

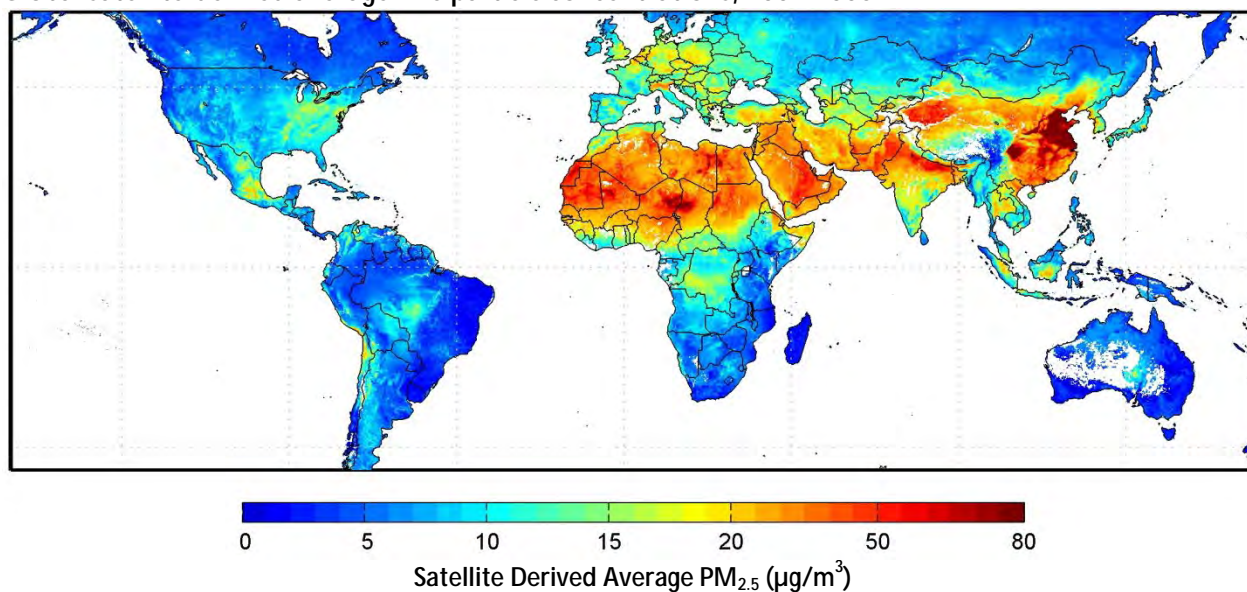


Fine Particle Pollution

Fine particle pollution is a complex mixture of extremely small particles and liquid droplets that are created during combustion and can also be formed as other gaseous pollutants react in the air. The US Environmental Protection Agency (EPA) has established standards for daily and annual fine particle concentrations to protect the public from adverse health effects associated with exposure to fine particle pollution. Exposure to high levels of fine particles can impact heart and lung health, resulting in increased hospital and emergency room visits, lost work and school days, and premature death.

Fine particle pollution is a global health concern. Most areas of the world do not have monitors to measure fine particle pollution, but satellite measurements provide an estimate of average fine particle levels across the globe. These satellite measurements reveal a striking band, which stretches from the Saharan Desert in Northern Africa to Eastern Asia, of elevated fine particle pollution. Based on these satellite estimates, the World Health Organization estimates that more than 80% of the global population is exposed to unhealthy levels of fine particle pollution (the World Health Organization considers annual average fine particle concentrations greater than $10 \mu\text{g}/\text{m}^3$ to be unhealthy).

Global satellite-derived average fine particle concentrations, 2001-2006



Credit: Dalhousie University, Aaron van Donkelaar

How does Minnesota's air quality compare to the rest of the world?

Fine particle pollution in Minnesota is much lower than many areas of the world. Across the United States, the highest levels of fine particle pollution are typically measured in the industrial Midwest and Eastern states. While fine particle pollution in the U.S. has decreased since the Clean Air Act went into effect, some areas of the country continue to experience unhealthy levels of fine particle pollution. In Minnesota, annual average fine particle concentrations are below levels of health concern, but fine particle pollution can reach unhealthy levels several days each year.

