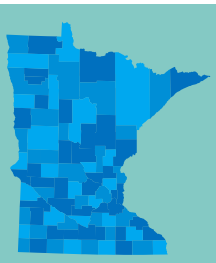
Air Monitoring

January 2019

North Minneapolis Air Monitoring Study: 2017 Data Summary

MINNESOTA POLLUTION CONTROL AGENCY



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Foreword

On October 1, 2014, the Minnesota Pollution Control Agency (MPCA) began monitoring for Total Suspended Particulates (TSP) in an industrial area of North Minneapolis. This monitoring site is known as Lowry Avenue (909). In response to frequent exceedances of the state TSP standard at the Lowry Avenue site, on June 23, 2015, the MPCA began operating a second monitoring site, called Pacific Street (910), in the area approximately ¼ of a mile south of the existing monitor at Lowry Avenue. The addition of a second air monitoring site in the area of the existing site provides important upwind/downwind pollution information that helps identify sources contributing to the exceedances and violations of the state TSP standard. The MPCA added a third air monitoring site across the river in 2017 as part of the Community Air Monitoring Project. The Bottineau/Marshall Terrace site (1909) is temporarily monitoring air pollution levels on the east side of the Mississippi River in North Minneapolis.

The three sites are located in an area that contains a mix of land uses including metals recyclers, manufacturing facilities and retail.

North Minneapolis monitoring sites, 2017

This report summarizes monitoring results collected in 2017. For more information about this project, visit the North Minneapolis Air Monitoring Project website, https://www.pca.state.mn.us/air/north-minneapolis-air-monitoring-project.

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Executive summary

What are the results?

Elevated levels of airborne particulate and heavy metals have been measured at monitors located near the west side of the Lowry Avenue Bridge in North Minneapolis. An additional temporary monitor was added on the east side of the river in 2017. Air monitoring results in 2017 have identified:

- Violations of the daily and annual Total Suspended Particulate (TSP) standards
- Exceedances of the daily PM_{10} standard
- Elevated lead concentrations, measured at 80% of the national lead standard
- Elevated heavy metal concentrations including four metals (arsenic, chromium, cobalt, and nickel) measured above chronic inhalation health risk guidelines.
- Formaldehyde and chloroform levels measured above the chronic inhalation health risk guidelines. Formaldehyde concentrations are above guidelines at most monitoring locations in the Twin Cities Metropolitan area. The higher chloroform concentration at the Bottineau/Marshall Terrace site was due to two large spikes on September 4, 2017. All other measured concentrations of chloroform were very low.

What do these results mean?

These results indicate that air pollution in the area surrounding the monitors may contribute to adverse health effects and degraded environmental quality.

- Elevated TSP concentrations may contribute to respiratory irritation and nuisance dust. The majority of the particles in this size range are removed by the body, through coughing or protective mucus, before reaching the lungs.
- Elevated PM_{10} concentrations may contribute to respiratory irritation, damage to lung tissue, and premature death. These smaller particles can reach lower regions of the respiratory tract.
- Elevated lead concentrations may contribute to developmental problems in young children (behavioral problems, learning deficits, and lowered IQ) and cardiovascular effects in adults.
- Elevated metals and VOC concentrations may contribute to increased population risks for adverse health outcomes including cancer and non-cancer conditions. With respect to carcinogenic (cancer) effects, the health guidelines are developed so the additional lifetime risk of developing cancer is less than or equal to one additional chance in 100,000 for continuous exposure to the inhalation health benchmark concentration for a lifetime.

What is the MPCA doing to address the problem?

The Minnesota Pollution Control Agency (MPCA) is actively working to address the elevated air pollution levels in the area surrounding these monitors. Ongoing activities include:

- Working with facilities in the surrounding area and the city of Minneapolis to identify the source(s) that contribute to the elevated air pollution concentrations and to identify and implement pollution reduction activities to improve air quality. Specifically:
  - Northern Metals

        - On August 31, 2016, the District Court ordered a partial shutdown of operations at Northern Metals. The partial shutdown required Northern Metals to cease operating the Metals Recovery Plant and the attached Rain and Snow Shed beginning on September 2, 2016.
        - Under a February 28, 2017, settlement with the MPCA and the city of Minneapolis, Northern Metals agreed to move its shredder to a new, non-metro location by August 2019 and pay $2.5 million in costs and penalties.
    - Other potential sources of particulate pollution in the area have been identified. The MPCA has asked these facilities to implement short-and long-term operational and maintenance changes at their sites that will reduce particulate pollution. These activities include increasing the frequency of site and street spraying and sweeping, moving activities indoors, and changing material handling practices.
- Continuing air monitoring at the Lowry Avenue and Pacific Street sites and providing timely public access to results, www.pca.state.mn.us/air/north-minneapolis-air-monitoring-project. In 2017, a new neighborhood-monitoring site, Bottineau/Marshall Terrace (1909), was added on the east side of the river.

How can I stay informed?

Information related to the North Minneapolis Air Monitoring Project is updated frequently at the following sources:

- The North Minneapolis Air Monitoring Project website is updated every one to two months with air pollution monitoring results, www.pca.state.mn.us/air/north-minneapolis-air-monitoring-project.
- Real-time PM_{10} and $PM_{2.5}$ monitoring results are available from the Current Conditions Details page of the Air Quality Index website, www.pca.state.mn.us/aqi.

If you would like to be included on a mailing list for future updates about the project, please sign up for our GovDelivery email notification, https://public.govdelivery.com/accounts/MNPCA/subscriber/new?topic_id=MNPCA_144.

Results compared to air quality standards

Three pollutants measured at the Lowry Avenue and Pacific Street sites have state or federal regulatory standards. These pollutants include: Total suspended particulate (TSP), particulate with an aerodynamic diameter less than 10 micrometers (PM_{10}), and lead.

Total suspended particulate (TSP)

In 2017:

- The Lowry Avenue (909) monitor met the primary and secondary annual TSP standards
- The Lowry Avenue (909) monitor violated the secondary daily TSP standard
- The Pacific Street (910) monitor violated the primary and secondary annual TSP standards
- The Pacific Street (910) monitor violated the primary and secondary daily TSP standards
- The Bottineau/Marshall Terrace (1909) monitor met the primary and secondary annual TSP standards

- The Bottineau/Marshall Terrace (1909) monitor met the primary and secondary daily TSP standards

In Minnesota, TSP levels in the air are regulated through the Minnesota Ambient Air Quality Standards (MAAQS), which are established by Minn. R. 7009.0080. The MAAQS includes four distinct standards for TSP. These standards include:

Table 1. Minnesota Ambient Air Quality Standards for TSP

Standard Type	Time Interval	Level of Standard	A monitoring site meets the standard if…
Primary[1]	Daily (24-hour)	260 micrograms per cubic meter	...the annual 2nd highest daily TSP concentration is less than or equal to 260 µg/m^3
	Annual	75 micrograms per cubic meter	...the annual geometric mean is less than or equal to 75 µg/m^3
Secondary[2]	Daily (24-hour)	150 micrograms per cubic meter	...the annual 2nd highest daily TSP concentration is less than or equal to 150 µg/m^3
	Annual	60 micrograms per cubic meter	...the annual geometric mean is less than or equal to 60 µg/m^3

[1]A primary standard is set to protect against human health effects associated with exposure to an air pollutant.
[2]A secondary standard is set to protect against environmental or public welfare effects associated with exposure to an air pollutant.

Annual TSP standards

A monitoring site meets the primary annual TSP standard when the annual geometric mean of measured TSP concentrations is less than or equal to 75 micrograms per cubic meter (µg/m3). A primary standard is set to protect against human health effects associated with exposure to an air pollutant.

A monitoring site meets the secondary annual TSP standard when the annual geometric mean of measured TSP concentrations is less than or equal to 60 µg/m3. A secondary standard is set to protect against environmental or public welfare effects associated with exposure to an air pollutant.

