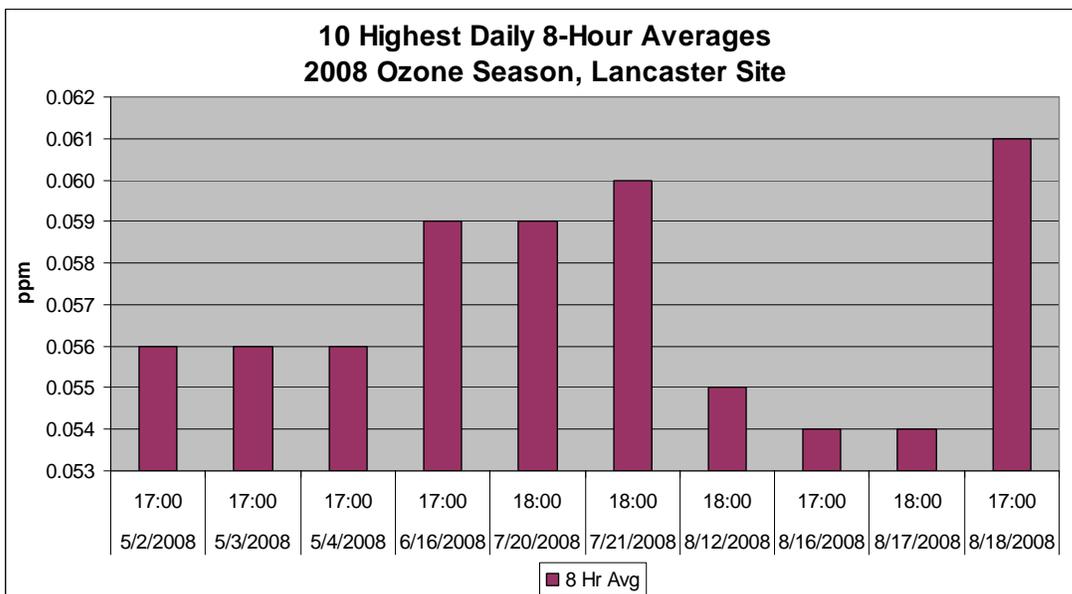


Figure 3. Ten highest 8-hour averages of ozone concentration in 2008

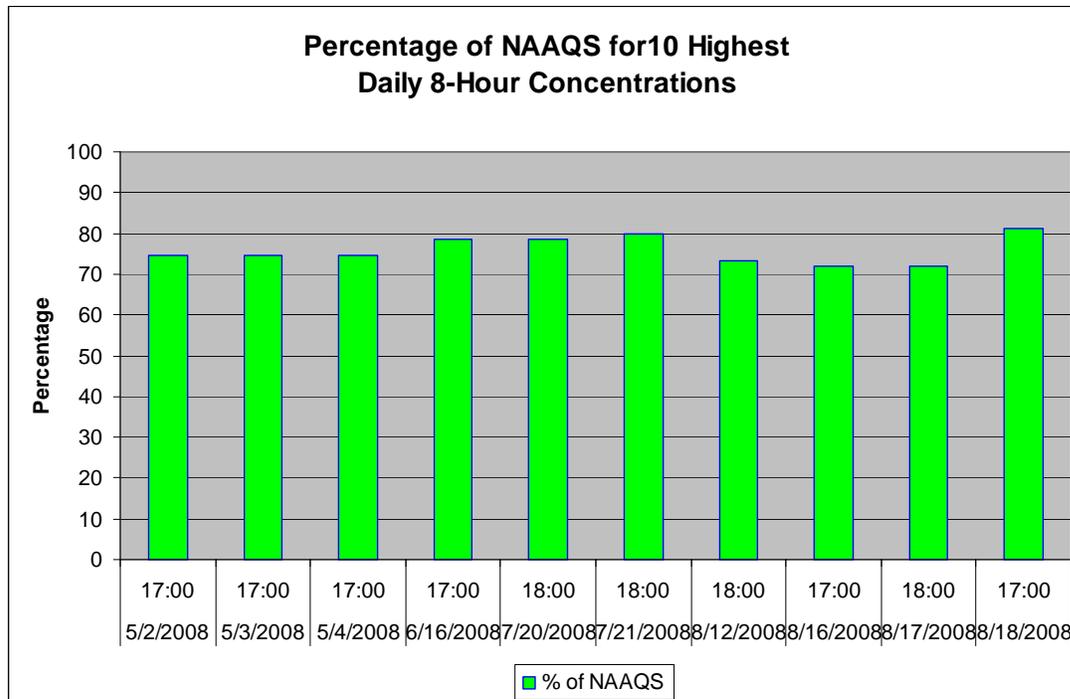


Figure 4. Ten highest 8-hour averages of ozone concentration in 2008, as a percentage of the ozone standard

Because temperature is one factor in the formation of ozone, the lower temperatures during the summer of 2008 most likely had some effect in reduced ozone formation. Nevertheless, ozone in the area measured at 72% – 82% of the federal standard over the ten highest concentration days as shown in Figure 4.

Figure 5 shows the average monthly temperatures at the Lancaster site during 2008 and the historical average for the area. The Lancaster averages were computed from data measured at the monitoring site, and the regional averages were from measurements taken at the Spokane International Airport. The graph depicts how much higher the historical average was than the 2008 averages. Overall, the 2008 summer months were 2.8 degrees Fahrenheit lower than a typical summer. As DEQ continues with ozone monitoring and the collection of meteorological data at the Lancaster site we will be better able to look into on-site trends of temperature and other atmospheric parameters.

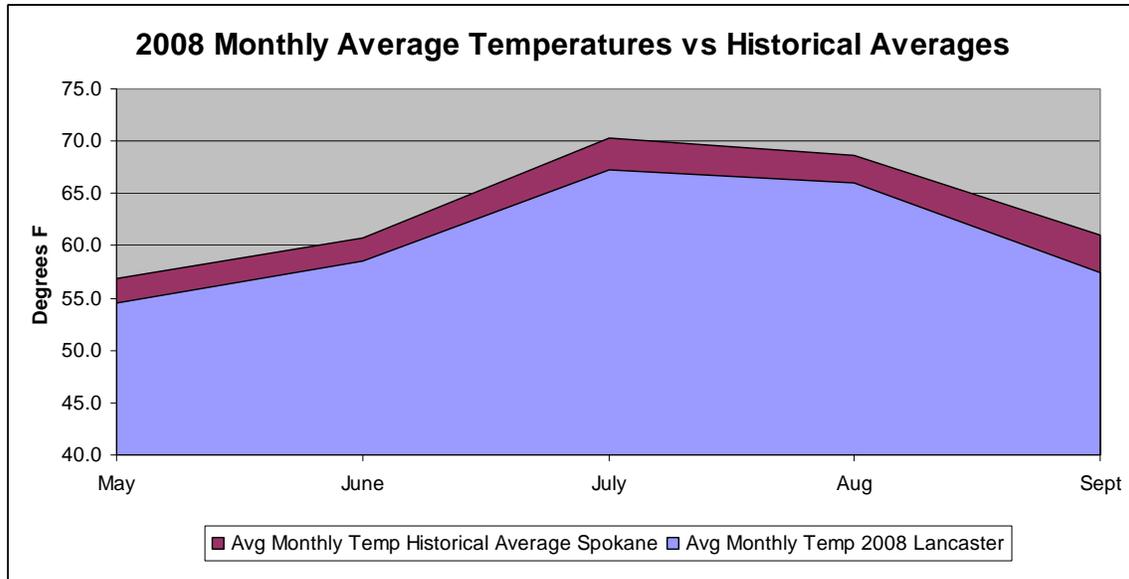


Figure 5. 2008 monthly average temperatures at the Lancaster site versus historical averages

Table 2 compares the average precipitation amounts for the May to September ozone season to the actual 2008 precipitation amounts. Rainfall data is not collected at the Lancaster monitoring site at this time due to budget constraints. The data meant to depict regional conditions in this comparison are taken from the National Weather Station at Spokane.