What are the sources of fine particle pollution?

Fine particles can be emitted directly or formed in the air from gases. On a typical day in Minnesota, roughly half of the fine particles in the air are emitted directly with the other half being formed in the air. Most of the fine particles in the air result from the combustion of fuels.

The amount of fine particle pollution in the air varies by time of year and location and is affected by changes in weather such as temperature, humidity, and wind. Increases in fine particle pollution can be caused by dirty air being blown into Minnesota from other states or local pollution emissions being trapped in the area due to stagnant weather conditions.

Indirect particle sources



Indirect particle formation
(chemical and condensation process)

Fine particle pollution

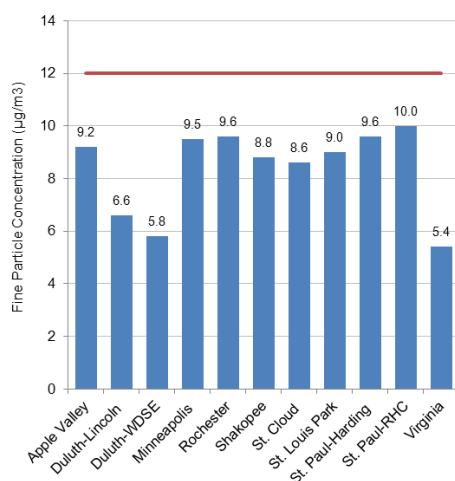
Direct particle sources



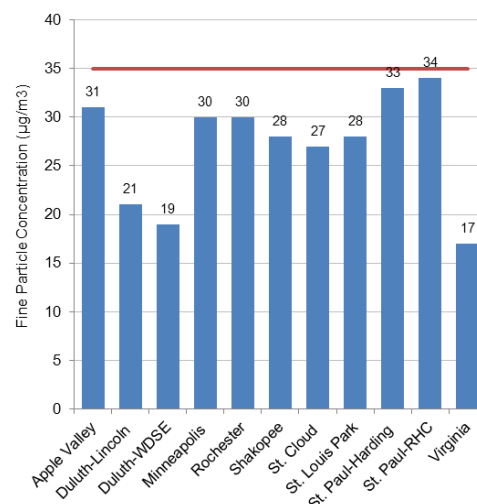
Does Minnesota meet federal fine particle standards?

Fine particles are regulated on an annual and daily basis to guard against chronic and acute health effects. A monitoring site meets the annual fine particle standard if the 3-year average of the annual average fine particle concentration does not exceed $12 \mu\text{g}/\text{m}^3$. The daily standard is met if the 3-year average of the annual 98th percentile daily fine particle concentration does not exceed $35 \mu\text{g}/\text{m}^3$. **All areas of Minnesota currently meet these standards.**

Annual (2009-2011)



Daily (2009-2011)