The annual geometric mean TSP concentration at the Lowry Avenue (909) site in 2017 is equal to 60 µg/m3. The Lowry Avenue (909) site has met the primary and secondary annual TSP standards in 2017. The annual geometric mean TSP concentration at the Pacific Street (910) site in 2017 is equal to 109 µg/m3. The Pacific Street (910) site has violated the primary and secondary annual TSP standards in 2017. The annual geometric mean TSP concentration at the Bottineau/Marshall Terrace (1909) site in 2017 is equal to 40 µg/m3. The Bottineau/Marshall Terrace (1909) site has met the primary and secondary annual TSP standards in 2017.

Daily TSP standards

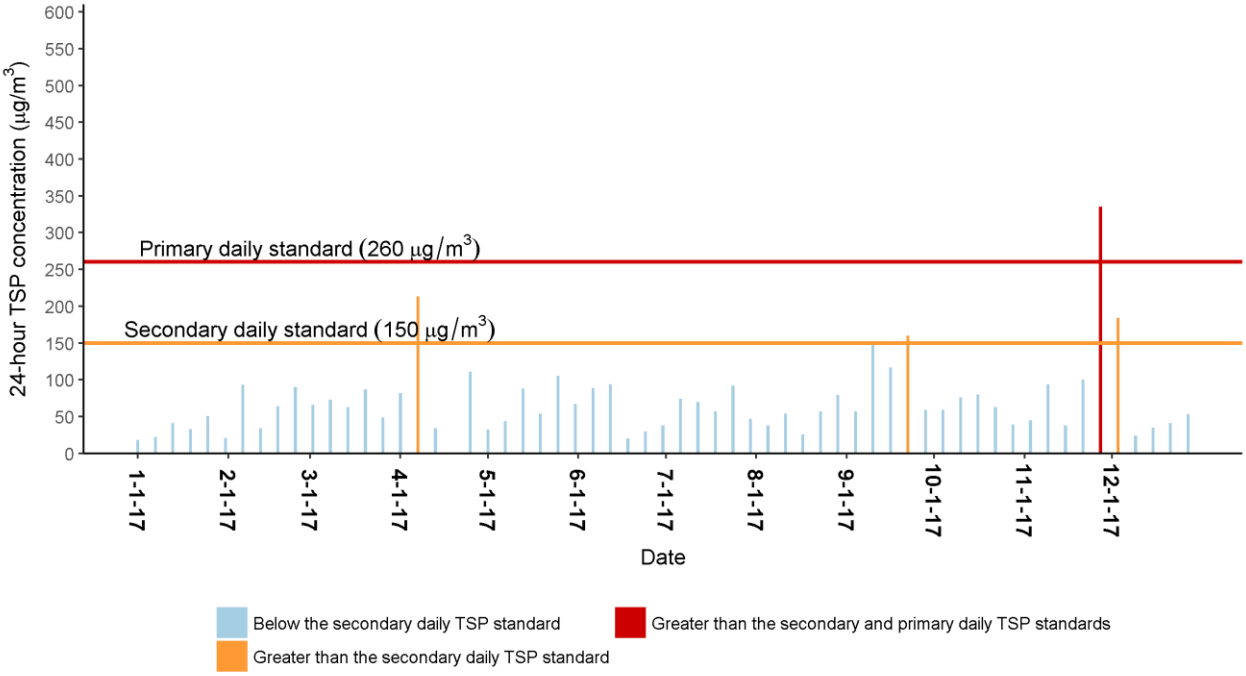
A monitoring site meets the primary daily TSP standard when the second highest daily average TSP concentration is less than or equal to 260 micrograms per cubic meter (µg/m3). A primary standard is set to protect against human health effects associated with exposure to an air pollutant.

A monitoring site meets the secondary daily TSP standard when the second highest daily average TSP concentration is less than or equal to 150 µg/m3. A secondary standard is set to protect against environmental or public welfare effects associated with exposure to an air pollutant.

In 2017, at the Lowry Avenue (909) site, the second highest daily average TSP concentration was 213 µg/m3. As a result, the Lowry Avenue (909) site has violated the secondary daily TSP standard, but

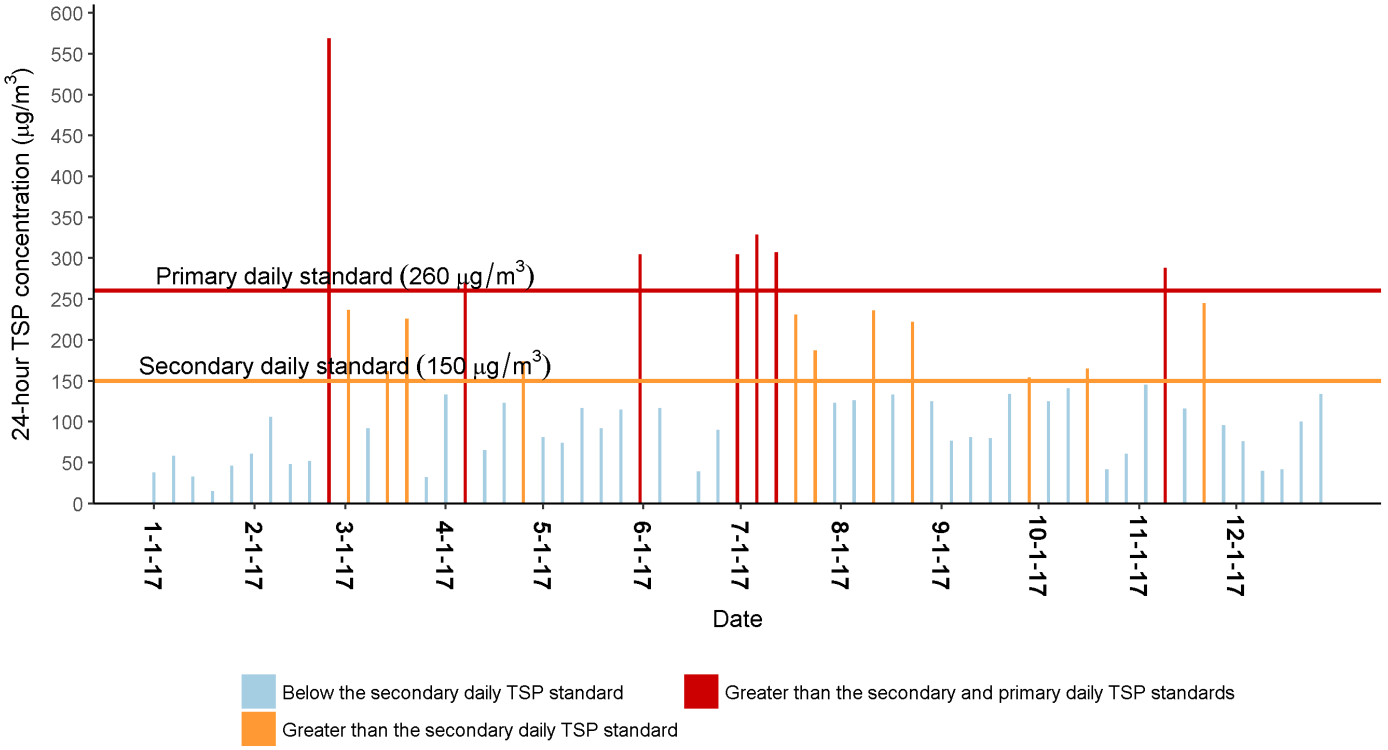
has met the primary daily TSP standard. In 2017, the Lowry Avenue site measured four exceedances of the secondary daily TSP standard and one exceedance of the primary daily TSP standard.

