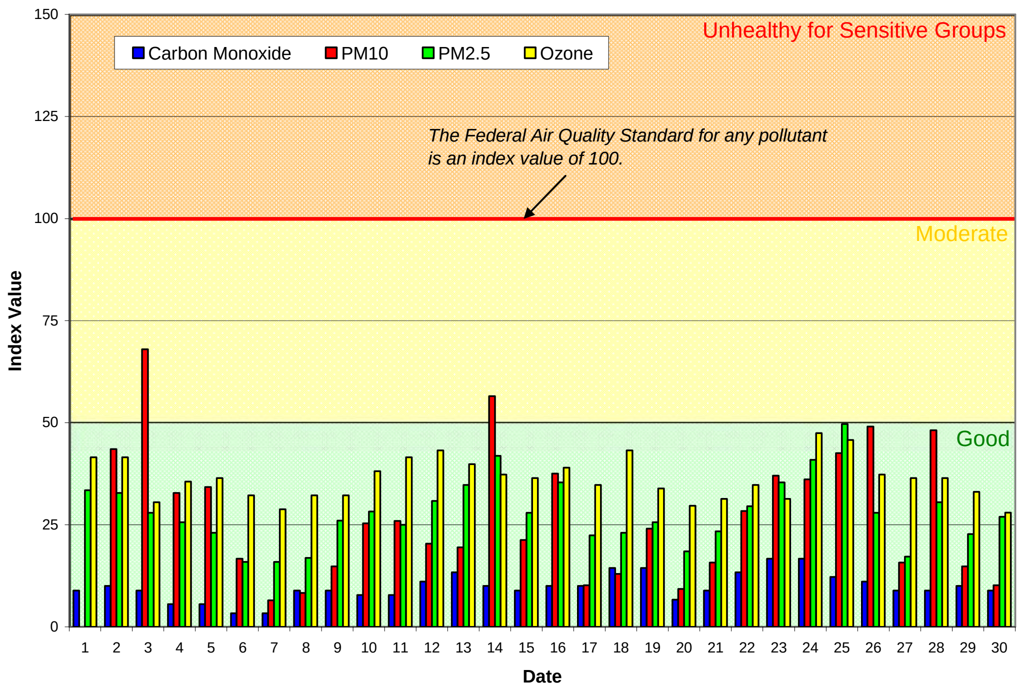
Spokane Regional Clean Air Agency
Air Quality Report - September 2009

Cities and unincorporated areas within Spokane County experienced mostly good air quality in September, although moderately high concentrations of particulate matter (PM_{10}, see definitions Appendix 1) as determined by the Air Quality Index (AQI) occurred on the 3rd and 14th (Figure 1). The Air Quality Index (AQI) is EPA's color-coded tool for communicating daily air quality to the general public and can be calculated for any of the pollutants regulated under the National Ambient Air Quality Standards (NAAQS), except lead. The AQI categorizes air quality as "good", "moderate", "unhealthy for sensitive groups", "unhealthy", "very unhealthy" or "hazardous," depending on air pollution levels. See appendices 2 and 3 for descriptions of the NAAQS and AQI, respectively.

The AQI on the 3rd was 68 (moderate air quality), the highest of the month, and was recorded at the Turnbull Wildlife Refuge monitoring station (Table 1). It was based on a 24-hour average PM_{10} concentration of 90 $\mu g/m^3$, which resulted from a dust storm. Wind speeds on the 14th were not spectacular, but were higher than average for the month. Something that should be noted with respect to PM_{10} monitoring at Turnbull Wildlife Refuge, the only station in Spokane County where PM_{10} is monitored on a daily basis, is that there has been a substantial amount of construction and earth-moving very close to the PM_{10} monitor as part of a project at the Turnbull Wildlife Refuge headquarters. Also, the monitoring station is in close proximity to gravel roads, which wildlife refuge personnel use to access their maintenance shops. These roads receive a lot of traffic, especially in the morning, just prior to the start of the work day.

In addition to PM_{10}, fine particulate matter ($PM_{2.5}$) and ground-level ozone (O_3) reached AQI levels close to moderate on the 24th and 25th when the region was experiencing dry and stable conditions under an upper atmospheric high pressure ridge. Ventilation was inhibited on the 24th and 25th until a dry cold front moved through the region on the 26th, which brought breezy conditions, lower $PM_{2.5}$ and ozone concentrations, but probably some blowing dust, based on the higher PM_{10} AQI compared to the $PM_{2.5}$ and ozone AQI sub-indices (Figure 1).

<u>Figure 1</u>: Air Quality Index (AQI) values for September 2009



The data used for calculating the AQIs are obtained using automated air pollution monitoring methods that provide "real time" data, which the SRCAA uses in its day-to-day programs, e.g., air quality forecasting and burning curtailment. For measurement of particulate matter concentrations, the SRCAA operates a network of continuous particulate matter monitors consisting of Tapered Element Oscillating Microbalances (TEOM) and nephelometers. The Department of Ecology operates ozone monitors at Greenbluff, northeast of Spokane, and at Turnbull Wildlife Refuge, south of Cheney. Ecology also operates a carbon monoxide monitor near the intersection of 3rd & Washington in downtown Spokane. Daily air quality data for all pollutants and all monitoring stations within Spokane County are provided in tabular form in Appendix 4.