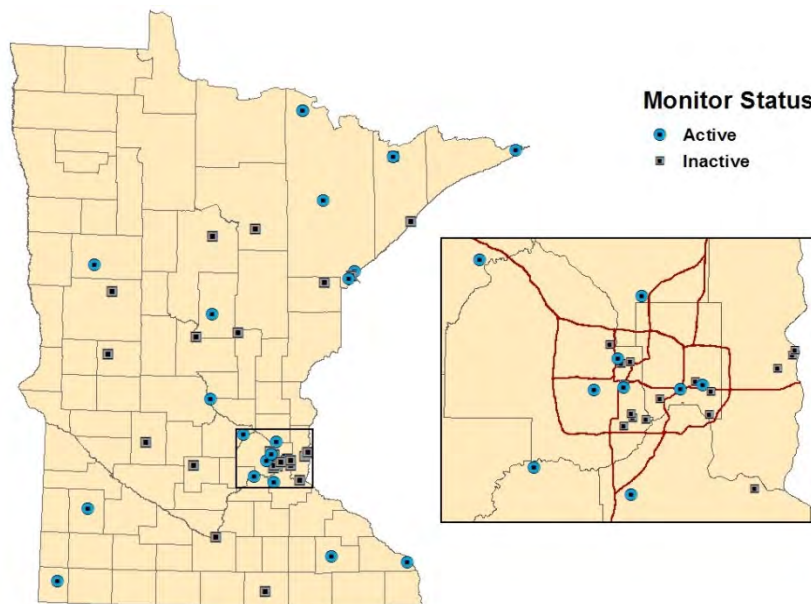
Fine particle monitoring in Minnesota

The Minnesota Pollution Control Agency began monitoring fine particle pollution in 1999 and has monitored fine particles at over 55 locations across Minnesota. Currently, the MPCA is measuring fine particles at 22 locations across the state.

Fine particle monitoring locations, 1999-2013

Monitoring is used to:

- Show compliance with federal air quality Standards
- Report real time air quality conditions via the Air Quality Index
- Notify the public of unhealthy air quality conditions via Air Quality Alerts
- Answer questions about the sources and health effects of fine particle pollution



More information about the MPCA's fine particle monitoring network is available in the Annual Air Monitoring Network Plan, <http://www.pca.state.mn.us/mvri439>.

How do fine particle levels compare across Minnesota?

A comparison of annual average fine particle results from 2011 highlights the regional differences in fine particle pollution across Minnesota. Fine particle pollution is lowest in the Northern areas of the state, while the highest fine particle levels are measured in the most densely populated areas such as the Twin Cities and Rochester.

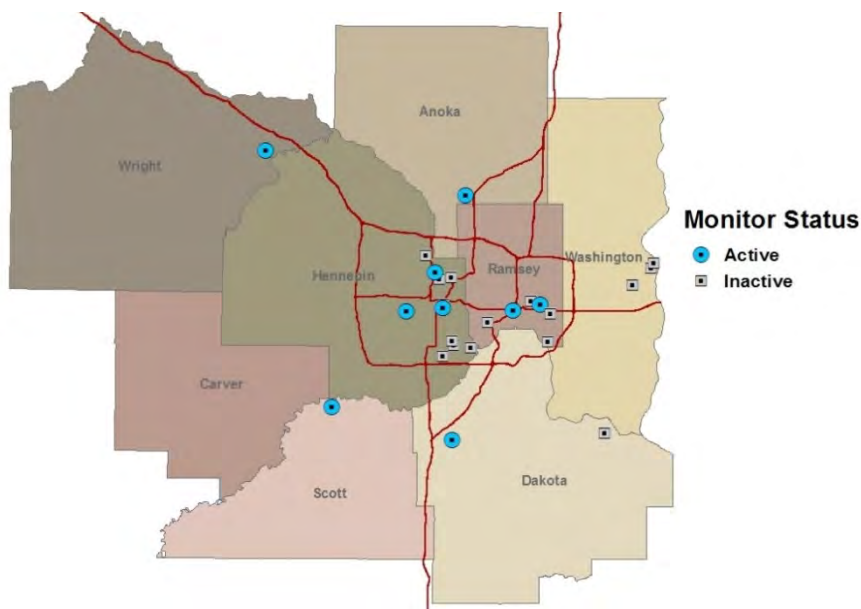
While there are clear differences in fine particle levels between regions of the state, there is little statistical evidence (blue shading represents 95% confidence) of differences in fine particle levels within regions.



Fine particle monitoring in the Twin Cities

The MPCA has monitored fine particles at 24 locations across the Twin Cities metropolitan area. In 2013, the MPCA will operate 10 fine particle monitoring sites in the Twin Cities, including new sites in North Minneapolis and along the I-94 and I-35W freeway commons in South Minneapolis.