Figure 1. Daily TSP concentrations at the Lowry Avenue (909) site compared to the daily TSP standards, 2017



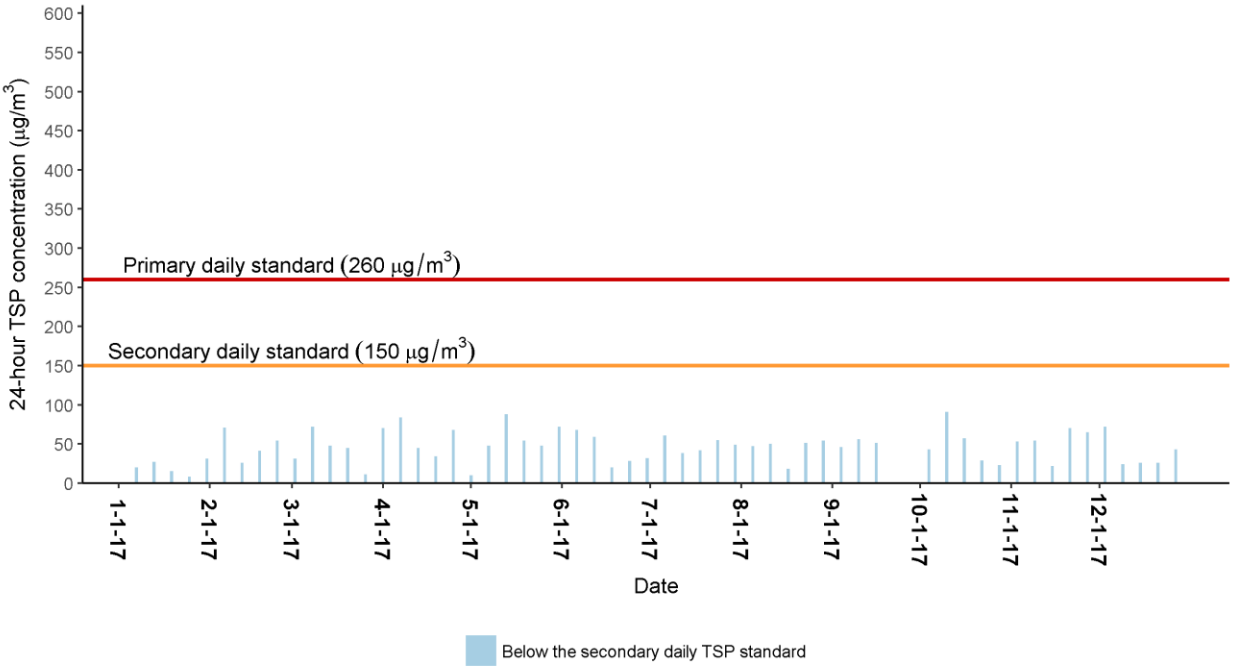
In 2017, at the Pacific Street (910) site, the second highest daily average TSP concentration was 328 µg/m3. As a result, the Pacific Street site has violated the primary and secondary daily TSP standards. In 2017, the Pacific Street (910) site measured 18 exceedances of the secondary daily TSP standard and 7 exceedances of the primary daily TSP standard.

Figure 2. Daily TSP concentrations at the Pacific Street site (910) compared to the daily TSP standards, 2017



In 2017, at the Bottineau/Marshall Terrace (1909) site, the second highest daily average TSP concentration was 87 µg/m3. As a result, the Bottineau/Marshall Terrace site has met the primary and secondary daily TSP standards. In 2017, the Bottineau/Marshall Terrace (1909) site measured no exceedances of the primary or secondary TSP standards.

Figure 3. Daily TSP concentrations at the Bottineau/Marshall Terrace site (910) compared to the daily TSP standards, 2017



PM_{10}

In 2017

- The Lowry Avenue monitor did not measure any exceedances of the daily PM_{10} standard.
- The Pacific Street monitor measured one exceedance of the daily PM_{10} standard.
- PM_{10} was not monitored at the Bottineau/Marshall Terrace site.

In Minnesota, PM_{10} levels in the air are regulated through the National Ambient Air Quality Standards and the Minnesota Ambient Air Quality Standards (MAAQS). The MAAQS are defined in Minnesota Administrative Rules 7009.0080. The PM_{10} standards include:

Table 2. Ambient Air Quality Standards for PM_{10}

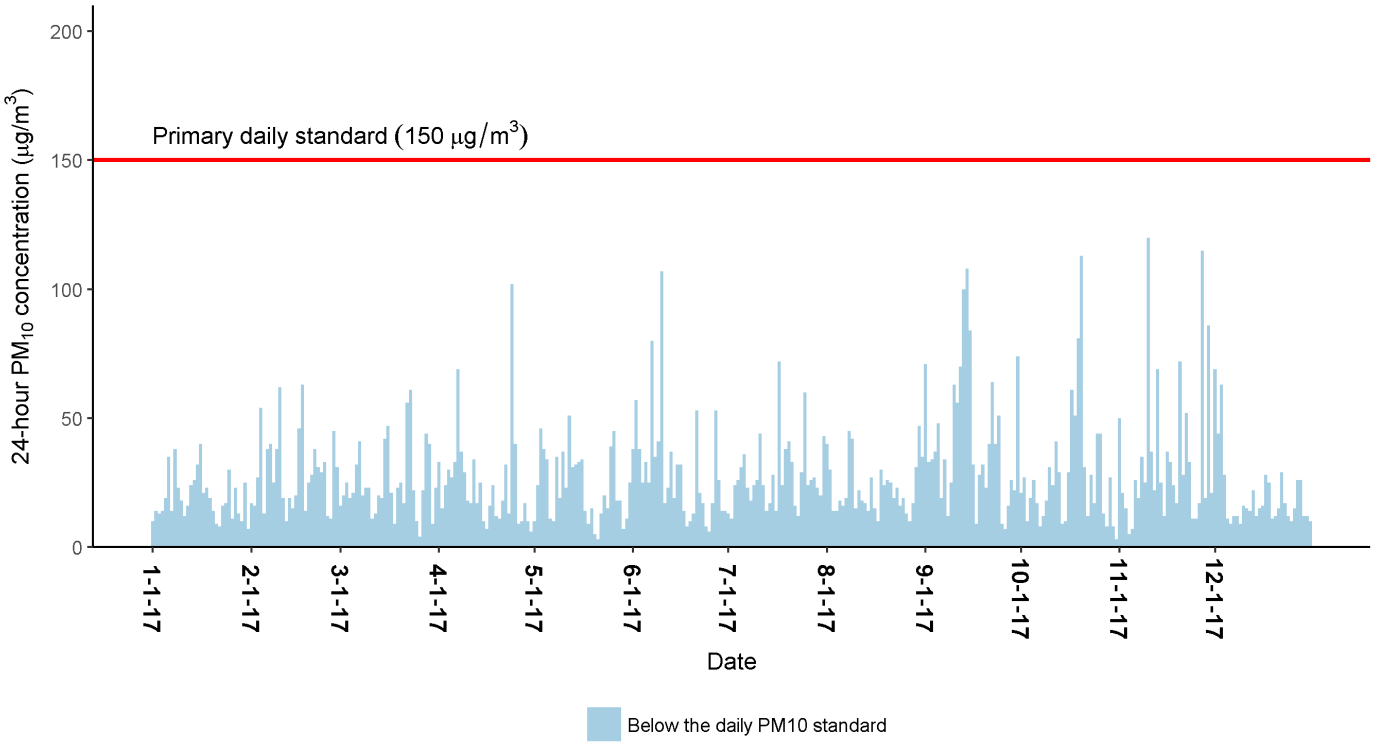
Standard Type	Time Interval	Level of Standard	A monitoring site meets the standard if…
National Standard	Daily (24-hour)	150 micrograms per cubic meter	...the standard is not exceeded more than once per year, on average, over three years
State Standard	Daily (24-hour)	150 micrograms per cubic meter	... the standard is not exceeded more than once per year, on average, over three years
	~~Annual~~	~~50 micrograms per cubic meter~~	~~...the annual average concentration is less than or equal to 50 µg/m³~~

Note: For PM_{10}, the primary and secondary standards are identical. The state standard for annual PM_{10} was revoked on December 27, 2016 through omnibus rulemaking.