Tables 1 and 2 contain the maximum AQI values for each pollutant for the month and for the year to date. Table 3 summarizes the year to date daily AQIs by category and compares them to last year's AQIs. Note that the 24-hour average PM_{10} concentration measured at Turnbull Wildlife Refuge on the 3rd was the highest so far this calendar year (Table 2). The breakdown of this year's AQIs recorded through September is similar to last year (Table 3).

Table 1: Maximum AQI values and pollutant concentrations for this reporting period

Pollutant	AQI/Concentration	Location	Date
CO	17/1.5 ppm	3rd & Washington	9/23 and 9/24/09
PM_{10}	68/90 $\mu g/m^3$	Turnbull Wildlife Refuge	9/3/09
$PM_{2.5}$	50/15.3 $\mu g/m^3$	Augusta Ave	9/25/09
O_3	47/0.056 ppm	Greenbluff and Turnbull WR	9/24/09

Table 2: Maximum AQI values and pollutant concentrations this year to date

Pollutant	AQI/Concentration	Location	Date
CO	33/3 ppm	3rd & Washington	4/1/09
PM_{10}	68/90 $\mu g/m^3$	Turnbull Wildlife Refuge	9/3/09
$PM_{2.5}$	105/43 $\mu g/m^3$	Airway Heights	7/4/09
O_3	78/0.068 ppm	Greenbluff	7/22/09

Table 3: AQI summary as of September 30, 2009

Category	Number of Days This Year	Last Year to Date
Good (0-50)	248	245
Moderate (51-100)	24	28
Unhealthy for Sensitive Groups (101-150)	1	1
Unhealthy (151-200)	0	0
Very Unhealthy (201-300)	0	0
Hazardous (>300)	0	0

While air quality is, in general, good in the month of September, there can be a few days of "moderate" air quality as determined by the AQI or even the rare day when the AQI reaches the "unhealthy for sensitive groups" or "unhealthy" categories. Air quality was relatively good in September 2009 compared to other Septembers during the past ten years, with twenty-eight "good" air quality days and only two "moderate" days (Figure 2). As discussed previously, the AQI reached the "moderate" level twice in September 2009 because of high PM_{10} concentrations caused by blowing dust. Other potential sources of moderate to unhealthy air pollution in September include smoke from wildfires or agricultural burning, which can cause $PM_{2.5}$ concentrations to rise sharply or fuel combustion, which, especially under an upper atmospheric high pressure ridge, which can bring sunny days but stable atmospheric conditions and marginal to poor air ventilation. Ozone and $PM_{2.5}$ concentrations often rise under these conditions. September 2003 and September 2006 are notable examples. Although September has a lower potential for high ozone days than earlier summer because there are fewer hours of daylight and sun angles are lower, it can still reach high concentrations, as occurred in 2003 and 2006 (Figure 2). A variety of air pollution sources, primarily combustion-related, including wildfires and agricultural burning or motor vehicle traffic, from gasoline burning passenger vehicles to diesel powered trucks, trains and heavy equipment are major contributors to ozone and $PM_{2.5}$ pollution in the month of September.

Figure 2: The number of days in September 2000-09 when the Air Quality Index was good (green), moderate (yellow), unhealthy for sensitive groups (USG; orange) or unhealthy (red). Air quality was better in September 2009 than most of the previous nine Septembers. To make the data comparable, all AQIs were calculated using the most current methods.