Table 2. Precipitation, Historical Average Compared With 2008

Precipitation Totals Over the Ozone Season, Historical Average vs. 2008		
Month	Average (inches)	2008 Season (inches)
May	2.25	0.93
June	2.06	1.00
July	1.02	0.00
August	1.16	0.57
September	1.12	0.54
Total	7.61	3.04

When precipitation occurs, it generally is accompanied by decreased temperatures and increased cloud cover. The lower temperatures will inhibit ozone formation as will decreased solar radiation caused by the cloud cover; therefore, less precipitation generally correlates with more ozone. Although the 2008 season was marked by much lower than average precipitation, this was not reflected by higher ozone levels. The lower temperatures for the season likely played a big role in keeping ozone levels down. The data suggests ozone is a regional issue encompassing eastern Washington and northern Idaho; therefore, regional weather conditions may be just as critical to understanding ozone transport and development as site-specific conditions.



The relationship between temperature and ozone concentration can be seen in Figure 6. The temperature values come from a meteorological tower located at the same site as the ozone monitor, where temperature is measured at 2 meters above the ground in degrees Celsius. The contours of the two lines follow the same general pattern of highs and lows suggesting that temperature had an influence on the ozone concentration. The fact that ozone formation does not have a linear relationship with temperature, due to the influence of other factors such as availability of precursors and transport into the area of ozone from other areas, is shown in this graph.

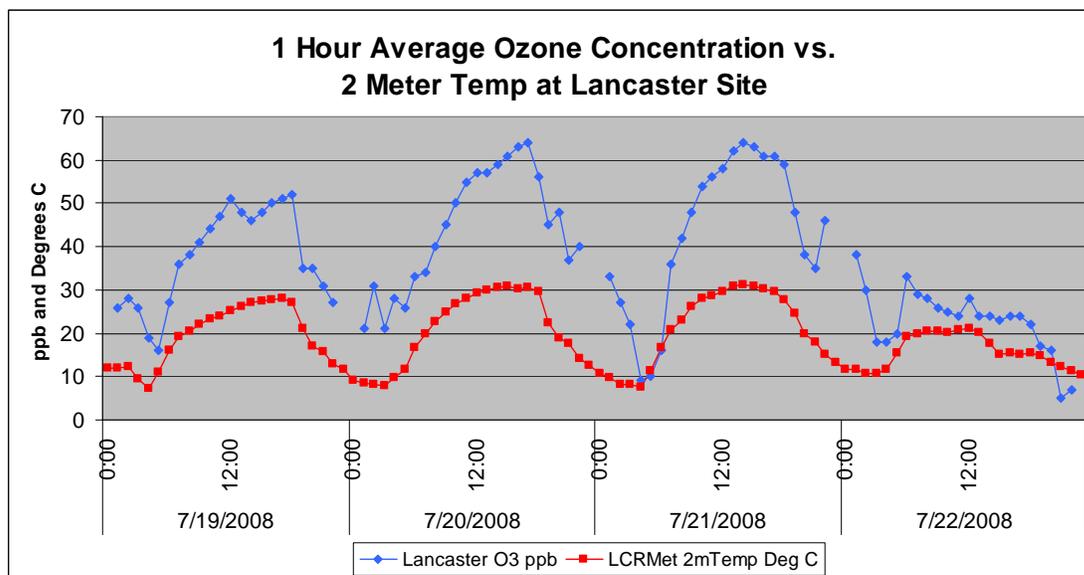


Figure 6. Hourly ozone concentration compared with temperature

Figure 7 shows the relationship of ozone concentrations, ambient temperature, and solar radiation. Solar radiation is measured in watts per meter squared (w/m^2) and represents the amount of energy being provided by the sun to drive the chemical reactions that form ozone. Solar radiation is measured at the Lancaster site using a pyranometer.

Once again, Figure 7 shows that the levels of solar radiation and temperature seem to mirror the ozone levels. The lines all have similar contours with the shape of the solar radiation line being very similar to the shape of the ozone concentration line. This shows that sunlight and temperature are two limiting factors for the production of ozone. More information to determine the presence of precursors such as NO_x and VOCs is needed to further identify and understand the other limiting factors affecting ozone development in Kootenai County.

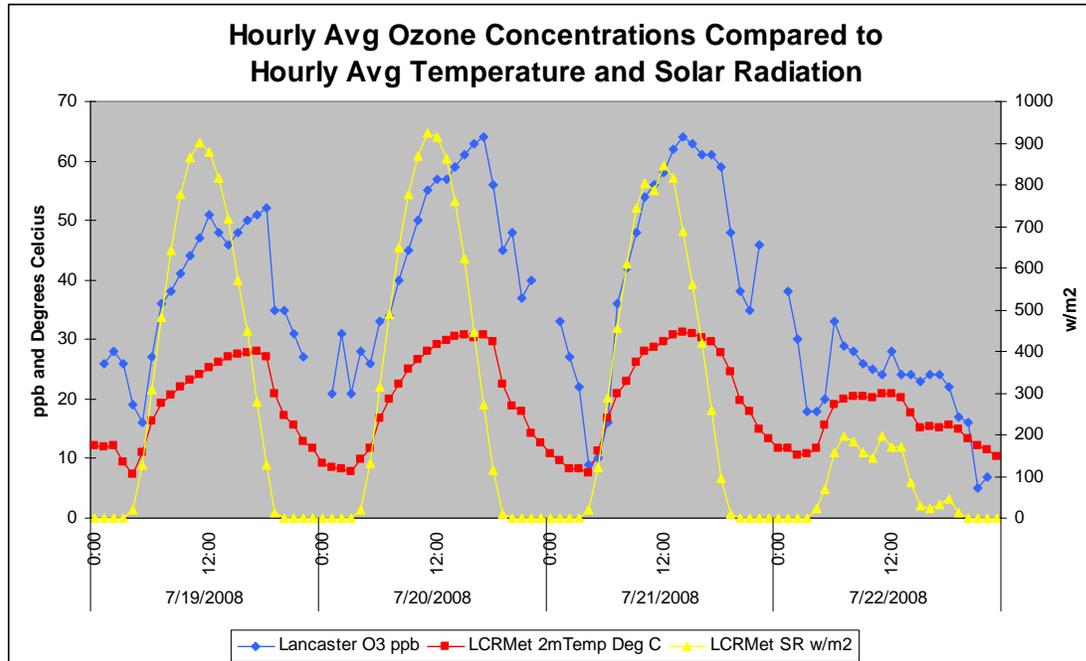


Figure 7. Hourly ozone concentration, temperature, and solar radiation compared

Though NO_x is not discussed in detail in this report it is important to understand its relationship with ozone.

Figure 8 shows NO_x concentrations in relationship to ozone concentrations. Note that when ozone is at its peak concentration for the day NO_x concentrations are at their lowest. When ozone concentrations start to drop late in the day, NO_x concentrations rise and NO_x reaches its peak early in the morning at the lowest point of ozone. This inverse relationship is a representation of the fact that as the day warms up and sunlight is at its strongest NO_x and other available precursors are converted to ozone. As the sun sets and temperatures cool NO_x begins to reform as the ozone molecules disassociate and NO_x concentrations build up again.

The early morning NO_x peak coincides with morning commute times while the rise in NO_x in the evening coincides with evening commute times. Issues with NO_x and Ozone measurement can be tied to the proximity and amount of traffic because NO_x is emitted by combustion engines. Excess NO_x near a monitoring site (fresh NO_x) has been shown to cause a “scouring” effect and inhibit ozone development in sufficient concentrations thus biasing ozone results low. This scouring effect is the reason for specific setback criteria from roads as is stated in the Code of Federal Regulations Title 40 Part 58 Appendix E Section 6.1. There is still some debate over the ability to truly isolate monitors from the effects of emissions from commuter traffic.

Another potential confounding issue at the Lancaster site is its proximity to the Coeur d’Alene airport. An active airport could influence local ozone concentrations. The Coeur d’Alene airport likely provides some ozone precursor emissions but it is not likely that the emissions notably contribute to increased ozone development measured at the Lancaster site. On days when significant stagnant weather conditions are prevalent a



greater likelihood of impact exists from airport VOC emissions. On the other hand, fresh NO_x emissions from the airport could be a limiting factor for ozone development. The scouring effect that fresh NO_x has on ozone creation is suggested in studies conducted elsewhere. This scouring effect actually decreases ozone formation. It is hoped that the results from the WSU precursor study will help to shed further light on this issue.