Daily PM_{10} standards

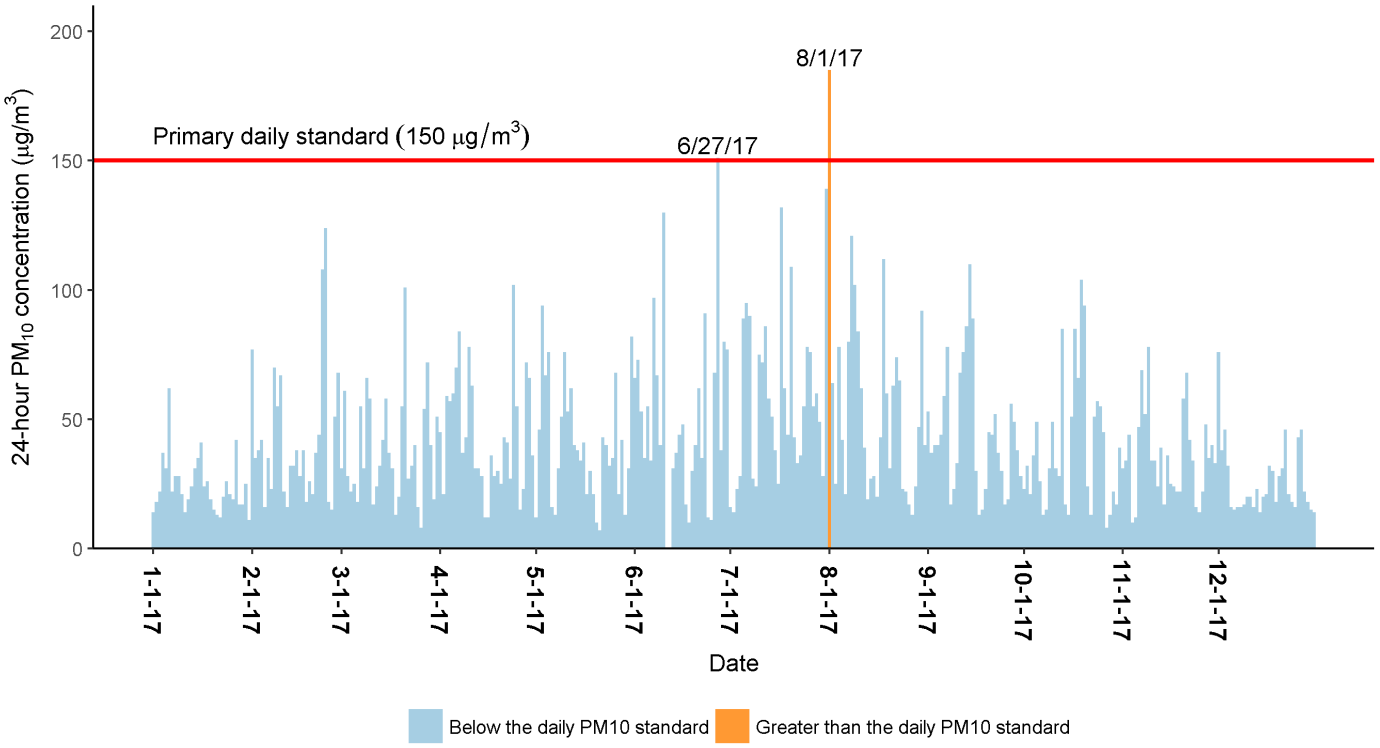
A monitoring site meets the daily PM_{10} standard when the level of the standard is not exceeded more than once per year, on average, over three years. Since monitoring began in January 2015, the Lowry Avenue site has measured two exceedances of the daily PM_{10} standard. In 2017, the Lowry Avenue site met the daily PM_{10} standard. Since the level of the daily PM_{10} standard was last exceeded at the Lowry Avenue site in 2015, those exceedances will not affect the attainment status of the daily PM_{10} standard at the Lowry Avenue site in 2018 and future years.

Figure 4. Daily PM_{10} concentrations at the Lowry Avenue site compared to the daily PM_{10} standards, 2017



Since monitoring began in July 2015, the Pacific Street site has had two measured exceedances of the daily PM_{10} standard through the end of 2017. If the Pacific Street site measures two additional exceedances in 2018 or three additional exceedances before the end of 2019, the site will violate the daily PM_{10} standard.

Figure 5. Daily PM_{10} concentrations at the Pacific Street site compared to the daily PM_{10} standards, 2017



Note: The Pacific Street monitor measured a 24-hour average PM_{10} concentration of 151 micrograms per cubic meter on June 27, 2017. This result is greater than the primary daily standard of 150 micrograms per cubic meter, but is not considered an exceedance of the PM_{10} daily standard since EPA rules require measured PM_{10} concentrations to be rounded to the nearest ten micrograms per cubic meter before comparing to the daily standard.

Lead

In 2017

- The Lowry Avenue, Pacific Street, and Bottineau/Marshall Terrace monitors did not exceed the rolling three-month lead standard.
- The Lowry Avenue, Pacific Street, and Bottineau/Marshall Terrace monitors did not exceed the cancer and non-cancer inhalation health benchmarks for lead.

The Lowry Avenue and Pacific Street sites had elevated lead concentrations compared to other non-source oriented lead monitoring sites. Lead results at Lowry Avenue and Pacific Street were similar to measured results near a lead-battery recycler in Eagan. Lead results at the Bottineau/Marshall Terrace site were similar to measured results at other non-source oriented lead monitoring sites. In Minnesota, lead levels in the air are regulated through the National Ambient Air Quality Standards and the Minnesota Ambient Air Quality Standards (MAAQS).

Table 3. Ambient air quality standards for lead

Standard Type	Time Interval	Level of Standard	A monitoring site meets the standard if…
National and State Standard	Rolling 3-month	0.15 micrograms per cubic meter	...the 3-month rolling average does not exceed the level of the standard, over three years.

Note: For lead, the primary and secondary standards are identical.

Rolling 3-month lead standard

A monitoring site meets the rolling 3-month lead standard when the maximum 3-month rolling average lead concentration is less than or equal to the level of the standard, over three years. The maximum 3-month rolling average lead concentration at the Lowry Avenue site in the three years from 2015 to 2017 is 0.12 µg/m3, which is 80% of the lead standard. The maximum 3-month rolling average lead concentration at the Pacific Street site in the three years from 2015 to 2017 is 0.08 µg/m3, which is 53% of the lead standard. One more year of monitoring is needed at the Pacific Street site to demonstrate compliance with the lead standard. The Bottineau/Marshall Terrace site has lead concentrations well below the lead standard and much lower that the Lowry Avenue and Pacific Street sites. Monitoring at the site will likely end in 2018.