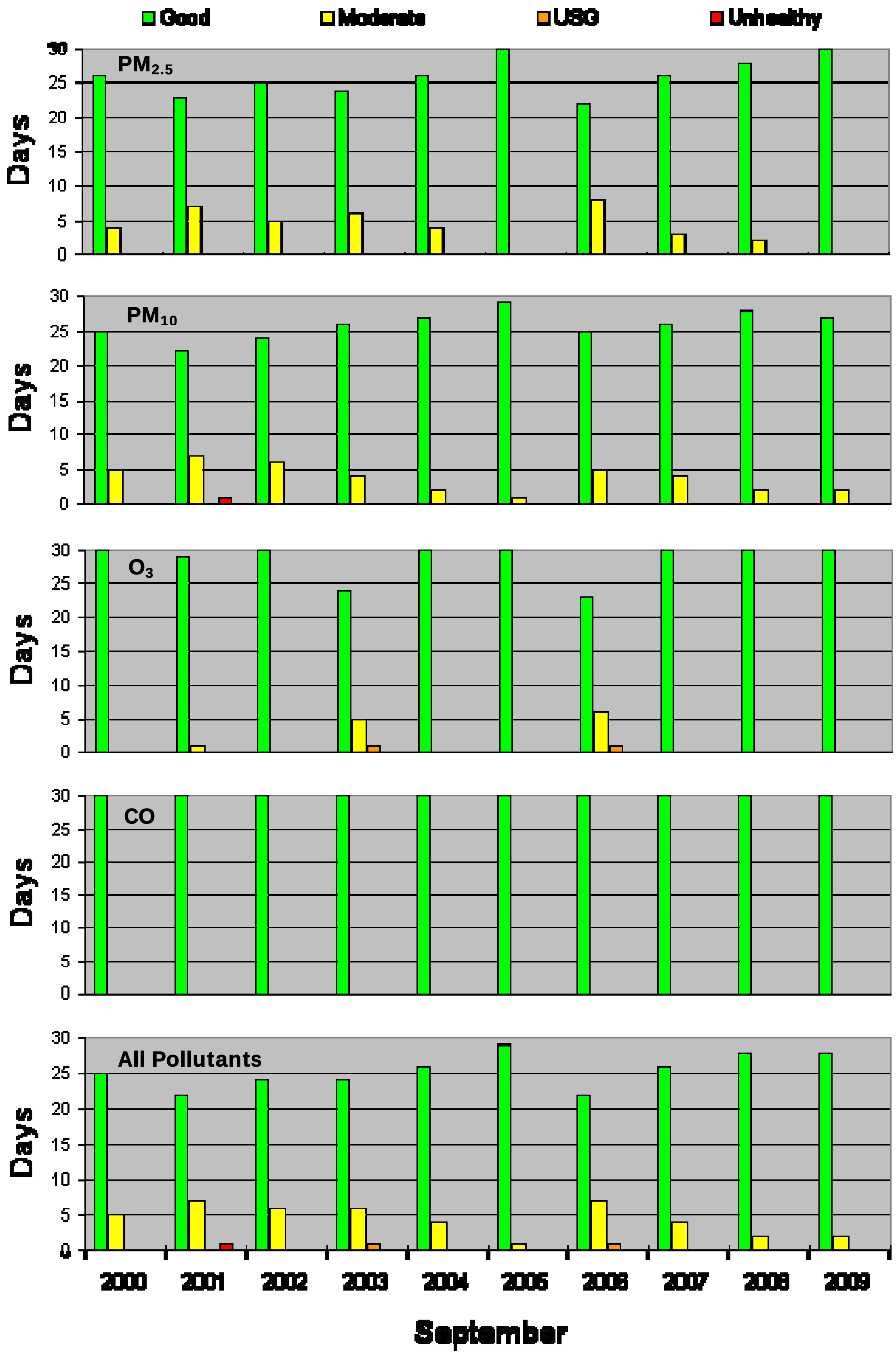
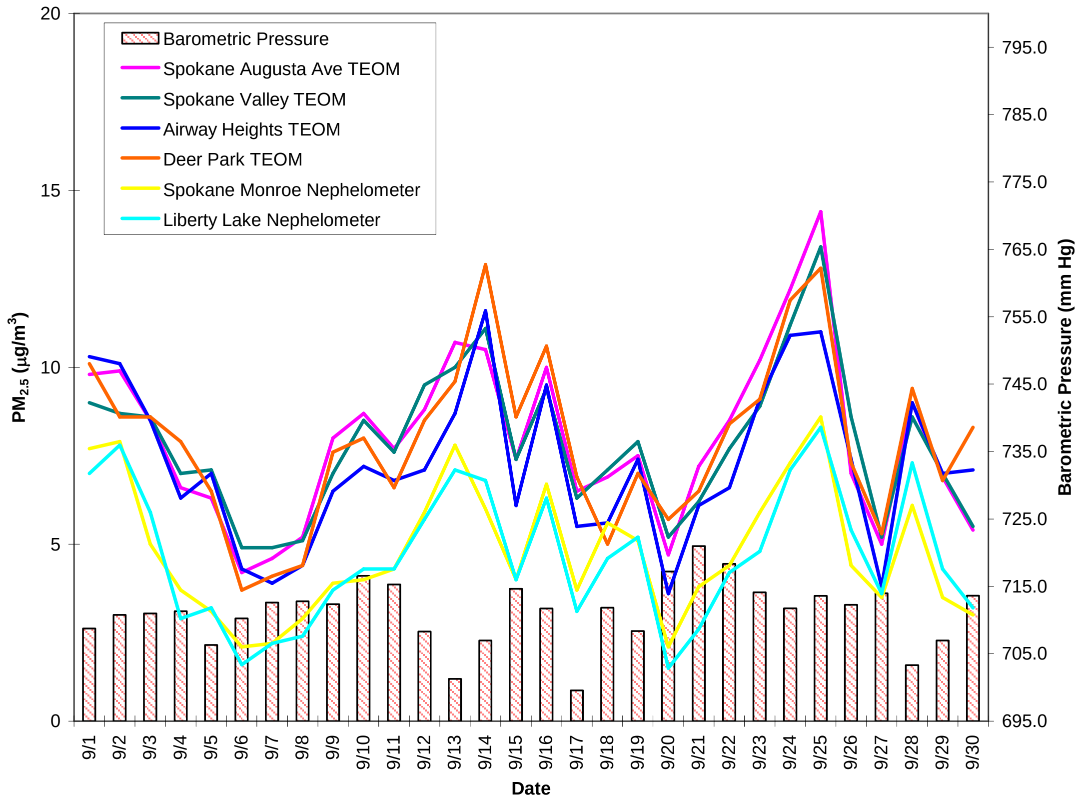