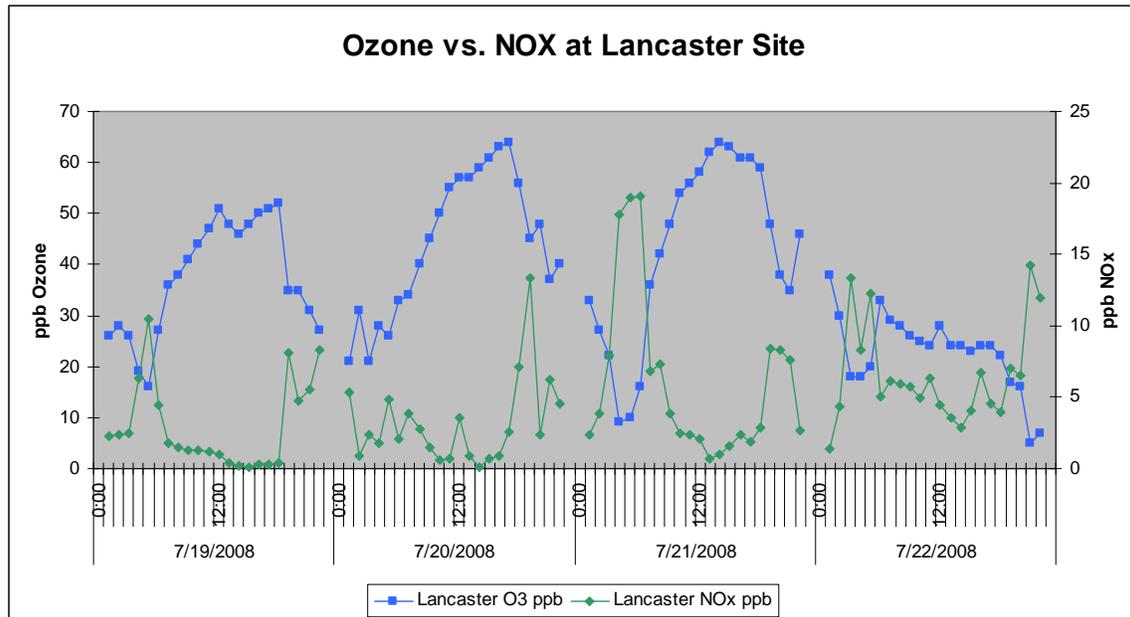


Figure 8. Ozone concentrations compared with nitrogen oxides

The graph in Figure 9 is called a wind rose. A wind rose depicts the direction that the wind is coming from to a point such as a wind sensor. The different spokes around the wheel indicate the different directions the wind is coming from. The length of each spoke is related to the percentage of time the wind is coming from that direction. The different colored sections of the spokes represent the wind speeds and length of the different colored sections shows the percentage of time the wind was travelling at that speed. Wind speed is shown in meters per second; Table 3. below shows the equivalents for wind speed in miles per hour.

Table 3. Meters Per Second Converted To Miles Per Hour

Meters Per Second	Miles Per Hour
0.000 – 2.000	0.000 – 4.474
2.000 – 4.000	4.474 – 8.948
4.000 – 6.000	8.948 – 13.422
6.000 – 9.000	13.422 – 20.132
9.000 – 12.000	20.132 – 26.843

The wind rose in Figure 9 is for the entire 2008 ozone season at the Lancaster site. The purpose of this graph is to give an impression of the prevailing wind directions for the season. The wind at the Lancaster site came mainly from three directions during the



ozone season: south, north-northeast, and southwest. Additionally this graph illustrates that when the wind is moving the fastest it generally is coming from the west-southwest, the southwest, and the south-southwest. Upwind in these directions are found large urban and industrial areas.

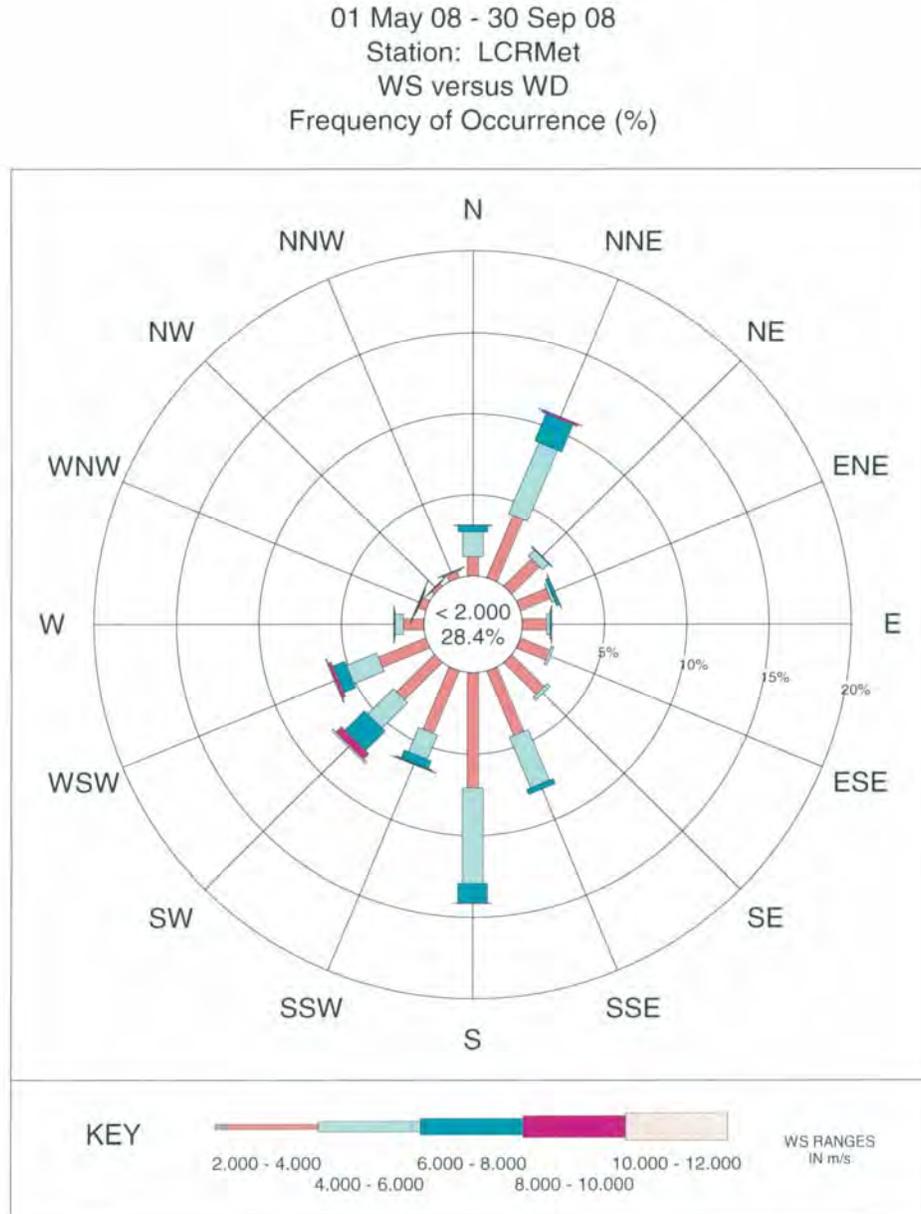


Figure 9. Wind rose for the 2008 ozone season

The wind rose in Figure 10. is for the month of July 2008, which had some of the highest ozone concentrations during the 2008 season. The graph demonstrates that the predominant wind directions during periods with higher temperatures and strong sunlight are in the south to south-southwest range. Another point of interest on this graph is that the wind speed in the dominate direction is above 4 meters per second (8.948 miles per hour) for a higher percentage of the time. Higher wind speeds would suggest greater



transport over a longer distance. The AIRPACT model has on occasion identified a potential large scale regional ozone issue that includes areas as far away as Walla Walla, Washington. This phenomenon will need to be investigated further. The Lancaster Road site is located approximately 3 hours downwind at typical wind speeds (roughly 30 miles) from the urban and industrial areas to the west and southwest. This is significant because the time needed for the photochemical reactions necessary to form ozone is 3-4 hours.