Twin Cities fine particle monitoring locations, 1999-2013



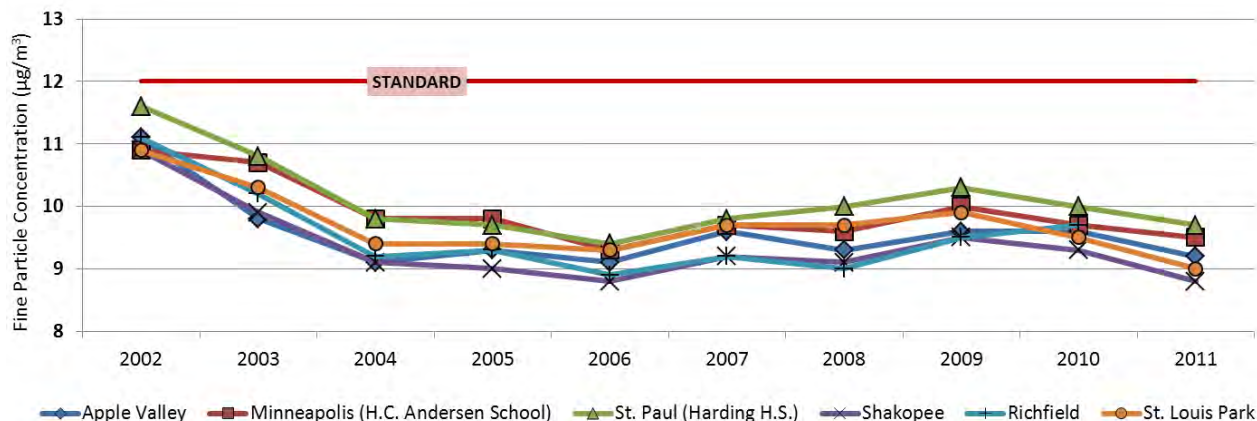
Monitored Cities

- Apple Valley
- Bayport
- Blaine
- Hastings
- Minneapolis
- Richfield
- St. Louis Park
- St. Michael
- St. Paul
- Shakopee
- Stillwater

How do fine particle levels compare across the Twin Cities?

Fine particle concentrations are very similar across the Twin Cities metropolitan area. Across the Twin Cities, annual average fine particle concentrations have improved over time.

The highest annual average fine particle concentrations are measured at monitors located in Minneapolis and St. Paul. Concentrations are slightly lower in areas outside of the urban core, which is likely influenced by the density of fine particle emission sources, such as cars and trucks, located in Minneapolis and St. Paul.



Reported data is the 3-year average of the annual average fine particle concentration at reported sites, which is the method used to determine whether a site meets the federal air quality standard. The year reported is the end year of the 3-year average (e.g. 2011 includes data from 2009, 2010, and 2011).

Fine particle monitoring in Minneapolis

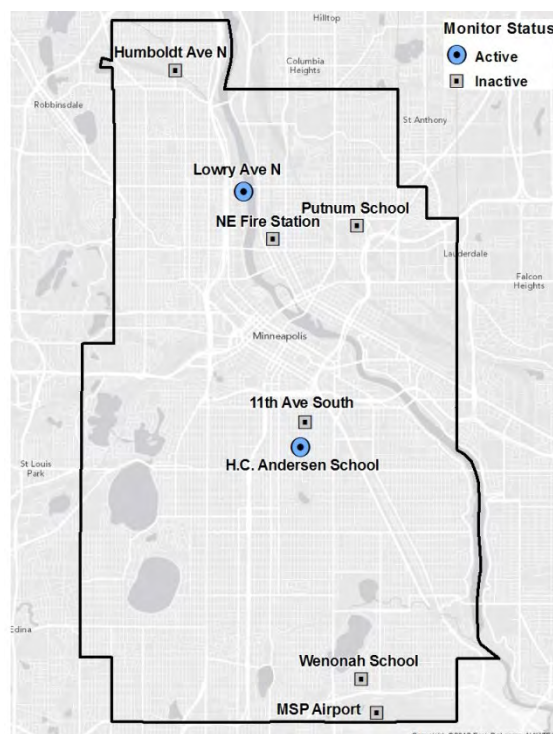
Fine particles have been monitored at eight locations in Minneapolis including sites in North Minneapolis, the Phillips neighborhood, and near the Minneapolis-St. Paul International Airport.

How do fine particle levels compare across Minneapolis?