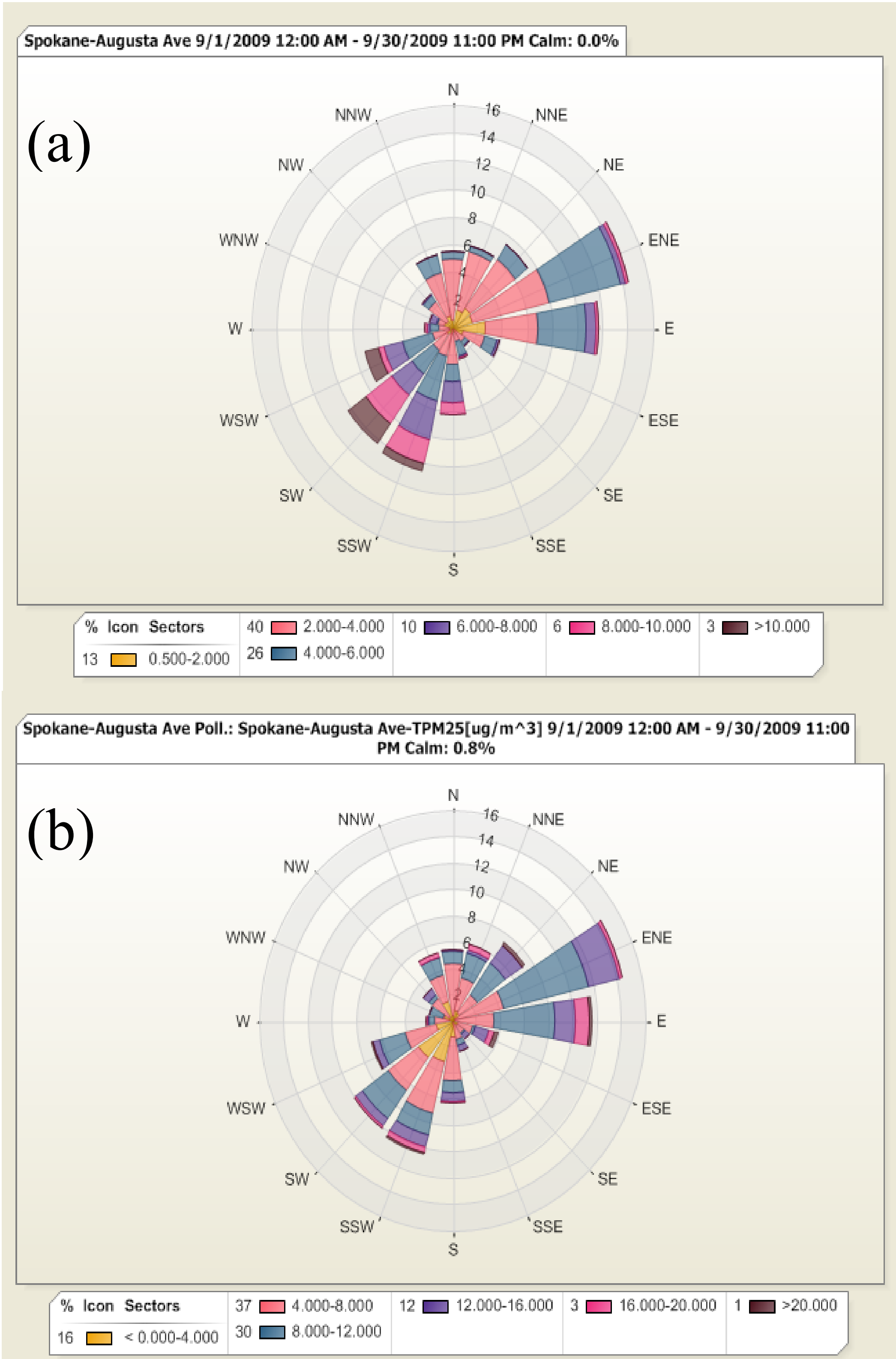
Figure 3 depicts the 24 hour average $PM_{2.5}$ mass concentrations across the monitoring network as they changed through the month of September. Levels of $PM_{2.5}$ remained within the range that is considered good (<15.5 µg/m^3) as determined by the Air Quality Index, but flirted with the moderate air quality threshold under stable atmospheric conditions (inhibits ventilation) on the 25th. Note that the two nephelometers generate somewhat lower mass concentration data than the TEOMs. It is not known if this is caused by differences in the methods or different air quality characteristics of the monitoring locations. The $PM_{2.5}$ mass concentrations appear to have varied almost inversely with station pressure in September. It is not known why this was the case, but pollution levels are affected by many emissions and meteorological factors.