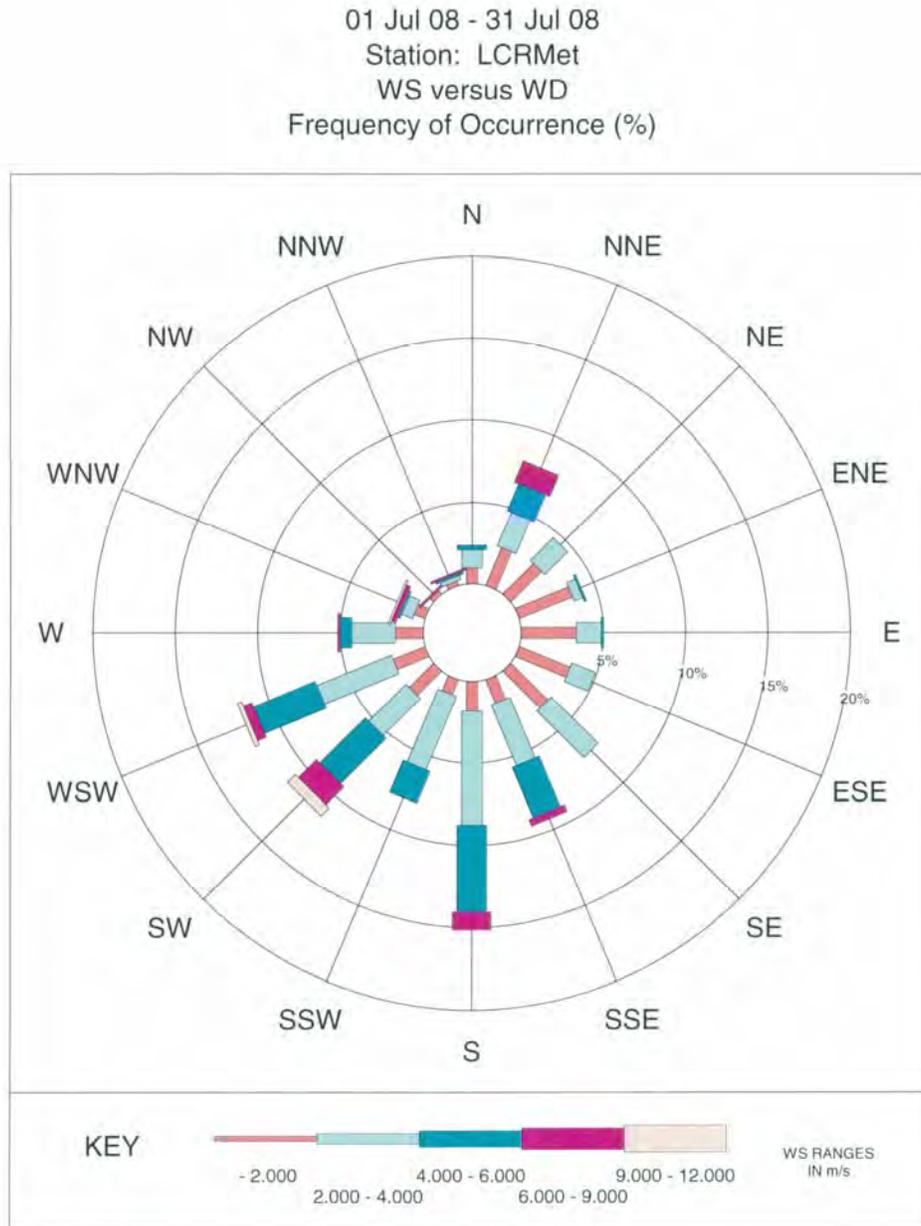


Figure 10. Wind rose for July 2008

The graph in Figure 11. is called a pollution rose. Rather than comparing wind speed against wind direction, this rose compares hourly ozone concentrations against wind direction. The predominant wind directions with the highest concentrations are between



west and south-southwest. Once again, this suggests that either ozone or its precursors are being transported from the urban and industrial areas to the west and southwest.

01 Aug 08 - 31 Aug 08
Station: HaydenIP
O3 versus WD (LCRMet)
Frequency of Occurrence (%)

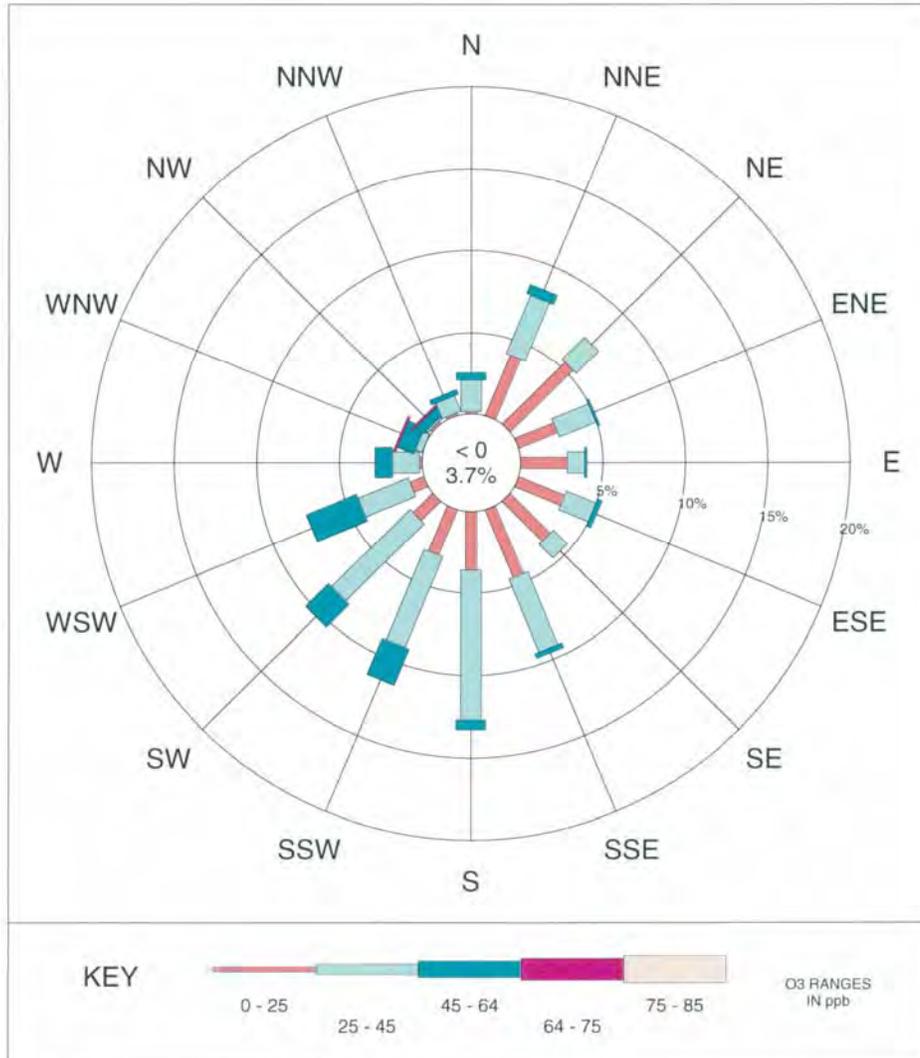


Figure 11. Pollution rose for ozone, August 2008

The map in Figure 12. shows the break in the mountains to the southwest of the Lancaster site that likely funnels the winds coming from the west towards the site. The effects of terrain could act to focus the flow of ozone and precursors formed to the west towards the site. Once again, this is data from only one season and further study is needed before any conclusions are reached.

Figure 12. shows the Lancaster site with predominant wind directions on the highest and lowest ozone concentration days (8-hour averages) represented by the colored triangles.



The orange-shaded triangle indicates the dominant wind directions on the highest-ozone days while the blue-shaded triangle shows the dominant wind directions during the lowest-ozone days. This map indicates that transport of ozone from the urban areas to the west and southwest of the site may play a part in higher concentrations at the site on the highest days. This theory warrants further study to determine its validity. While this map was created with a limited amount of data from one season, a future report will compile data from three ozone seasons to better understand the various influences on ozone concentrations measured in Kootenai County.