Figure 6. Rolling 3-month average lead concentrations at Lowry Avenue (909) compared to the lead standard

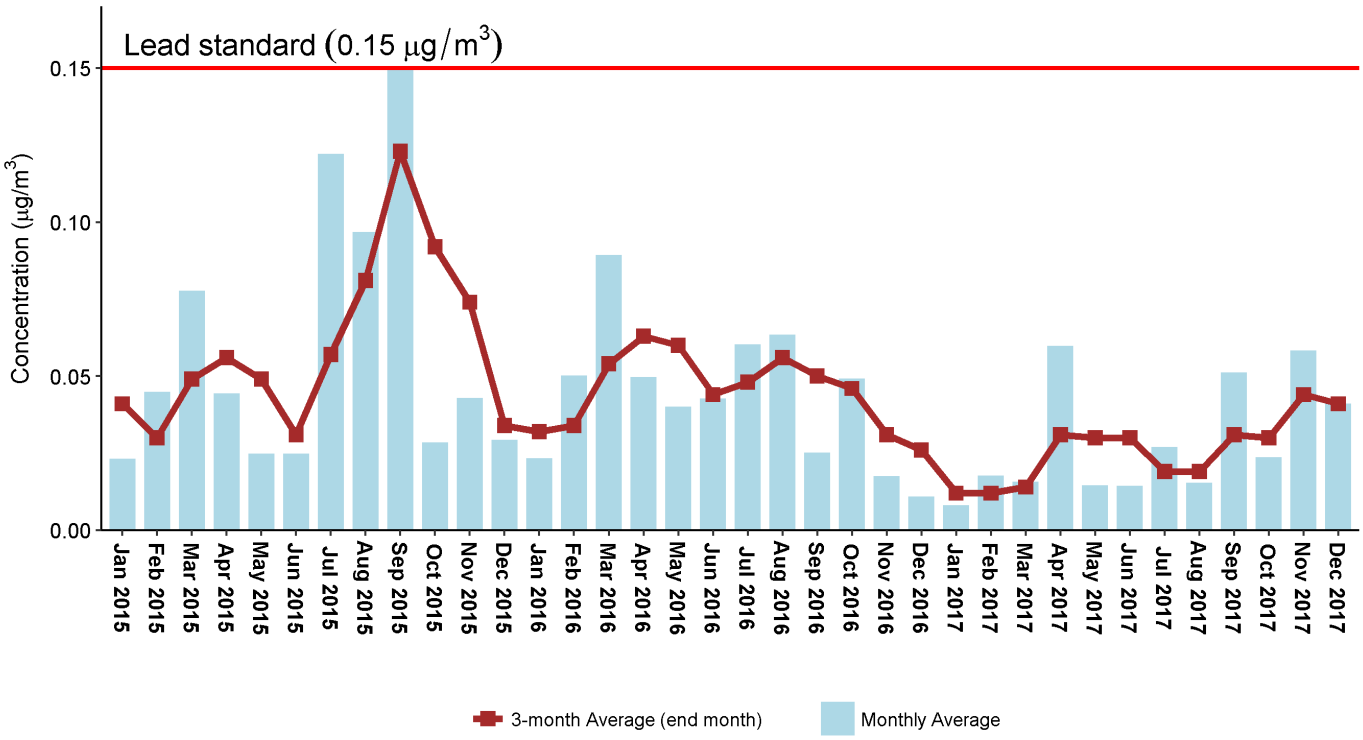


Figure 7. Rolling 3-month average lead concentrations at Pacific Street (910) compared to the lead standard

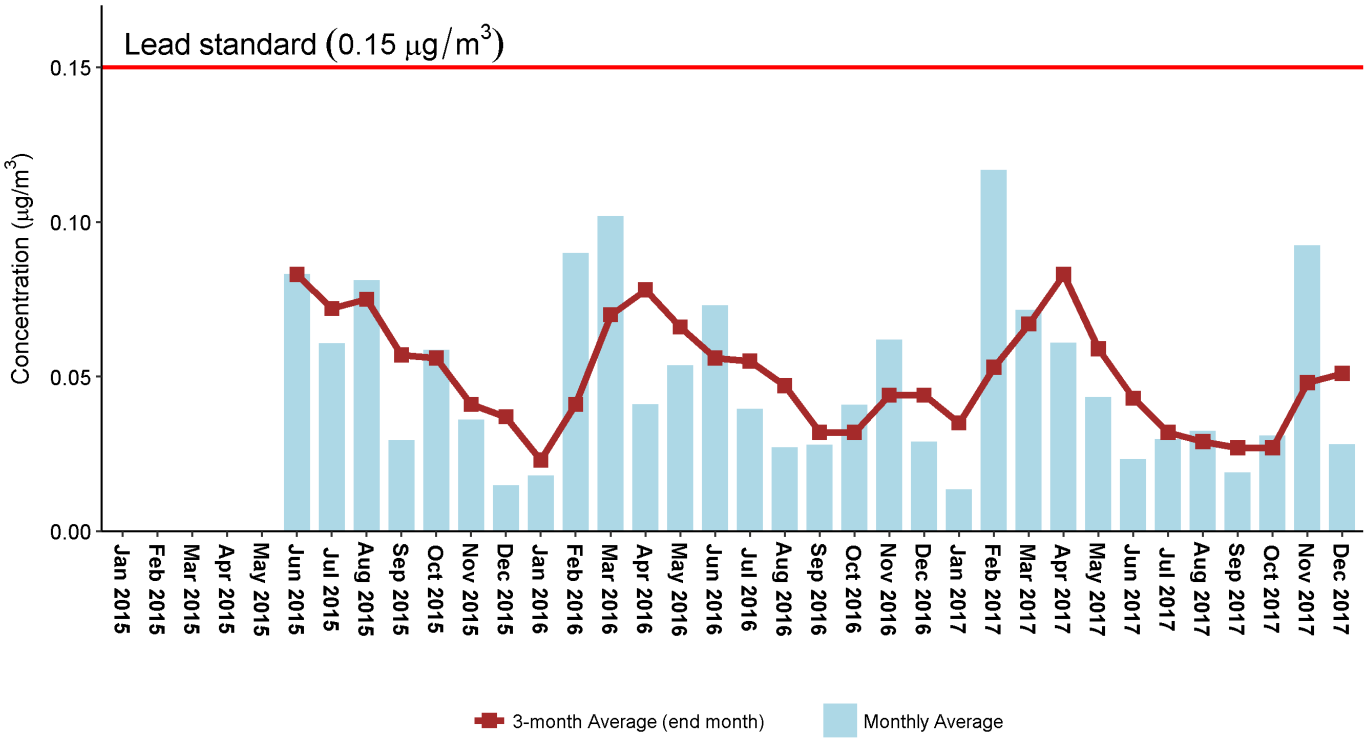
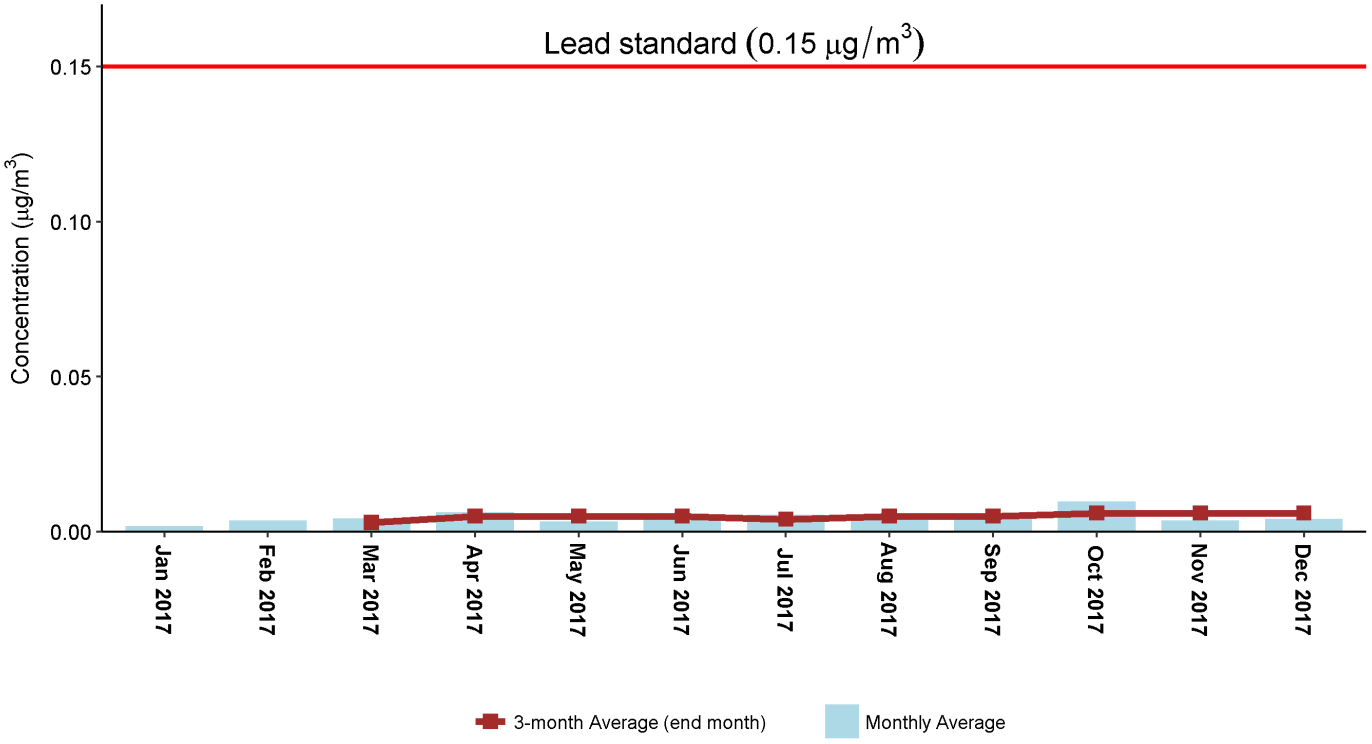