Figure 3: $PM_{2.5}$ multi-station time series for September 2009



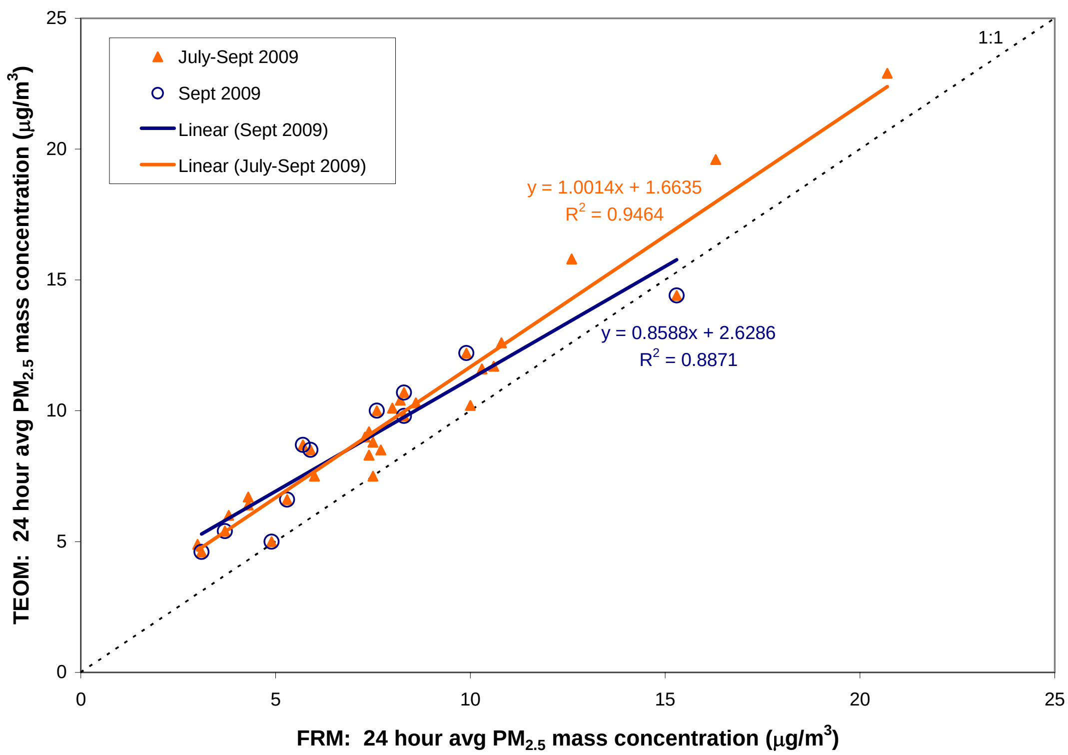
Surface wind directions at the Augusta Ave monitoring station for the month were mostly southwesterly (SW), south-southwesterly (SSW), easterly (E) and east-northeasterly (ENE). As usual, wind speeds were generally higher from the SW and SSW sectors, but E and NE winds were more common, as light winds were predominantly from those directions (Figure 4a). Higher $PM_{2.5}$ concentrations were spread across the wind direction sectors (Figure 4b). For the more dominant wind directions, however, higher $PM_{2.5}$ concentrations were measured more frequently with E and ENE winds. This could be expected because $PM_{2.5}$ concentrations are usually higher when wind speeds are light.

Figure 4: The wind rose (a) and $PM_{2.5}$ pollution rose (b) summarize the percentage of time during the month of September that wind speed and $PM_{2.5}$, respectively, varied with wind direction. The charts are derived from hourly-averaged data.