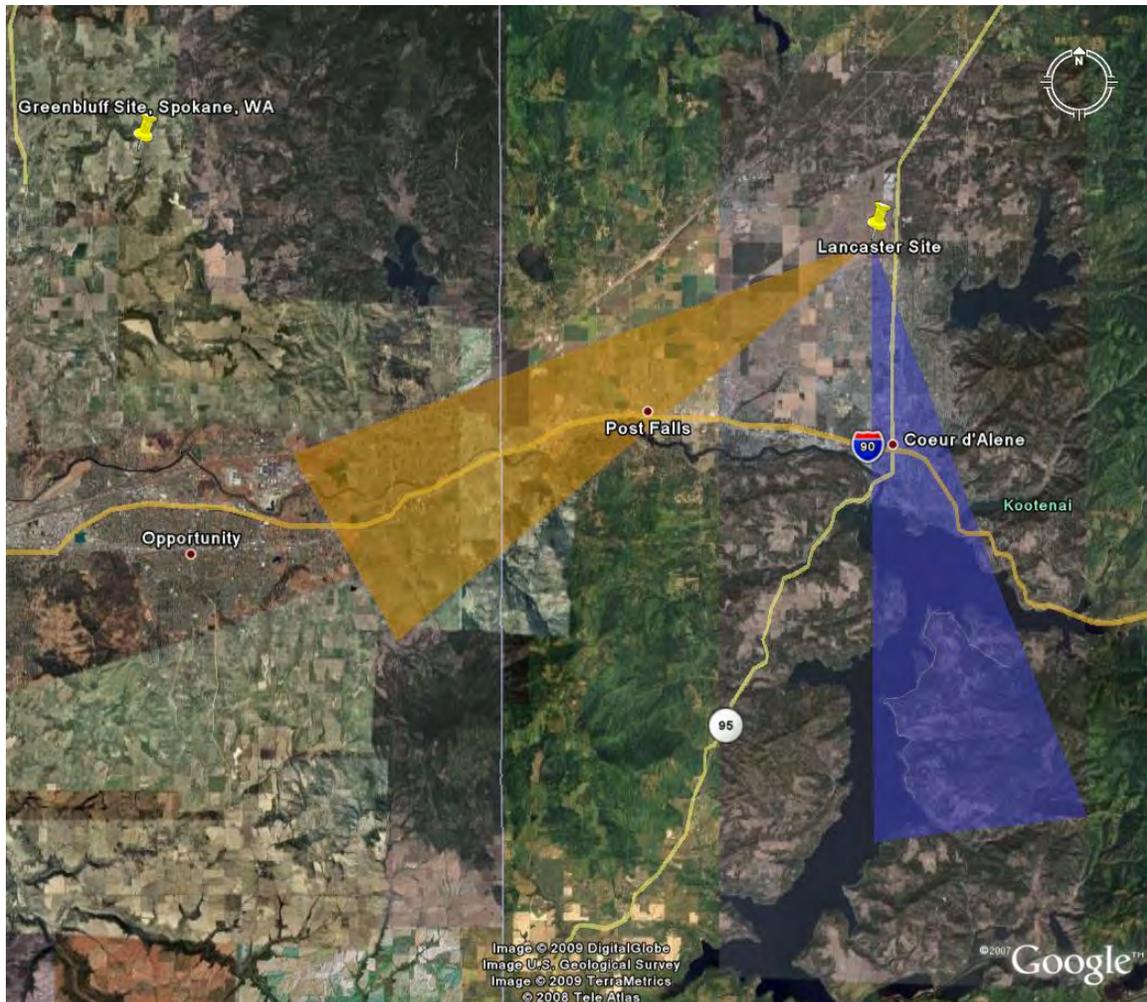


Figure 12. Map of the Coeur d'Alene area, with wind directions indicated during periods of highest (orange) and lowest (blue) ozone concentrations

Ozone data was acquired from the Washington State Department of Ecology's Greenbluff ozone monitoring site northeast of Spokane (see map on page 21 for location). The Greenbluff data is compared to the Lancaster Data in Figure 13 and Figure 14, to provide the reader a limited observation of the potential variability of ozone on a regional basis. The chart in Figure 13 covers some of the highest-ozone days at the Lancaster site. The contours of the two lines mirror each other fairly closely. This suggests a regional connection in ozone concentrations.

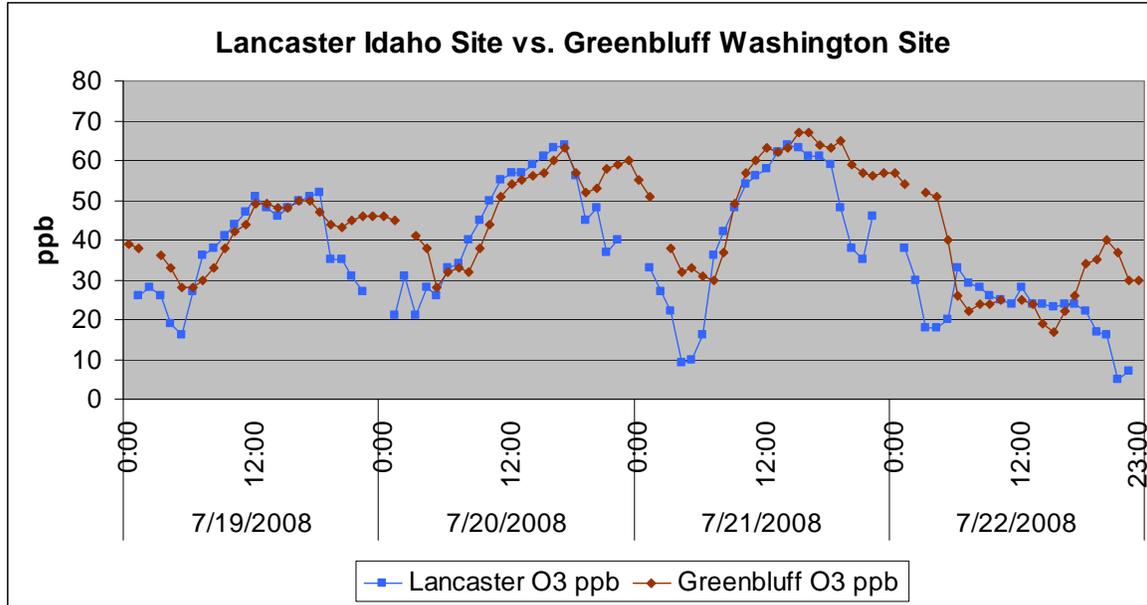


Figure 13. Ozone at Lancaster, Idaho compared with ozone at Greenbluff, Washington for four select days

The chart in Figure 14 compares hourly measurements for the entire month of July, 2008. While much of the time the two sites are very similar, there are periods where they also vary widely. Looking just at these two comparisons, it can be seen that when more data are considered, a regional relationship is still suggested, but the relationship may not be as straightforward as expected. Again, more study is warranted.

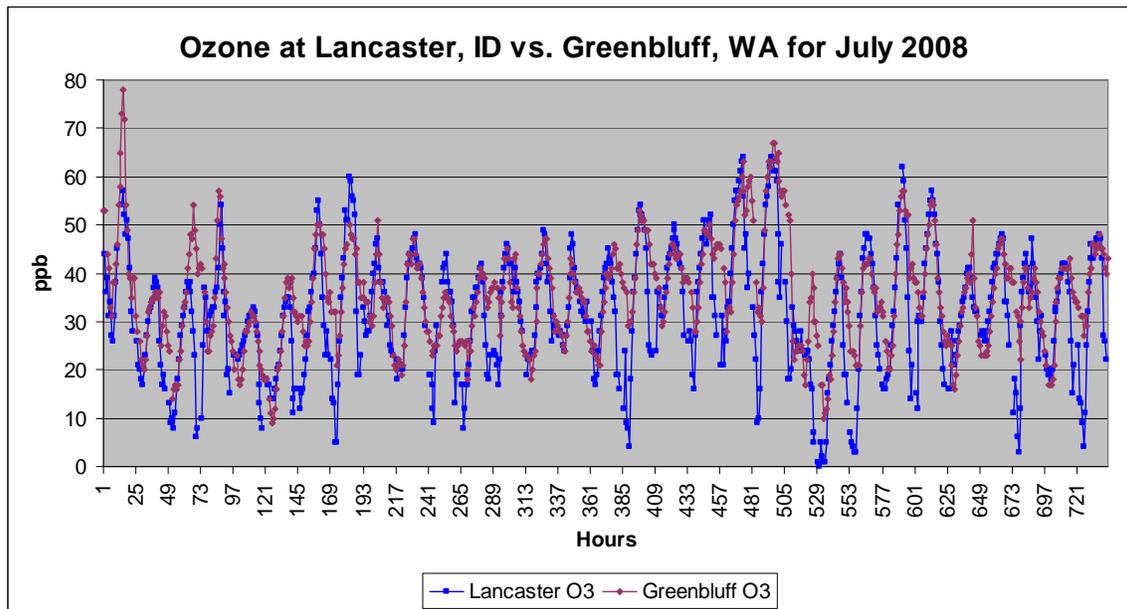


Figure 14. Ozone at Lancaster, Idaho compared with ozone at Greenbluff, Washington for July 2008



Monitoring Network

The Idaho monitoring network is a composite of meteorological and pollutant-specific monitoring equipment. Data from the ozone network are sent directly to engineers and scientists through a wireless telemetry network. This data is used to update both DEQ and EPA websites of current pollution levels as well as to update air quality index (AQI) information. The data is also quality-assured and submitted to EPA, and also disseminated to public and private entities that use the data for a variety of projects.