Figure 8. Rolling 3-month average lead concentrations at Bottineau/Marshall Terrace (1909) compared to the lead standard



Air toxics results

The U.S. Environmental Protection Agency (EPA) defines air toxics as those pollutants that cause or may cause cancer or other serious health effects (such as reproductive or birth defects), or adverse environmental and ecological effects. Air toxics include, but are not limited to, the 188 Hazardous Air Pollutants (HAPs) specified in the 1990 Clean Air Act Amendments, http://www.epa.gov/ttn/atw/orig189.html.

The MPCA's air toxics monitoring network analyzes air samples for 54 volatile organic compounds (VOCs), 7 carbonyls, and 13 metals. Air toxics do not have standards. Instead, the MPCA uses guidelines called inhalation health benchmarks. However, many air toxic pollutants have no established health benchmarks. Pollutant benchmarks come from a variety of sources including:

- Minnesota Department of Health's Health Risk Values (HRVs), Health Based Values (HBVs), and other Risk Assessment Advice, http://www.health.state.mn.us/divs/eh/risk/guidance/air/table.html
- EPA's Integrated Risk Information System (IRIS), http://www.epa.gov/iris/
- California's Office of Health Hazard Assessment, http://www.oehha.ca.gov/air.html.
- Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV), http://hhpprtv.ornl.gov/

Inhalation health benchmarks are established to protect against both short and long-term exposures to air pollutants. An acute inhalation health benchmark is a concentration in ambient air at or below which a chemical is unlikely to cause an adverse health effect to sensitive populations when exposure occurs for one-hour. A chronic health benchmark is a concentration in ambient air at or below which a chemical is unlikely to cause an adverse health effect to sensitive populations when exposure occurs over a lifetime. Chronic health benchmarks are set separately for cancer (carcinogenic) and noncancer related health outcomes. With respect to carcinogenic effects, the health benchmarks are developed so the additional lifetime risk of developing cancer is less than or equal to one additional chance in 100,000 for continuous exposure to the inhalation health benchmark concentration for a lifetime.

Lowry Avenue (909) air toxics results

In 2017, at the Lowry Avenue site, three air toxic pollutants were measured at concentrations above a chronic inhalation health benchmark. These pollutants include two metals, chromium and cobalt, and one carbonyl, formaldehyde. The elevated chromium and cobalt results at Lowry Avenue are unique in the Twin Cities Metropolitan Area and indicate a local source may be contributing to the elevated concentrations. Formaldehyde is an air toxic pollutant that is above the inhalation health benchmark at all urban air toxics monitoring sites and is the result of regional air pollution emissions.

Table 4. Air toxics pollutants above inhalation health benchmarks (IHBs) at Lowry Avenue (909), 2017

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
Chromium	0.00807**	0.0103**	0.008	129%**
Cobalt	0.00108**	0.00144**	0.0011	131%**
Formaldehyde	3.68	4.01*	2	200%*

* The pollutant did not meet the seasonal completeness requirement. To meet the seasonal completeness requirement, a valid sample must be collected for that pollutant on at least 75% of possible sampling days for each quarter of the year. If a pollutant

does not meet the seasonal completeness requirement, then the annual mean, UCL of the annual mean, and percent of the lowest IHB are considered unofficial.

** Less than 20% of samples were above the reporting limit. Measured concentrations below the reporting limit are estimated.

[1.] The chromium inhalation health benchmarks are based on risks associated with exposure to Hexavalent Chromium ($Cr6^{+}$). The MPCA air toxics monitoring network measures total chromium. To assess health risks, we assume that hexavalent chromium is 10% of total chromium measurements. The chronic health benchmarks have been adjusted to allow comparisons to the measured total chromium concentrations.

The following tables summarize all air toxics monitoring results by pollutant group, which includes carbonyls, metals, and VOCs. Due to uncertainty associated with instrument detection limits, a mean is not calculated for pollutants with less than 20% of samples above the detection limit. To assess risks, the 95% UCL (95% Upper Confidence Limit) of the annual mean is divided by the lowest chronic health benchmark. Pollutants with a "Percent of Lowest IHB" greater than 100% exceed the associated inhalation health benchmark.

Table 5. Annual carbonyls results at Lowry Avenue (909) compared to IHBs, 2017

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
Acetaldehyde	1.75	1.95	5	39%
Acetone	4.02	4.54	No IHB	
Benzaldehyde	0.161	0.184	20	1%
Butyraldehyde	0.263	0.289	70	0%
Formaldehyde	3.68	4.01	2	200%
Propionaldehyde	0.406	0.447	8	6%
Trans-Crotonaldehyde	0.0596	0.0759	No IHB	

* The pollutant did not meet the seasonal completeness requirement. To meet the seasonal completeness requirement, a valid sample must be collected for that pollutant on at least 75% of possible sampling days for the six warmest and six coolest months of the year. If a pollutant does not meet the seasonal completeness requirement, then the annual mean, UCL of the annual mean, and percent of the lowest IHB are considered unofficial.

** Less than 20% of samples were above the reporting limit. Measured concentrations below the reporting limit are estimated.

Table 6. Annual metals results at Lowry Avenue (909) compared to IHBs, 2017

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
Antimony	0.00349**	0.00473**	0.2	2%**
Arsenic	0.00127**	0.00159**	0.002	80%**
Beryllium	Below the detection limit		0.004	
Cadmium	0.000907**	0.0013**	0.006	22%**
Chromium	0.00807**	0.0103**	0.008	129%**
Cobalt	0.00108**	0.00144**	0.0011	131%**
Lead	0.028	0.0362	0.15	24%
Manganese	0.0648	0.0806	0.2	40%
Nickel	0.00707**	0.00883**	0.014	63%**
Selenium	Below the detection limit		20	

* The pollutant did not meet the seasonal completeness requirement. To meet the seasonal completeness requirement, a valid sample must be collected for that pollutant on at least 75% of possible sampling days for the six warmest and six coolest months of the year. If a pollutant does not meet the seasonal completeness requirement, then the annual mean, UCL of the annual mean, and percent of the lowest IHB are considered unofficial.

** Less than 20% of samples were above the reporting limit. Measured concentrations below the reporting limit are estimated.