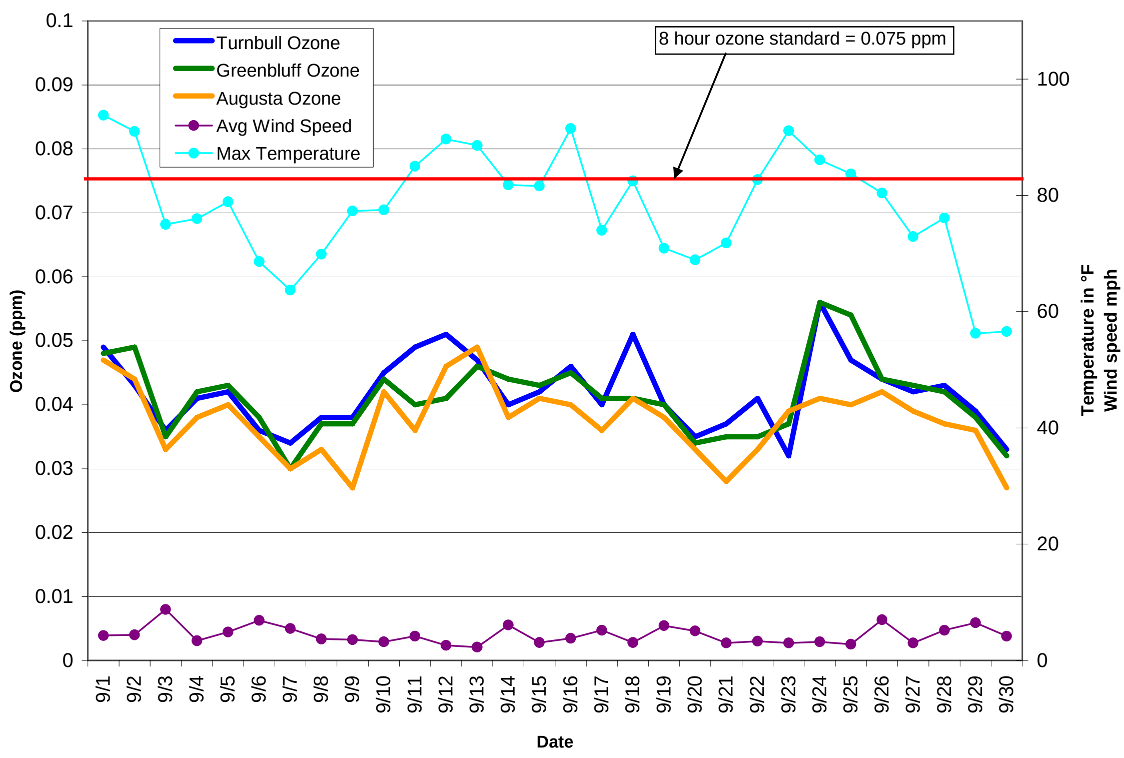
The Augusta monitoring station contains both automated and manual methods for monitoring $PM_{2.5}$. The manually-operated Federal Reference Method (FRM) is the "gold-standard" for measurement of the 24-hour average particulate matter concentration and meets the requirements for demonstrating attainment of federal air quality standards. The accuracy of the TEOM sample data can be verified by comparison with co-located FRM data. The correlation coefficient (R^2) for the $PM_{2.5}$ TEOM and FRM data was 0.89 for the month of September and 0.95 for the three month period ending September 30. The trend for the three month period was for the TEOM to over-report by about 1.7 μg/m³ compared to the FRM (Figure 5). The month of September would likely show a similar trend if not for the "outlier," which was actually one of the more accurate $PM_{2.5}$ measurements using the TEOM.

<u>Figure 5</u>: Comparison between Augusta Ave $PM_{2.5}$ TEOM and FRM data for September 2009. The combined July, August and September data are shown in orange. Blue circles and trend line represent the data for September only.



Maximum daily eight-hour average ground-level ozone concentrations followed the same general pattern as maximum daily temperatures in September (Figure 6). September ozone data from Turnbull Wildlife Refuge, Greenbluff and Spokane Augusta Ave followed similar patterns and were of similar magnitudes, although ozone concentrations at Augusta Ave tended to be slightly lower than the other stations.

Figure 6: Eight hour maximum ozone concentrations for the Spokane region in September. Daily average wind speed and daily maximum temperature are also shown. Daily maximum temperature can be used as a surrogate for solar radiation (ozone is formed through a photochemical reaction) for determining potential ozone maximum concentrations. The threshold for the moderate category for the AQI for ozone is 0.06 ppm averaged over eight hours. An ozone measurement above 0.075 ppm, averaged over eight hours, is the threshold value for the federal ozone standard. It is not a violation of the standard to exceed this level on a given day because determination of attainment status is based on averaging data over a period of years. See Appendix 2 for more detailed information about attainment of federal air quality standards.



Appendix 1

ABBREVIATIONS, ACRONYMS and TERMINOLOGY

Air Quality Index	See Appendix 3.
AQI	Air Quality Index.
CO	Carbon monoxide.
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FRM	Federal Reference Method. Air pollution monitoring method approved by EPA and determined to produce accurate data.
mph	miles per hour
NAAQS	National Ambient Air Quality Standard. Contains limits set by EPA for specific air pollutants. See Appendix 2.
Nephelometer	An automated (continuous) method for monitoring particulate matter mass concentrations. Used to monitor visibility, but can be used to measure particulate matter mass concentrations indirectly, i.e., by making adjustments to the data.
O_3	Ozone.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometers, mass concentration in ambient air. The most significant form of PM_{10} in Spokane County is blowing dust, although PM10 also includes smaller combustion generated particles (see $PM_{2.5}$).
$PM_{2.5}$	Fine particulate matter with an aerodynamic diameter of less than 2.5 micrometers. It is the fraction of smaller particles within PM_{10} and is emitted mostly through fuel combustion (fires, operation of diesel-powered equipment, etc.) or formed by chemical reactions.
ppm	Parts per million. Unit measure used to express concentration of gaseous air pollutants ozone and carbon monoxide.
SRCAA	Spokane Regional Clean Air Agency
TEOM	Tapered Element Oscillating Microbalance. An automated (continuous) method for monitoring particulate matter mass concentrations.
$\mu g\ m^{-3}$	micrograms per cubic meter, a unit measure of particulate matter mass concentration in the air

Appendix 2 – National Ambient Air Quality Standards

The Clean Air Act requires EPA to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants, carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$), ground-level ozone (O_3) and sulfur dioxide (SO_2). These are known as "criteria" pollutants because the US EPA established regulatory limits to concentrations in ambient air using human health or environmentally based criteria. See Table 4 for a summary of the NAAQS. Carbon monoxide, particulate matter and ozone are monitored in Spokane County by the Spokane Regional Clean Air Agency (SRCAA) and the Washington State Department of Ecology (Ecology).