At the Lancaster site pollutants and meteorological information are measured using reference methods that are approved by EPA. Table 4 presents the methodology used for measurements of ozone concentrations at site.

Table 4. Pollutant Monitoring Methods used at Lancaster Site in 2008 in Coeur d'Alene

Pollutant Code	Measurement	Method	Units
O ₃	Ozone	UV Absorption	Parts per Billion
NO _x	Oxides of Nitrogen	Chemiluminescence	Parts per Billion

Methods used for collecting the meteorological data are presented in Table 5. This data is collected by a variety of instruments on a 10-meter weather tower.

Table 5. Meteorology Monitoring Methods used in 2008 in Coeur d'Alene

Parameter Code	Measurement	Method	Units
WS	Wind Speed	Propeller-type anemometer	Meters per Second
WD	Wind Direction	Tail Wind Vane	Degrees (0-360)
SR	Solar Radiation	Pyranometer	Watts per Meter Squared (w/m ²)
2m Temp	2 Meter Ambient Temperature	Platinum Resistance Thermometer	Degrees Celsius
10m Temp	10 Meter Ambient Temperature	Platinum Resistance Thermometer	Degrees Celsius
Dew Point	Relative Humidity	Capacitive Polymer H chip	%

The Washington State University (WSU) Laboratory for Atmospheric Research sampled for ozone precursors at two sites in Kootenai County during the 2008 season: the Lancaster site and the Post Falls site. The data collected will be used for a precursor study that is due to be submitted to DEQ in early 2009. This study will examine NO_x/volatile organic chemical (VOC) mixing ratios and ozone formation limiting factors. The equipment and methods used by WSU are listed in Table 6.

Table 6. Monitoring Methods used by WSU for Ozone Precursor Study

Pollutant Code	Measurement	Method	Units
VOCs	Volatile Organic Chemicals	Proton Transfer Reaction Mass Spectrometry (PTRMS)	Parts per Trillion
VOCs	Volatile Organic Chemicals	Canister sampler and lab analysis	Parts per Trillion
NO _x	Oxides of Nitrogen	Chemiluminescence	Parts per Billion
O ₃	Ozone	UV Absorption	Parts per Billion
CO	Carbon Monoxide	Infrared Absorption	Parts per Million



Regional Air Emission Inventory

This section presents an air emission inventory summary for NO_x and volatile organic compounds (VOCs), as precursors of ozone. This inventory was completed by DEQ in June of 2008 in response to the new EPA ozone standards. An emission inventory helps to identify the sources of pollutants. Identified sources of pollutants can then be addressed with efforts to reduce emissions through improved technologies, education and encouragement to change behaviors, and economic incentives. DEQ used the customary and accepted emission inventory development process to develop this emission inventory. A more-detailed emission inventory would be required if concentrations were high enough to exceed NAAQS and trigger pre-defined responses, and would be preferred for other state-implemented legislation.

Source Categories

There are five general categories that are used to characterize air emission sources (with virtually hundreds of subcategories). The five general categories are:

- Point Sources
- Mobile On-Road Sources
- Non-Road Sources
- Stationary Area Sources
- Biogenic Sources

Four of these categories are for emissions of criteria air pollutants. The fifth category (biogenics) is for emissions that are natural, and therefore probably unavoidable, but their effects need to be considered. Each of these categories is described below.

Point sources are those that many people think of when they think of air pollution. These include large industries that emit tons of pollutants each year from a single location. A description of the regulatory thresholds associated with these sources is included in the final section of this document.

Mobile on-road sources include cars, trucks, and buses, both commercial and private. This category includes vehicles that run on both gasoline and diesel fuel. As with stationary area sources, on-road mobile sources contribute significantly to air pollution in Idaho.

Non-road sources include, for example, farm vehicles, construction vehicles, aircraft, locomotives, and garden equipment.

Stationary area sources are much smaller than point sources but in any given area there are many of them. Individually, they do not emit as much tonnage as point sources. Area sources include commercial businesses such as dry cleaners, printers, and small construction operations, as well as everyday activities such as burning in a wood stove or fireplace. Although they individually emit far less pollution than point sources, their large numbers make them a significant contributor to air pollution in Idaho.



Biogenic emissions come from natural sources, and need to be accounted for in photochemical grid models. Often, only the emissions from vegetation and soils are included, but other relevant sources include volcanic emissions, lightning, and sea salt.

The emission inventory completed by DEQ in June of 2008 for the Coeur d'Alene area summarized the quantities of criteria air pollutants from sources in the four categories described above, and also included anthropogenic (human-generated) sources and biogenic (naturally-generated) sources of VOCs such as crops and other vegetation. Isoprene, which is generally produced by biogenic sources, can have a substantial impact on ozone formation. The biogenic data in the inventory is taken from EPA estimates. The inventory represents Kootenai County and the greater Spokane area. Data used to generate this inventory came from:

- DEQ's and Washington Ecology's 2005 emissions inventories for submittal to EPA for the National Emissions Inventory (NEI) (point sources)
- Biogenic data from the 2005 NEI that EPA generated.

Point sources can provide the most straightforward information for the emission inventory, because point source facilities are required to report the amount of each pollutant they release each year. For area sources, estimates derived from emission factors are used, and these may have more uncertainty associated with them, because they must take activity levels into account. For example, assumptions are made about how often an activity such as burning wood in a fireplace, driving to work, or even smaller activities that produce stationary source emissions are performed. These assumptions about activity levels are developed from sources such as surveys, census reports, etc. In addition to the uncertainty associated with activity levels, there is also uncertainty regarding the emission factors themselves (for more information about emission factors, see the Using Emission Factors section on page 22). These values are typically developed by EPA in consultation with state and local air agencies and industry representatives. Additional information on emission factors and how they are derived is available at <http://www.epa.gov/ttn/chief/efpac/index.html>.

Table 7 presents the amounts of NO_x and VOCs contributed in Kootenai County from sources in each category.

Table 7. Idaho 2005 Estimated Criteria Air Pollutant Emission Inventory, Summary for Kootenai County

Source Category	NO _x	VOC
Point Sources (Large Facilities)	275	296
On-Road Mobile Sources	3,231	2,123
Non-Road Mobile Sources	810	1,739
Stationary Area Sources	893	3,842
Biogenics	0	22,528
Totals (Tons/Year)	5,209	30,528



This Spokane area inventory summary presented in Table 8 demonstrates that on-road mobile sources make up the most significant contributions to NO_x in the area's atmosphere, while biogenics outpaces all others in VOC emissions.

Table 8. Idaho 2005 Estimated Criteria Air Pollutant Emission Inventory, Summary for Spokane Area

Source Category	NO _x	VOC
Point Sources (Large Facilities)	783	788
On-Road Mobile Sources	10,244	6,516
Non-Road Mobile Sources	2,240	3,280
Stationary Area Sources	2,950	6,836
Biogenics	983	20,871
Totals (Tons/Year)	17,200	38,291

By combining emissions inventory data with wind data, we can create some possible scenarios for determining the limiting factor in ozone formation in the area. With the wind coming from the Spokane area during much of the time on the 10 highest-ozone days of the season, one scenario is that transportation sources or large industrial sources could be affecting ozone levels at the Lancaster site, possibly resulting from the transport of either ozone or ozone precursors from the Spokane area into the Coeur d'Alene area. Because a much smaller amount of NO_x is generated in Kootenai County, it is possible that the limiting factor is the availability of NO_x for the ozone-forming reaction in the vicinity of the monitor at Lancaster. It is not possible to be certain that any such scenario is correct because of the limited amount of data, currently from just one season, with relatively cool temperatures during that season. The results from the WSU precursor study and further studies are needed to help make such determinations, if such determinations are possible. Combining Spokane emissions and Kootenai County emissions may be necessary to understand what significantly influences Kootenai County ozone concentrations. In addition the airshed boundary for Kootenai County needs to be further evaluated and developed.

Sources of NO_x and VOCs as pollutants in Kootenai County are discussed briefly below, and information from Table 7 and Table 8 is presented graphically.