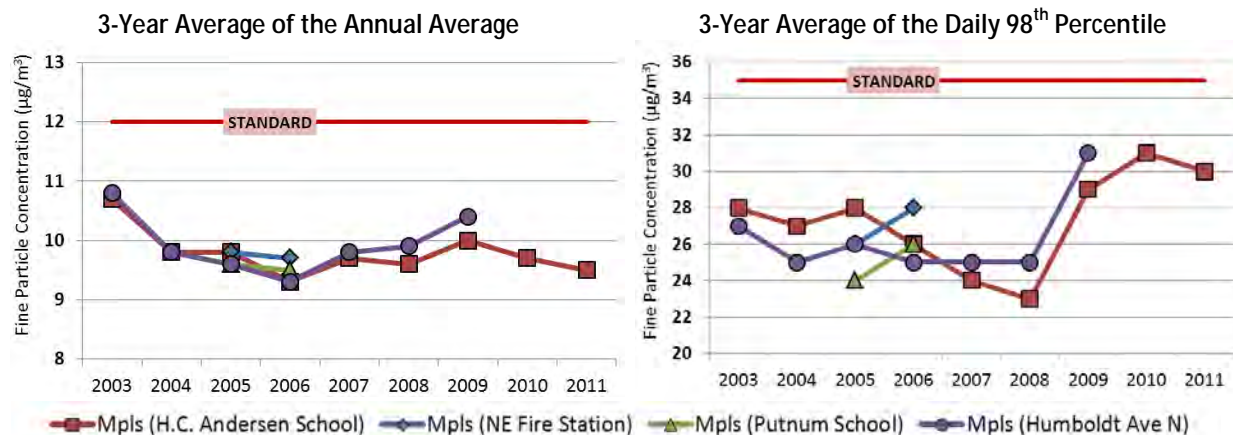
The MPCA's air monitoring network is designed to measure community wide concentrations of fine particle pollution. Monitoring results show that on average, fine particle levels are very similar across all areas of Minneapolis.

Local factors, such as proximity to pollution emissions like busy roads, industry, or wood smoke may result in higher pollution exposures than what is measured at air monitors. The new near-roadway monitoring project will help the MPCA better understand how living or working near heavily trafficked roads impacts fine particle pollution exposure.

Minneapolis fine particle monitors, 1999-2013



Fine particle monitoring results in Minneapolis compared to federal air quality standards

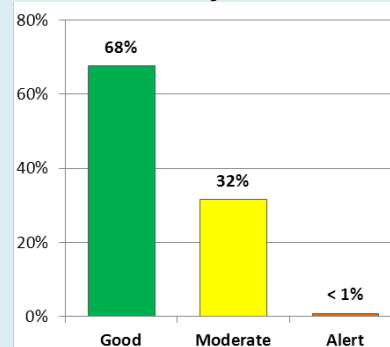


How often is air quality unhealthy due to fine particle pollution in Minneapolis?

In Minneapolis, fine particle levels are considered good on the majority of days each year.

Annual differences in weather conditions influence the number of unhealthy days each year, but on average fewer than 1% of all days are unhealthy for fine particle pollution.

Percent of AQI Days, 2007-2011



Fine particle monitoring in St. Paul

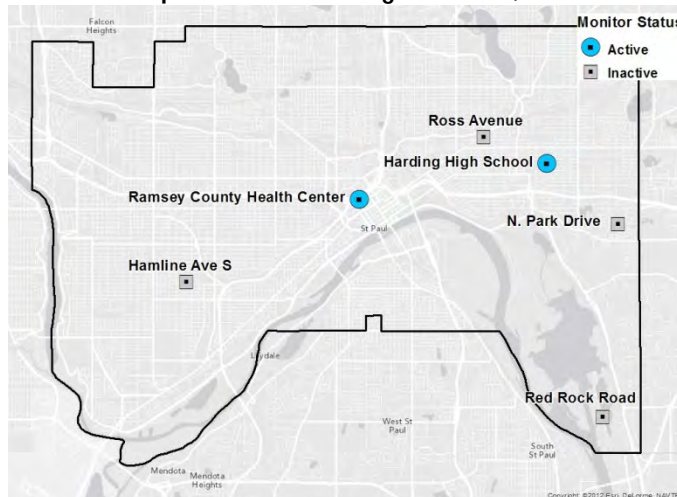
The MPCA has monitored fine particles in six locations in St. Paul including two currently active sites at Harding High School in East St. Paul and the Ramsey County Health Center in Downtown St. Paul.