Table 4: National Ambient Air Quality Standards

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm ($10\ mg/m^3$)	8-hour (1)	None	
	35 ppm ($40\ mg/m^3$)	1-hour (1)		
Lead	$0.15\ \mu g/m^3$ (2)	Rolling 3-Month Average	Same as Primary	
	$1.5\ \mu g/m^3$	Quarterly Average	Same as Primary	
Nitrogen Dioxide	0.053 ppm ($100\ \mu g/m^3$)	Annual (Arithmetic Mean)	Same as Primary	
Particulate Matter (PM_{10})	$150\ \mu g/m^3$	24-hour (3)	Same as Primary	
Particulate Matter ($PM_{2.5}$)	$15.0\ \mu g/m^3$	Annual (4) (Arithmetic Mean)	Same as Primary	
	$35\ \mu g/m^3$	24-hour (5)	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour (6)	Same as Primary	
	0.08 ppm (1997 std)	8-hour (7)	Same as Primary	
	0.12 ppm	1-hour (8) (Applies only in limited areas)	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)	0.5 ppm ($1300\ \mu g/m^3$)	3-hour (1)
	0.14 ppm	24-hour (1)		

(1) Not to be exceeded more than once per year.

(2) Final rule signed October 15, 2008.

(3) Not to be exceeded more than once per year on average over 3 years.

(4) To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed $15.0\ \mu g/m^3$.

(5) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population oriented monitor within an area must not exceed $35\ \mu g/m^3$ (effective December 17, 2006).

(6) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (Effective May 27, 2008)

(7) (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

(8) (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.
(b) As of June 15, 2005 EPA revoked the 1-hour ozone standard in all areas except the 8-hour ozone nonattainment Early Action Compact (EAC) Areas.

Appendix 3 – Air Quality Index

The AQI is EPA's color-coded tool for communicating daily air quality to the public and can be calculated for any of the criteria pollutants except lead, provided monitoring data are available. An index value above 100 indicates that the concentration of a criteria pollutant exceeded the limit established in the NAAQS. Categories of the AQI are "good" (green, 0-50), "moderate" (yellow, 51-100), "unhealthy for sensitive groups" (orange, 101-150), "unhealthy" (red, 151-200), "very unhealthy" (purple, 201-300) and "hazardous" (maroon, 301-500). See Table 5 for more information about the AQI.

Table 5: Air pollutant breakpoints for the Air Quality Index.

Air Quality Index Levels of Health Concern	Color Code	Index Numerical Value	Breakpoints					Health Effects
			O_3 (ppm) 8-hour	O_3 (ppm) 1-hour[(1)]	$PM_{2.5}$ ($\mu g/m^3$) 24-hour	PM_{10} ($\mu g/m^3$) 24-hour	CO (ppm) 8-hour	
Good	Green	0-50	0.000-0.059	[(3)]	0.0-15.4	0-54	0.0-4.4	Air quality is considered satisfactory and air pollution poses little or no risk.
Moderate	Yellow	51-100	0.060-0.075	[(3)]	15.5-35.4	55-154	4.5-9.4	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	Orange	101-150	0.076-0.095	0.125-0.164	35.5-65.4	155-254	9.5-12.4	People especially sensitive to air pollution may experience health effects. The general public is not likely to be affected. An AQIin this category or above indicates that air pollution exceeds levels acceptable under federal air quality standards.
Unhealthy	Red	151-200	0.096-0.115	0.165-0.204	65.5-150.4	255-354	12.5-15.4	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	Purple	201-300	0.116-0.374	0.205-0.404	150.5-250.4	355-424	15.5-30.4	Health alert: everyone may experience more serious health effects.
Hazardous	Maroon	>300	[(2)]	0.405+	250.5+	425+	30.5+	Health warnings of emergency conditions. The entire population is more likely to be affected.

[1]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 more precautionary. In these cases, in addition to calculating the 8-hour ozone index value, the 1-hour ozone index value may be calculated, and the maximum of the two values reported.

[2]8-hour O_3 values do not define higher AQI values ($\geq$ 301). AQI values of 301 or greater are calculated with 1-hour O_3 concentrations.

[3]There is no AQI for 1-hour O_3 concentrations below the Unhealthy for Sensitive Groups level.

Appendix 4

<u>Table 6</u>: Summary air quality data for September from all of the analyzers operated in Spokane County. The CO and data are 8-hour maximums in parts per million (ppm) and the PM data are 24-hour averages in micrograms per cubic meter of air (µg/m^3). There are no Turnbull $PM_{2.5}$ FRM or Liberty Lake dichotomous PM data because SRCAA's microbalance was under repair.