[1.] The chromium inhalation health benchmarks are based on risks associated with exposure to Hexavalent Chromium ($Cr6^{+}$). The MPCA air toxics monitoring network measures total chromium. To assess health risks, we assume that hexavalent chromium is 10% of total chromium measurements. The chronic health benchmarks have been adjusted to allow comparisons to the measured total chromium concentrations.

[4.] The nickel inhalation health benchmarks are based on risks associated with exposure to nickel sub-sulfide. The MPCA air toxics monitoring network measures total nickel. This data has not been adjusted to reflect the likely nickel sub-sulfide contribution to the total nickel measurements.

Table 7. Annual VOC results at Lowry Avenue (909) compared to IHBs, 2017

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
1,1-Dichloroethane	Below the detection limit		6.3	
1,1-Dichloroethylene	Below the detection limit		200	
1,1,2-Trichloroethane	0.0358*	0.0456*	0.63	7%*
1,1,2,2-Tetrachloroethane	0.0717*	0.0896*	0.17	53%*
1,2-Dichlorobenzene	Below the detection limit		No IHB	
1,2-Dichloropropane			4	
1,2,4-Trichlorobenzene	Below the detection limit		2	
1,2,4-Trimethylbenzene	0.131*	0.17*	60	0%*
1,3-Butadiene	0.0696*	0.0851*	0.2	43%*
1,3-Dichlorobenzene	Below the detection limit		No IHB	
1,3,5-Trimethylbenzene	0.331*	0.435*	No IHB	
1,4-Dichlorobenzene	Below the detection limit		0.91	
Benzene	0.685*	0.814*	1.3	63%*
Benzyl Chloride	0.0391*	0.0442*	0.2	22%*
Bromodichloromethane	Below the detection limit		No IHB	
Bromoform	Below the detection limit		9.1	
Bromomethane	Below the detection limit		5	
Carbon Disulfide	0.101*	0.151*	700	0%*
Carbon Tetrachloride	0.519*	0.54*	1.7	32%*
Chlorobenzene	0.0391*	0.0667*	1000	0%*
Chloroethane	Below the detection limit		10000	
Chloroform	0.115*	0.149*	0.43	35%*
Chloromethane	0.3*	0.4*	90	0%*
Cis-1,2-Dichloroethene	Below the detection limit		No IHB	
Cis-1,3-Dichloropropene	0.0308*	0.0405*	No IHB	
Cyclohexane	0.198*	0.259*	6000	0%*
Dibromochloromethane	Below the detection limit		No IHB	
Dichlorodifluoromethane	2.65*	2.94*	No IHB	
Dichloromethane	0.635*	0.723*	20	4%*
Ethylbenzene	0.328*	0.407*	4	10%*
Ethylene Dibromide	Below the detection limit		0.05	
Ethylene Dichloride	0.0956*	0.104*	0.38	27%*
Freon 113	0.601*	0.657*	No IHB	
Freon 114	Below the detection limit		No IHB	
Hexachlorobutadiene	Below the detection limit		0.45	
M/P Xylene	0.693*	0.979*	100	1%*
Methyl Butyl Ketone	0.0857*	0.116*	30	0%*
Methyl Chloroform	0.122*	0.241*	5000	0%*

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
Methyl Ethyl Ketone	1.04*	1.36*	5000	0%*
Methyl Methacrylate			700	
Methyl Tert-Butyl Ether	Below the detection limit		38	
N-Heptane	0.314*	0.404*	No IHB	
N-Hexane	0.531*	0.671*	50	1%*
O-Xylene	0.353*	0.456*	100	0%*
Styrene	0.13*	0.2*	1000	0%*
Tetrachloroethylene	0.0667*	0.0941*	2	5%*
Toluene	1.58*	1.92*	400	0%*
Trans-1,2-Dichloroethylene	0.0252*	0.0418*	60	0%*
Trans-1,3-Dichloropropene	Below the detection limit		No IHB	
Trichloroethylene	0.0609*	0.0854*	2	4%*
Trichlorofluoromethane	1.6*	1.6*	No IHB	
Vinyl Acetate	0.201*	0.35*	200	0%*
Vinyl Chloride	Below the detection limit		1	

* The pollutant did not meet the seasonal completeness requirement. To meet the seasonal completeness requirement, a valid sample must be collected for that pollutant on at least 75% of possible sampling days for the six warmest and six coolest months of the year. If a pollutant does not meet the seasonal completeness requirement, then the annual mean, UCL of the annual mean, and percent of the lowest IHB are considered unofficial.

** Less than 20% of samples were above the reporting limit. Measured concentrations below the reporting limit are estimated.

Pacific Street (910) metals results

In 2017, at the Pacific Street site, four air toxic pollutants were measured at concentrations above a chronic inhalation health benchmark. These pollutants include arsenic, chromium, cobalt, and nickel. The elevated metals results at Pacific Street are unique in the Twin Cities Metropolitan Area and indicate a local source may be contributing to the elevated concentrations.

Table 8. Annual metals results at Pacific Street (910) compared to IHBs, 2017

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
Antimony	0.00374**	0.0048**	0.2	2%**
Arsenic	0.00176**	0.00207**	0.002	103%**
Beryllium	Below the detection limit		0.004	
Cadmium	0.00116**	0.0015**	0.006	25%**
Chromium	0.0139**	0.0173**	0.008	216%**
Cobalt	0.00172**	0.00206**	0.0011	187%**
Lead	0.0455	0.058	0.15	39%
Manganese	0.125	0.148	0.2	74%
Nickel	0.0119**	0.0148**	0.014	106%**
Selenium	Below the detection limit		20	

* The pollutant did not meet the seasonal completeness requirement. To meet the seasonal completeness requirement, a valid sample must be collected for that pollutant on at least 75% of possible sampling days for the six warmest and six coolest months of the year. If a pollutant does not meet the seasonal completeness requirement, then the annual mean, UCL of the annual mean, and percent of the lowest IHB are considered unofficial.

** Less than 20% of samples were above the reporting limit. Measured concentrations below the reporting limit are estimated.

1. The chromium inhalation health benchmarks are based on risks associated with exposure to Hexavalent Chromium ($Cr6^{+}$). The MPCA air toxics monitoring network measures total chromium. To assess health risks, we assume that hexavalent chromium is 10% of total chromium measurements. The chronic health benchmarks have been adjusted to allow comparisons to the measured total chromium concentrations.

4. The nickel inhalation health benchmarks are based on risks associated with exposure to nickel sub-sulfide. The MPCA air toxics monitoring network measures total nickel. This data has not been adjusted to reflect the likely nickel sub-sulfide contribution to the total nickel measurements.

Bottineau/Marshall Terrace (1909) air toxics results

In 2017, at the Bottineau/Marshall Terrace site, two air toxic pollutants were measured at concentrations above a chronic inhalation health benchmark. These pollutants include formaldehyde and chloroform. Both pollutants did not meet seasonal completeness requirements for 2017 since monitoring for formaldehyde and chloroform did not begin at the Bottineau/Marshall Terrace site until April 2017. The high chloroform results at this site were driven by very high concentrations on two days, September 4, 2017. These high concentrations were not observed at the other North Minneapolis monitoring sites and their cause is not known. On other days, concentrations of chloroform were very low. Formaldehyde is an air toxic pollutant that is above the inhalation health benchmark at all urban air toxics monitoring sites and is the result of regional air pollution emissions.

Table 9. Air toxics pollutants above inhalation health benchmarks (IHBs) at Bottineau/Marshall Terrace (1909), 2017

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
Chloroform	0.217*	0.436*	0.43	101%*
Formaldehyde	3.15*	3.48*	2	174%*

* The pollutant did not meet the seasonal completeness requirement. To meet the seasonal completeness requirement, a valid sample must be collected for that pollutant on at least 75% of possible sampling days for the six warmest and six coolest months of the year. If a pollutant does not meet the seasonal completeness requirement, then the annual mean, UCL of the annual mean, and percent of the lowest IHB are considered unofficial.