Nitrogen Oxides

The graph in Figure 15 shows sources of NO_x in Kootenai County. The combination of all vehicles and equipment is the greatest source of emissions of NO_x, making up 79% of the total source contribution. The largest subcategories for these contributors of NO_x are off-road vehicles and equipment, and on-road gasoline vehicles. The small area source facilities make up the bulk of the remaining contribution with 21%.

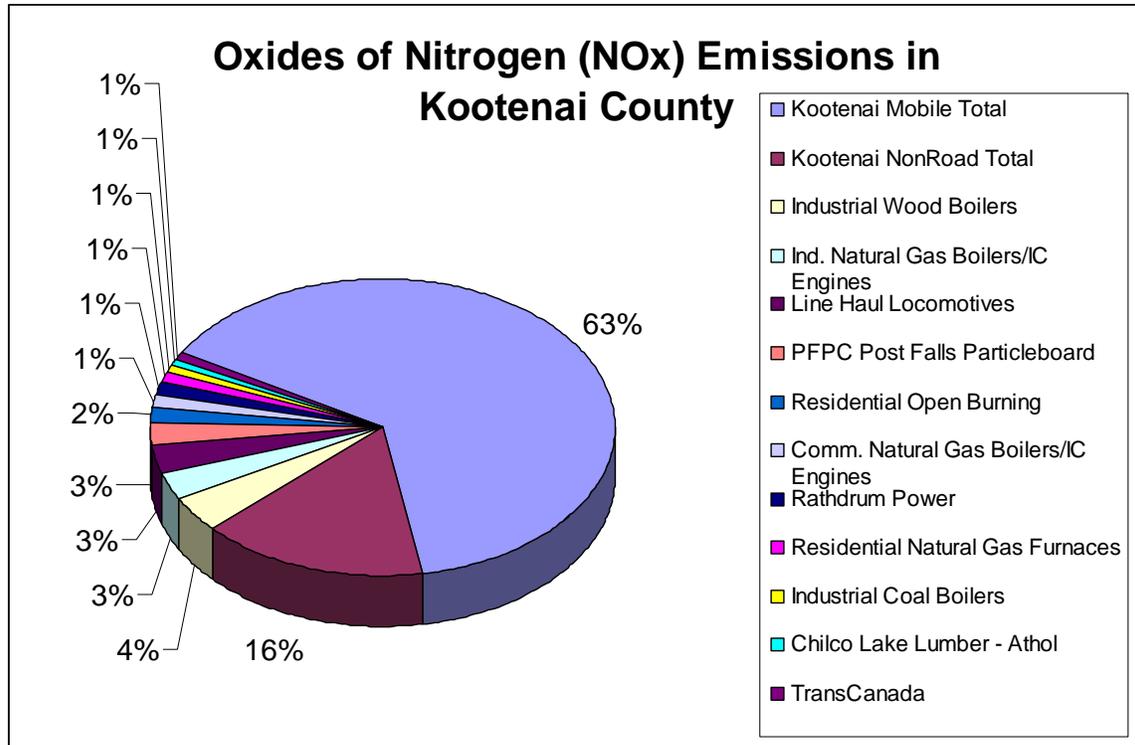


Figure 15. Sources of NOx in Kootenai County

Volatile Organic Compounds

Although VOCs are not criteria air pollutants, they are included in discussion of the criteria air pollutants emission inventory because they are a primary precursor for ozone, which is a criteria pollutant. The graph in Figure 16 shows that, aside from biogenics, vehicles and associated equipment contribute the greatest portion of VOCs to the atmosphere in Kootenai County, making up 13% of the total. The other largest contributing subcategories for area sources are asphalt applications, part degreasing, indoor wood burning, and surface coating (mainly of furniture and vehicles).

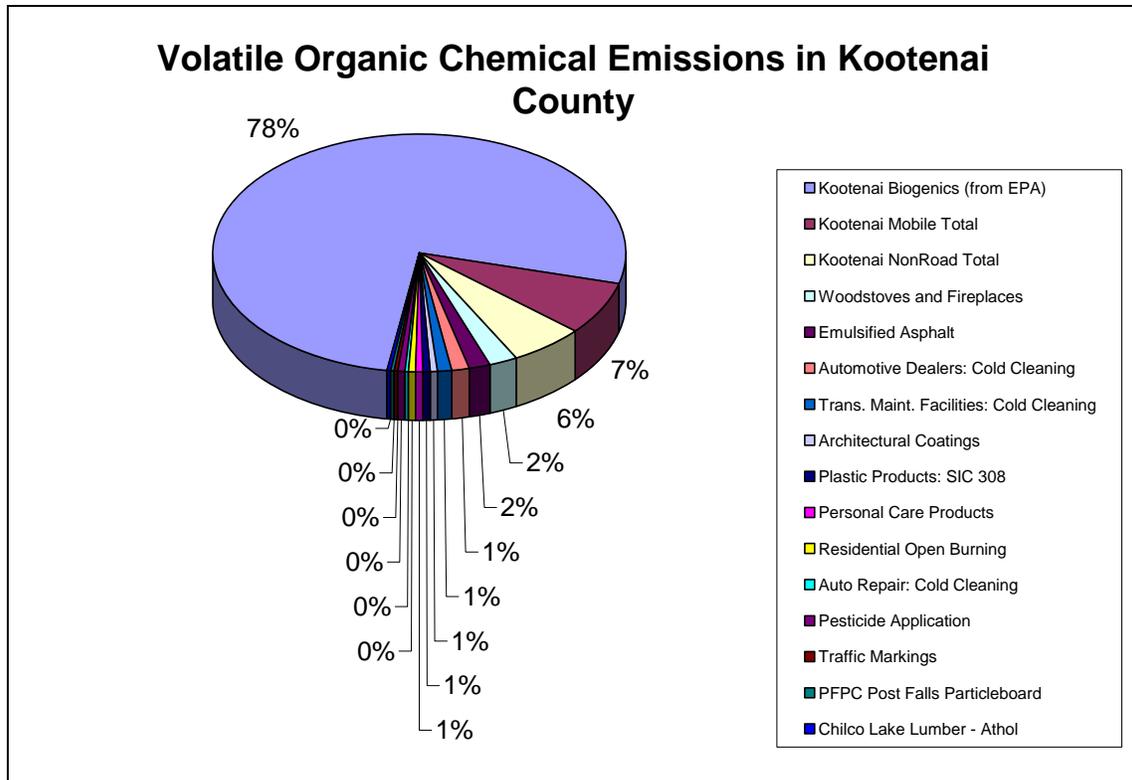


Figure 16. Sources of volatile organic chemicals in Kootenai County

Using Emission Factors to Calculate Amounts of Air Pollutants

Definition

An emission factor is a numerical value derived from source tests that measure amounts of pollutants released from point sources during their operations, material balance calculations, or engineering comparisons with similar processes for which the amounts of pollutants being released are known.

How Emission Factors Are Used

Emission factors are used to estimate emissions from process quantities. The amount of material processed is multiplied by an emission factor for a given pollutant to determine the amount of that pollutant produced by the process.

For example, if a factory makes 2,000 pounds of ABC gum each hour, and the process of making one pound of ABC gum produces 0.00087 pound of pollutant xyz, then we would know that the factory produces 1.74 pounds ($2,000 \times 0.00087 = 1.74$) of pollutant xyz each hour. And, if the factory makes ABC gum for 10 hours every day for 365 days of every year, we would know that they produce 6,351 pounds of pollutant xyz each year ($1.74 \times 10 \times 365 = 6,351$).



We can make the same kind of determinations for how many pounds of certain pollutants are produced for every mile driven by various types of cars or for every hour that a given type of lawnmower is operated.

Air Quality Standards

The national Clean Air Act, last amended in 1990, requires EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The standards are designed to primarily protect the general public, including sensitive populations such as asthmatics, children, and the elderly. They are also intended to safeguard public welfare by reducing effects such as decreased visibility and damage to animals, crops and other vegetation, and buildings. EPA has established standards for six criteria pollutants. Table 9 describes the standard for ozone, which the state of Idaho has adopted. For more information, the EPA air quality standards and supporting rationale are available at <http://epa.gov/air/criteria.html>.