Date	CO 3rd & Washington (ppm)	Ozone Greenbluff (ppm)	Ozone Turnbull Wildlife Refuge (ppm)	Ozone Augusta & Fiske (ppm)	PM10 Augusta & Fiske FRM (µg/m3)	PM2.5 Augusta & Fiske FRM (µg/m3)	PM2.5 Augusta & Fiske TEOM (µg/m3)	PM2.5 Monroe & College TEOM (µg/m3)	PM2.5 Monroe & Wellesley nephelometer (µg/m3)	PM10 Turnbull Wildlife Refuge TEOM (µg/m3)	PM10 Turnbull Wildlife Refuge FRM (µg/m3)	PM2.5 Liberty Lake nephelometer (µg/m3)	PM2.5 Deer Park TEOM (µg/m3)	PM2.5 Spokane Valley TEOM (µg/m3)	PM2.5 Airway Heights TEOM (µg/m3)
9/1	0.8	0.048	0.049	0.047		8.3	9.8	9.6	7.7			7.0	10.1	9.0	10.3
9/2	0.9	0.049	0.043	0.044			9.9	10.0	7.9	47		7.8	8.6	8.7	10.1
9/3	0.8	0.035	0.036	0.033			8.5	8.2	5.0	90		5.9	8.6	8.6	8.5
9/4	0.5	0.042	0.041	0.038	32	5.3	6.6	6.1	3.7	35	35	2.9	7.9	7.0	6.3
9/5	0.5	0.043	0.042	0.040			6.3	6.1	3.1	37		3.2	6.5	7.1	7.0
9/6	0.3	0.038	0.036	0.035			4.2	4.0	2.1	18		1.6	3.7	4.9	4.3
9/7	0.3	0.030	0.034	0.030		3.1	4.6	3.6	2.2	7		2.2	4.1	4.9	3.9
9/8	0.8	0.037	0.038	0.033			5.2	3.7	2.9	9		2.4	4.4	5.1	4.4
9/9	0.8	0.037	0.038	0.027			8.0	6.9	3.9	16		3.7	7.6	7.0	6.5
9/10	0.7	0.044	0.045	0.042	27	5.7	8.7	7.9	4.0	23	23	4.3	8.0	8.5	7.2
9/11	0.7	0.040	0.049	0.036			7.7	7.0	4.3	28		4.3	6.6	7.6	6.8
9/12	1.0	0.041	0.051	0.046			8.8	9.1	5.9	22		5.7	8.5	9.5	7.1
9/13	1.2	0.046	0.047	0.049		8.3	10.7	10.5	7.8	21		7.1	9.6	10.0	8.7
9/14	0.9	0.044	0.040	0.038			10.5	10.2	6.0	67		6.8	12.9	11.1	11.6
9/15	0.8	0.043	0.042	0.041			7.4	7.1	4.0	23		4.0	8.6	7.4	6.1
9/16	0.9	0.045	0.046	0.040	39	7.6	10.0	10.9	6.7	40	41	6.3	10.6	9.4	9.5
9/17	0.9	0.041	0.040	0.036			6.5	6.4	3.7	11		3.1	6.9	6.3	5.5
9/18	1.3	0.041	0.051	0.041			6.9	6.6	5.6	14		4.6	5.0	7.1	5.6
9/19	1.3	0.040	0.040	0.038			7.5	7.6	5.1	26		5.2	7.0	7.9	7.4
9/20	0.6	0.034	0.035	0.033			4.7	4.2	2.1	10		1.5	5.7	5.2	3.6
9/21	0.8	0.035	0.037	0.028			7.2	6.4	3.8	17		2.6	6.5	6.2	6.1
9/22	1.2	0.035	0.041	0.033	31	5.9	8.5	9.1	4.4	26	27	4.2	8.4	7.7	6.6
9/23	1.5	0.037	0.032	0.039			10.2	10.9	5.9	40		4.8	9.1	8.9	9.1
9/24	1.5	0.056	0.056	0.041		9.9	12.2	12.6	7.3	39		7.1	11.9	11.2	10.9
9/25	1.1	0.054	0.047	0.040		15.3	14.4	11.7	8.6	46		8.3	12.8	13.4	11.0
9/26	1.0	0.044	0.044	0.042			7.0	7.3	4.4	53		5.4	7.3	8.6	7.4
9/27	0.8	0.043	0.042	0.039		4.9	5.0	5.1	3.5	17		3.6	5.3	5.2	3.8
9/28	0.8	0.042	0.043	0.037	39		9.0	9.3	6.1	46	52	7.3	9.4	8.6	9.0
9/29	0.9	0.038	0.039	0.036			6.9	6.5	3.5	16		4.3	6.8	7.0	7.0
9/30	0.8	0.032	0.033	0.027		3.7	5.4	5.7	3.0	11		3.2	8.3	5.5	7.1
Avg	0.9	0.041	0.042	0.038	33.7	7.1	7.9	7.7	4.8	29.5	35.6	4.7	7.9	7.8	7.3
Max	1.5	0.056	0.056	0.049	39.2	15.3	14.4	12.6	8.6	90.0	52.0	8.3	12.9	13.4	11.6