How do fine particle levels compare across St. Paul?

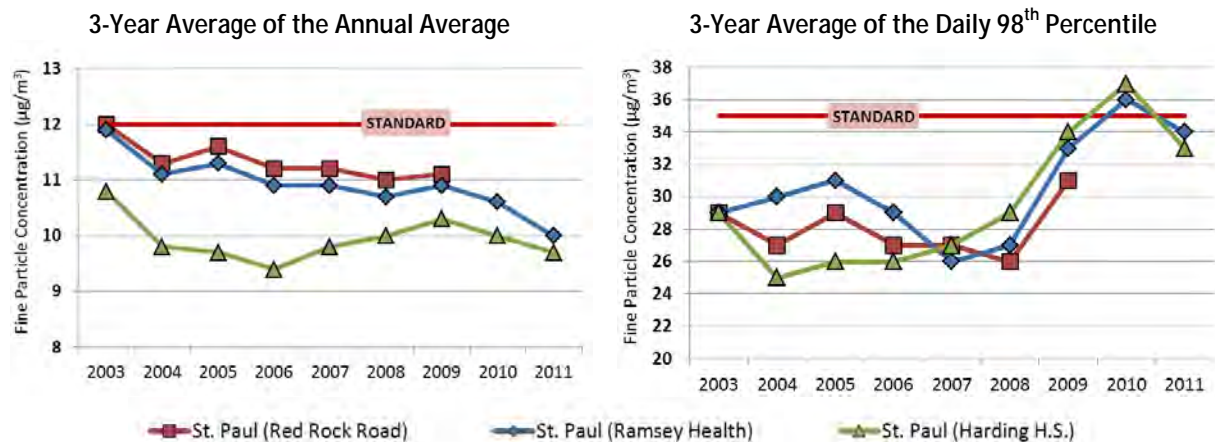
Monitoring results indicate that fine particle levels are very similar across monitoring sites in St. Paul. Compared to other metro sites, fine particle concentrations are slightly higher in St. Paul.

In 2010, two monitoring sites in St. Paul exceeded the daily fine particle standard. These exceedances were heavily influenced by abnormal weather conditions over the winter of 2009 and 2010. Fine particle levels have since fallen back below the daily and annual fine particle standards.

St. Paul fine particle monitoring locations, 1999-2013



Fine particle monitoring results in St. Paul compared to federal air quality standards

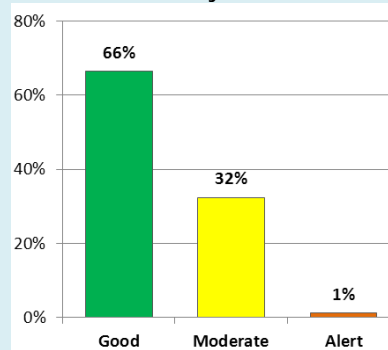


How often is air quality unhealthy due to fine particle pollution in St. Paul?

In St. Paul, fine particle levels are considered good on the majority of days each year.

Annual differences in weather conditions influence the number of unhealthy days each year. In St. Paul, about 1% of days have unhealthy levels of fine particle pollution.