Table 9. Air Quality Standard for Ozone

Pollutant	Standard	Level
Ozone	The 3-year average of the 4th--highest daily maximum 8-hour average concentration cannot exceed the level measured at each monitor within an area over each year.	0.075 ppm

When the EPA designated the new 8-hour ozone standard of 0.075 ppm this past year, they also tried to eliminate some confusion by directing agencies to treat significant figures differently than in the past when calculating compliance. The new calculating convention is to truncate (or cut off a number without rounding) the final concentration calculation after three significant figures. For example, a final concentration of 0.0759 would be 0.075 and not rounded to 0.076. The value of 0.075, shown in Table 9, is used to determine if an area is in compliance, and is reflected in the graphs in this report.

For each pollutant there typically are different standards for different averaging times (for example, annual, daily, hourly, and 8-hour averages). These different standards are created and enforced to address varied health impacts that happen as a result of shorter, higher-level exposures versus longer, lower-level exposures. These differences are addressed pollutant-by-pollutant in the following sections, and additional information is on the EPA Web site identified above. A distinction exists between “exceeding” and “violating” a standard; the two are not equivalent. This distinction is due to the nature of the standards. In most instances it is allowable for an area to exceed the standard a few times, to allow for possible meteorological aberrances. For example, an ozone 8-hour average of 0.090 ppm clearly exceeds the standard; however, the standard is not violated if the 3-year average of the annual 4th-highest daily maximum 8-hour concentration does not exceed 0.075 ppm.



Current Public Outreach and Potential Actions

Current Air Quality Forecasts

During ozone season DEQ currently provides forecasts of pollution conditions for ozone in the Coeur d'Alene area. Forecasts covering all days of the week are made using pollutant monitoring data and meteorological information. Ozone pollution can rise to very high levels when the area experiences hot days with few clouds in the sky. These optimal conditions for ozone formation are also optimal for outdoor activities. Since ozone tends to be at its worst when the weather is “best” for outdoor activities, ozone forecasts are a helpful tool for those who are easily affected. These forecasts are useful in that they help people who are sensitive to ozone pollution to plan their day. Additionally forecasts allow concerned citizens to plan their activities to lower impact on ozone precursors during high pollution periods. The ozone forecasts are available on DEQ’s website, www.deq.idaho.gov, as well as the EPA’s AIRNow website, www.airnow.gov

Potential for Issuing Ozone Alerts

Since we have no control over weather characteristics, controlling ozone would mean controlling what we put into our air. The possibility of issuing alerts for the area, conducting associated activities, to help curb ozone formation during high-concentration episodes is being considered. Currently, postings are made to the DEQ website, www.deq.idaho.gov, and to the EPA’s AIRNow site, www.airnow.gov. Possible future activities could include sending press releases to local media outlets and to others through an email notification list. Actions that could be requested of the public when ozone concentrations are high may include limiting driving and open burning, and putting off lawn mowing until after the alert is ended.

Information Provided by the Air Quality Index

The air quality index (AQI) is an index for reporting daily air quality. The AQI for your area tells you how clean or polluted the air is, and what associated health effects might be a concern for you. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health. Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy—at first for certain sensitive groups of people, then for everyone as AQI values get higher.



For more detailed information about the AQI and the pollutants it measures, go to the Web site at www.epa.gov/airnow/aqibroch.

Table 10. Calculation and Breakpoints for the Air Quality Index (AQI)

Breakpoints for Criteria Pollutants							AQI Categories	
O ₃ 8-hour (ppm)	O ₃ 1-hour ^a (ppm)	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)	CO (ppm)	SO ₂ (ppm)	NO ₂ (ppm)	AQI value	Category
0.000–0.059	—	0.0–15.3	0–54	0.0–4.4	0.000–0.034	(b)	0–50	Good
0.060–0.075	—	15.4–35.4	55–154	4.5–9.4	0.035–0.144	(b)	51–100	Moderate
0.076–0.095	0.125–0.164	35.5–65.4	155–254	9.5–12.4	0.145–0.224	(b)	101–150	Unhealthy for sensitive groups
0.096–0.115	0.165–0.204	65.5–150.4	255–354	12.5–15.4	0.225–0.304	(b)	151–200	Unhealthy
0.116–0.374	0.205–0.404	150.5–250.4	355–424	15.5–30.4	0.305–0.604	0.65–1.24	201–300	Very unhealthy
(c)	0.405–0.504	250.5–350.4	425–504	30.5–40.4	0.605–0.804	1.25–1.64	301–400	Hazardous
(c)	0.505–0.604	350.4–500.4	505–604	40.5–50.4	0.805–1.004	1.65–2.04	401–500	

- a Areas are generally required to report the AQI based on 8-hour ozone values. However, there are a small number of areas where an AQI based on 1-hour ozone values would be safer. In these cases, in addition to calculating the 8-hour ozone value, the 1-hour ozone value may be calculated, and the greater of the two values reported.
- b NO_x has no short-term National Ambient Air Quality Standard (NAAQS) and can generate an AQI only above a value of 200.
- c 8-hour O₃ values are not used to define AQI values above 300. AQI values above 300 are calculated with 1-hour O₃ concentrations.



More About Ozone

In this section, more information about ozone is provided, including more about how it is formed, why it is a concern, and how we calculate amounts of ozone and its precursors in our air.

General Definitions

Criteria Air Pollutants (CAPs)

Criteria air pollutants (CAPs) are often just called *criteria pollutants*. The Clean Air Act of 1970 defined six criteria pollutants and established criteria for ambient concentrations of these pollutants, set at levels to protect public health. EPA periodically has revised the original concentration limits and methods of measurement, most recently for ozone in 2008. One of the six, ozone, is addressed below, along with ozone-precursor VOCs.

Ozone (O₃)

Ozone, a colorless gas molecule with a strong odor, is composed of three atoms of oxygen. In the upper atmosphere, ozone occurs naturally and partially absorbs the sun's harmful ultraviolet rays. However, at ground level, ozone is a summertime air pollution problem.

Volatile Organic Compounds (VOCs) – Ozone Precursors

A VOC is an organic compound that participates in atmospheric photochemical reactions. This excludes all compounds determined by EPA to have negligible photochemical reactivity and listed in 40 CFR 51.100(s) in effect July 1, 1998.

More About Ozone: a Criteria Air Pollutant

- **How is it caused?**

Ozone forms when photochemical pollutants, which come mostly from cars, trucks, biogenic, and industrial sources, react in the presence of heat and sunlight. Ozone-forming pollutants include NO_x and VOCs. Although transportation and industrial sources are the biggest contributors, even gasoline-powered yard equipment, paints, solvents, and off-road vehicle motors contribute.

- **When does it happen?**

Ozone pollution is most common in the summer months, when sunlight and stable atmospheric conditions occur. Ozone levels are usually highest in the afternoon, as sunlight photochemically transforms NO_x and VOCs into ozone.

- **Who is affected?**

Children, the elderly, people who are active outdoors, people with respiratory disease such as asthma, and people with unusual sensitivity to ozone. During physical activity, ozone penetrates deeper into the lungs and can do more damage.

Ozone is a very reactive gas. For this reason, high concentrations of ozone can cause respiratory distress and disease in humans, decreased yields of agricultural



crops and forests, and damage to some rubber products, plastics, and paints used outdoors. National crop losses from ozone exposure are estimated at \$3 billion to \$5 billion annually. Forest losses are harder to estimate.

- **What are the health effects of ozone?**

Ozone can cause coughing and throat irritation, make deep vigorous breathing more difficult, and increase the chance of respiratory infections. It increases sensitivity to allergens and can trigger asthma attacks. The damage it causes to the lungs heals within a few days, but repeated or prolonged exposure may cause permanent damage.

- **What can I do about it?**

If ozone levels are high and you have a respiratory condition or are normally active outdoors, try to limit your outdoor exertion.

In the United States, management of ozone and other photochemical oxidants has been a major goal of federal and state clean air legislation such as the Clean Air Act. Although many of the pollution control efforts required by the Clean Air Act have been implemented, efforts to decrease ozone pollution have been only partially successful.

In the Coeur d'Alene airshed, ozone concentrations are elevated, but still within the Federal standards.

- **Where is ozone measured?**

Unlike other pollutants monitored here in Idaho, ozone is formed by precursors that react in the atmosphere. Winds transport ozone and chemical emissions from one area to another. For the Coeur d'Alene area, ozone precursors are emitted into the air in industrial areas of the airshed to the south and southwest and subsequently travel north and northwesterly to more rural areas as they react to form ozone. As a result, DEQ currently has one monitor on the Rathdrum Prairie at the Lancaster site.