** Less than 20% of samples were above the reporting limit. Measured concentrations below the reporting limit are estimated.

[1.] The chromium inhalation health benchmarks are based on risks associated with exposure to Hexavalent Chromium ($Cr6^{+}$). The MPCA air toxics monitoring network measures total chromium. To assess health risks, we assume that hexavalent chromium is 10% of total chromium measurements. The chronic health benchmarks have been adjusted to allow comparisons to the measured total chromium concentrations.

The following tables summarize all air toxics monitoring results by pollutant group, which includes: carbonyls, metals, and VOCs. Due to uncertainty associated with instrument detection limits, a mean is not calculated for pollutants with less than 20% of samples above the detection limit. To assess risks, the 95% UCL (95% Upper Confidence Limit) of the annual mean is divided by the lowest chronic health benchmark. Pollutants with a "Percent of Lowest IHB" greater than 100% exceed the associated inhalation health benchmark.

Table 10. Annual carbonyls results at Bottineau/Marshall Terrace (1909) compared to IHBs, 2017

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
Acetaldehyde	1.43*	1.59*	5	32%*
Acetone	3.68*	4.2*	No IHB	
Benzaldehyde	0.19*	0.214*	20	1%*
Butyraldehyde	0.187*	0.205*	70	0%*
Formaldehyde	3.15*	3.48*	2	174%*
Propionaldehyde	0.374*	0.414*	8	5%*
Trans-Crotonaldehyde	0.0646*	0.0833*	No IHB	

* The pollutant did not meet the seasonal completeness requirement. To meet the seasonal completeness requirement, a valid sample must be collected for that pollutant on at least 75% of possible sampling days for the six warmest and six coolest months of the year. If a pollutant does not meet the seasonal completeness requirement, then the annual mean, UCL of the annual mean, and percent of the lowest IHB are considered unofficial.

** Less than 20% of samples were above the reporting limit. Measured concentrations below the reporting limit are estimated.

Table 11. Annual metals results at Bottineau/Marshall Terrace (1909) compared to IHBs, 2017

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
Antimony	0.00196**	0.00242**	0.2	1%**
Arsenic	0.000879**	0.00124**	0.002	62%**
Beryllium	Below the detection limit		0.004	
Cadmium	Below the detection limit		0.006	
Chromium	0.00227**	0.00254**	0.008	32%**
Cobalt	Below the detection limit		0.0011	
Lead	0.00456**	0.00529**	0.15	4%**
Manganese	0.0313	0.0355	0.2	18%
Nickel	0.00152**	0.00172**	0.014	12%**
Selenium	Below the detection limit		20	

* The pollutant did not meet the seasonal completeness requirement. To meet the seasonal completeness requirement, a valid sample must be collected for that pollutant on at least 75% of possible sampling days for the six warmest and six coolest months of the year. If a pollutant does not meet the seasonal completeness requirement, then the annual mean, UCL of the annual mean, and percent of the lowest IHB are considered unofficial.

** Less than 20% of samples were above the reporting limit. Measured concentrations below the reporting limit are estimated.

[1.] The chromium inhalation health benchmarks are based on risks associated with exposure to Hexavalent Chromium ($Cr6^{+}$). The MPCA air toxics monitoring network measures total chromium. To assess health risks, we assume that hexavalent chromium is 10% of total chromium measurements. The chronic health benchmarks have been adjusted to allow comparisons to the measured total chromium concentrations.

[4.] The nickel inhalation health benchmarks are based on risks associated with exposure to nickel sub-sulfide. The MPCA air toxics monitoring network measures total nickel. This data has not been adjusted to reflect the likely nickel sub-sulfide contribution to the total nickel measurements.

Table 12. Annual VOC results at Bottineau/Marshall Terrace (1909) compared to IHBs, 2017

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
1,1-Dichloroethane	Below the detection limit		6.3	
1,1-Dichloroethylene	Below the detection limit		200	
1,1,2-Trichloroethane	0.048*	0.0676*	0.63	11%*
1,1,2,2-Tetrachloroethane	0.0918*	0.107*	0.17	63%*
1,2-Dichlorobenzene	Below the detection limit		No IHB	
1,2-Dichloropropane	0.0433*	0.0455*	4	1%*
1,2,4-Trichlorobenzene	Below the detection limit		2	
1,2,4-Trimethylbenzene	0.125*	0.159*	60	0%*
1,3-Butadiene	0.0867*	0.121*	0.2	60%*
1,3-Dichlorobenzene	Below the detection limit		No IHB	
1,3,5-Trimethylbenzene	0.37*	0.466*	No IHB	
1,4-Dichlorobenzene	Below the detection limit		0.91	
Benzene	0.744*	0.878*	1.3	68%*
Benzyl Chloride	0.0392*	0.0455*	0.2	23%*
Bromodichloromethane	Below the detection limit		No IHB	
Bromoform	Below the detection limit		9.1	
Bromomethane	Below the detection limit		5	
Carbon Disulfide	0.261*	0.355*	700	0%*
Carbon Tetrachloride	0.556*	0.629*	1.7	37%*
Chlorobenzene	0.0425*	0.0728*	1000	0%*
Chloroethane	Below the detection limit		10000	
Chloroform	0.217*	0.436*	0.43	101%*
Chloromethane	0.389*	0.512*	90	1%*
Cis-1,2-Dichloroethene	0.0481*	0.0834*	No IHB	
Cis-1,3-Dichloropropene	0.038*	0.0453*	No IHB	
Cyclohexane	0.193*	0.268*	6000	0%*
Dibromochloromethane	Below the detection limit		No IHB	
Dichlorodifluoromethane	1.86*	2.61*	No IHB	
Dichloromethane	0.706*	0.909*	20	5%*
Ethylbenzene	0.316*	0.408*	4	10%*
Ethylene Dibromide	Below the detection limit		0.05	
Ethylene Dichloride	0.0772*	0.0892*	0.38	23%*
Freon 113	0.661*	0.732*	No IHB	
Freon 114	Below the detection limit		No IHB	
Hexachlorobutadiene	Below the detection limit		0.45	
M/P Xylene	0.704*	0.924*	100	1%*
Methyl Butyl Ketone	0.0653*	0.0969*	30	0%*
Methyl Chloroform	Below the detection limit		5000	

Pollutant	Annual mean	95% UCL of annual mean	Lowest IHB	Percent of Lowest IHB
	micrograms per cubic meter			
Methyl Ethyl Ketone	0.948*	1.17*	5000	0%*
Methyl Methacrylate			700	
Methyl Tert-Butyl Ether	Below the detection limit		38	
N-Heptane	0.27*	0.413*	No IHB	
N-Hexane	0.354*	0.499*	50	1%*
O-Xylene	0.328*	0.41*	100	0%*
Styrene	0.292*	0.644*	1000	0%*
Tetrachloroethylene	0.0765*	0.111*	2	6%*
Toluene	1.8*	2.21*	400	1%*
Trans-1,2-Dichloroethylene	0.0272*	0.0394*	60	0%*
Trans-1,3-Dichloropropene	Below the detection limit		No IHB	
Trichloroethylene	0.078*	0.105*	2	5%*
Trichlorofluoromethane	1.82*	1.98*	No IHB	
Vinyl Acetate	Below the detection limit		200	
Vinyl Chloride	Below the detection limit		1	

* The pollutant did not meet the seasonal completeness requirement. To meet the seasonal completeness requirement, a valid sample must be collected for that pollutant on at least 75% of possible sampling days for the six warmest and six coolest months of the year. If a pollutant does not meet the seasonal completeness requirement, then the annual mean, UCL of the annual mean, and percent of the lowest IHB are considered unofficial.

** Less than 20% of samples were above the reporting limit. Measured concentrations below the reporting limit are estimated.