Percent of AQI Days, 2007-2011



Fine particle monitoring in Twin Cities suburbs

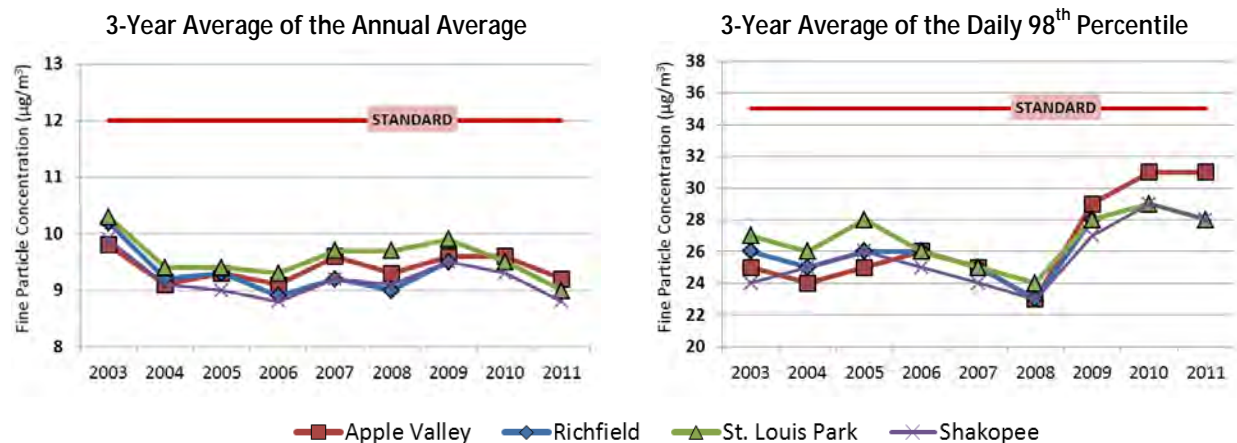
The MPCA has monitored fine particles at nine suburban locations in the Twin Cities, and is currently monitoring in five communities. Current monitoring sites are located in Apple Valley, Blaine, Shakopee, St. Louis Park, and St. Michael.

How do fine particle levels compare across Twin Cities suburbs?

Fine particle levels in suburban locations are generally lower than pollution levels measured in the urban core cities of Minneapolis and St. Paul.

Across suburban sites, annual average fine particle pollution levels are very similar. However, on a daily basis, suburban air pollution levels are sensitive to prominent wind directions. When a location is downwind of the urban core cities of Minneapolis and St. Paul, fine particle concentrations in the downwind area are more likely to increase.

Fine particle monitoring results in Minneapolis compared to federal air quality standards

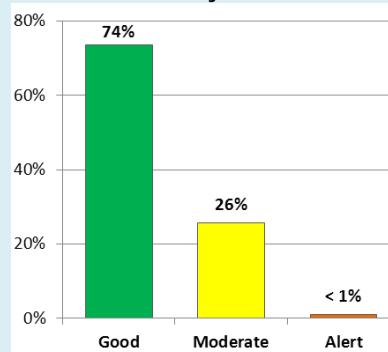


How often is air quality unhealthy due to fine particle pollution in suburban areas?

In the Twin Cities suburbs, fine particle levels are considered good on the majority of days each year and are good more often than in Minneapolis and St. Paul.

Annual difference in weather conditions influences the number of unhealthy days each year, but on average fewer than 1% of all days are unhealthy for fine particle pollution.

Percent of AQI Days, 2007-2011



Fine particle monitoring in Greater Minnesota

Outside of the Twin Cities metropolitan area, the MPCA has monitored fine particles at nearly 30 locations across Minnesota. Currently, the MPCA monitors for fine particles in nine cities across Greater Minnesota, including Brainerd, Detroit Lakes, Duluth, Ely, Grand Portage, Marshall, Rochester, St. Cloud, and Virginia.

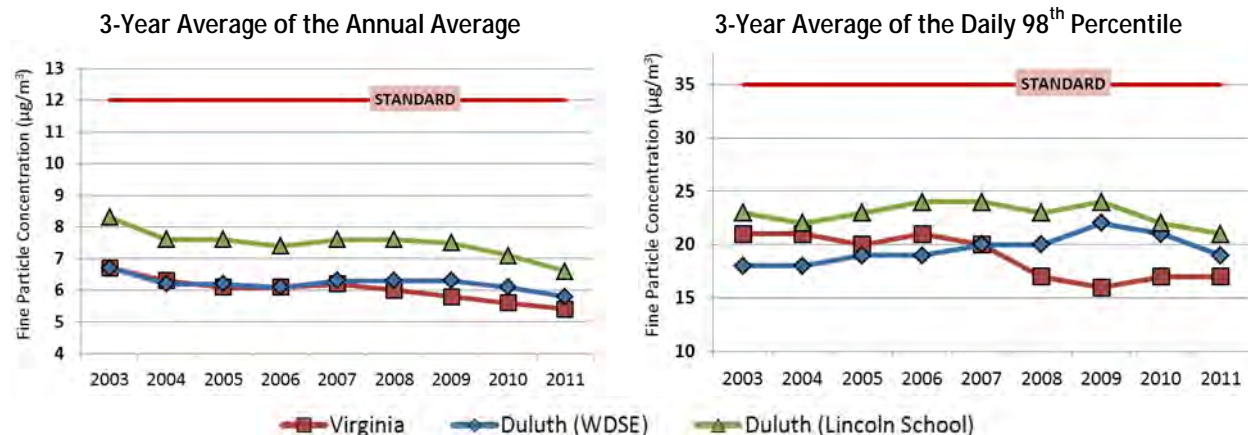
How do fine particle levels compare across Greater Minnesota?

Overall, fine particle levels in Greater Minnesota are lower than fine particle levels in the Twin Cities metropolitan area. However, fine particle levels in Rochester are most similar to levels measured in Minneapolis.

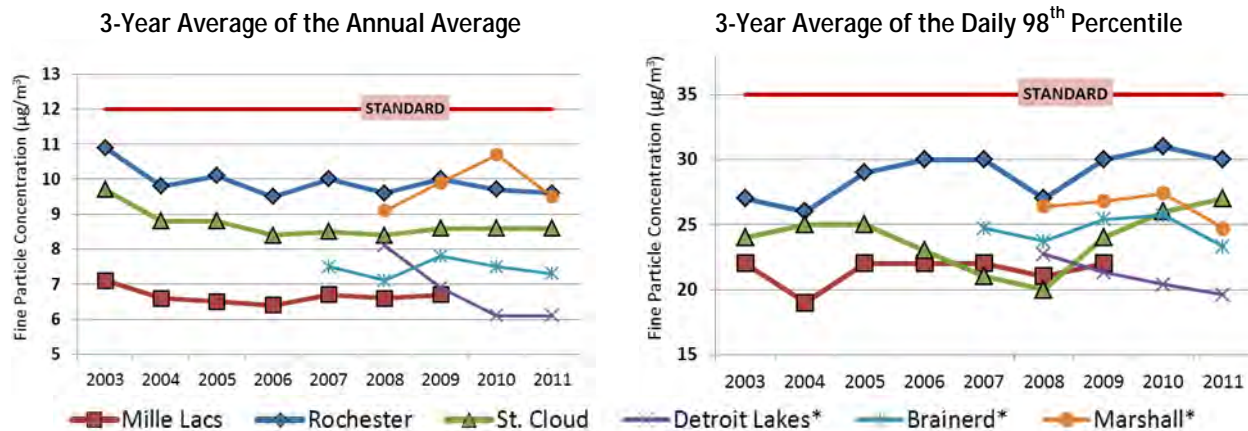
Across all of Minnesota, fine particle levels are lowest in the northeastern areas of the state. In Duluth, annual average fine particle results show a pronounced difference in fine particle levels near the harbor and in more elevated areas of the city. In recent years, fine particle levels near the harbor have been declining and are nearing levels measured at other sites.

In other areas of the state, fine particle pollution levels are more variable and are sensitive to differences in the amount of pollution transported into the region from other areas. In general, fine particle levels are higher in southern areas of the state than the north.

Fine particle monitoring results in Northern Minnesota compared to federal air quality standards



Fine particle monitoring results in Greater Minnesota compared to federal air quality standards



*Monitors are not qualified to show regulatory compliance with air quality standards

How often is air quality unhealthy due to fine particle pollution in Greater Minnesota?

While fine particle pollution is generally lower outside of the Twin Cities metropolitan area, all area of the state can experience unhealthy levels of fine particle pollution.

Across Greater Minnesota, the northernmost areas of the state experience the most good air quality days. While the majority of days in more urbanized and southern areas of Greater Minnesota have good air quality, these areas experience more moderate and alert days than areas further north.

Percent of AQI Days, 2007-2011

