Minnesota Pollution Control Agency

Near-Road Air Monitoring in Minnesota

Twin Cities Metropolitan Area Site Identification

May 2012

Contents

List of Tables

List of Figures

Background

In February of 2010, The U.S. Environmental Protection Agency (EPA) finalized new minimum monitoring requirements for the nitrogen dioxide (NO_2) monitoring network in support of a 1-hour NO_2 National Ambient Air Quality Standard (NAAQS). In the new monitoring requirements, state and local air monitoring agencies are required to install near-road NO_2 monitoring stations at locations where peak hourly NO_2 concentrations are expected to occur within the near-road environment in large urban areas. In August of 2011, the EPA extended the near-road monitoring requirements to the national carbon monoxide (CO) monitoring network. Per the regulation, at a minimum state and local air agencies must begin operating their required near-road NO_2 monitors by January 1, 2013, and must collocate the near-road CO monitors by January 1, 2015[1].

To assist state and local air agencies in identifying candidate near-road monitoring sites, the EPA has released the "Near-Road NO_2 Monitoring Technical Assistance Document" (henceforth referred to as the "near-road TAD"). This analysis utilizes the December 21, 2011 draft version of the near-road TAD to identify candidate near-road monitoring sites in Minnesota. A copy of the near-road TAD and additional information on EPA's near-road monitoring requirements are available from the EPA's Ambient Monitoring Technology Information Center, http://www.epa.gov/ttn/amtic/nearroad.html. As necessary, this document will be updated to reflect changes included in future iterations of the near-road TAD.

Identifying Core Based Statistical Areas Subject to the Near-Road Monitoring Requirements

According to 40 CFR Part 58 Appendix D, state and local air agencies are required to operate one near-road monitoring site in each Core Based Statistical Area (CBSA) with a population of 500,000 or more persons. In addition, CBSAs with 2,500,000 or more persons, or those CBSAs with one or more roadway segments carrying traffic volumes of 250,000 or more vehicles per day are required to operate two near-road monitoring sites.

Table 1 describes the U.S. Census Bureau's most recent (2009 vintage) CBSA population estimates for large CBSAs in Minnesota. The Minneapolis-St. Paul- Bloomington CBSA is the only CBSA in Minnesota that requires near-road monitoring. The 2009 population estimate for the Minneapolis-St. Paul-Bloomington CBSA is 3,269,814 persons, triggering the requirement for a second near-road monitoring site within the CBSA[2].

Table 1: U.S. Census Bureau CBSA Population Estimates for Minnesota, 2009 vintage

CBSA	NAME	POPESTIMATE2009	Sites
33460	Minneapolis-St. Paul-Bloomington, MN-WI	3,269,814	2
20260	Duluth, MN-WI	276,368	--
22020	Fargo, ND-MN	200,102	--
41060	St. Cloud, MN	189,148	--
40340	Rochester, MN	185,618	--

U.S. Census Bureau Population Estimates (2009 vintage)

[1] Deployment of near-road CO monitors will be tiered. Monitors in smaller CBSAs are due by January 1, 2017.
[2] The EPA is adopting a "build and hold" approach to the deployment of the near-road monitoring network. As a result the MPCA will be required to site one near-road monitoring site by January 1, 2013, and will evaluate the need for a second monitoring site based on monitoring results.

The CFR also asks states to consider the Annual Average Daily Traffic (AADT) counts of road segments within eligible CBSAs to determine monitoring requirements. Based on the 2010 AADT count data provided by the Minnesota Department of Transportation (MnDOT), the highest AADT count within the Minneapolis-St. Paul-Bloomington CBSA is located along I-94 and I-35W in downtown Minneapolis. The 2010 AADT count for this segment is 267,000 vehicles per day. Table 2 describes the 20 highest traffic segments, based on AADT count, in the Twin Cities metropolitan area in 2010.

Table 2: Top 20 AADT Counts for Road Segments in the Twin Cities Metropolitan Area, 2010

SEQ NUM	ROUTE NAME	LOCATION	YEAR	AADT	RANK
11256 & 11720[3]	I-94 & I-35W	W OF HIAWATHA & E OF PORTLAND AV IN MPLS	2010	267,000	1
10800	I-94	E OF HENNEPIN & LYNDALE AV IN MPLS	2010	191,000	2
11508	I-35E	BETWEEN E&W JCT OF I-94 ST PAUL	2010	185,000	3
11267	I-35W	S OF 31st ST E IN MPLS	2010	175,000	4
11179	I-494	W OF CSAH32 (PENN AV) IN BLOOMINGTON	2010	165,000	5
11256[4]	I-94	OVER THE TH55 BRIDGE IN MPLS	2010	165,000	5
11338	I-94	E OF CSAH53 (DALE ST) IN ST PAUL	2010	165,000	5
11207	I-494	E OF TH100 IN BLOOMINGTON	2010	164,000	8
9846	I-494	321 ATR W OF I-35W	2010	163,000	9
9851 & 9838[3]	I-35W	NB AND SB LANES OF I-35W S OF I-94	2010	160,000	10
11730	I-35W	N OF CSAH3 IN MPLS	2010	158,000	11
11257	I-94	W OF CSAH48 (25TH AV /RIVERSIDE AV)	2010	157,000	12
10809	I-35W	N OF CSAH46 (46TH ST E) IN MPLS	2010	156,000	13
11347	I-94	&12 E OF TH280 IN ST PAUL	2010	153,000	14
9837	I-94	LOWRY HILL TUNNEL	2010	153,000	14
11348	I-94	&12 W OF TH51 (SNELLING AV) IN ST PAUL	2010	153,000	14
9834	I-94	301 ATR W OF VICTORIA ST IN ST PAUL	2010	153,000	14
68277	I-394	E OF CSAH2 (PENN AV S)	2010	153,000	14
11336	I-94	E OF N JCT I-35E IN ST PAUL	2010	152,000	19
11350	I-94	&12 W OF LEXINGTON PKWY IN ST PAUL	2010	152,000	19

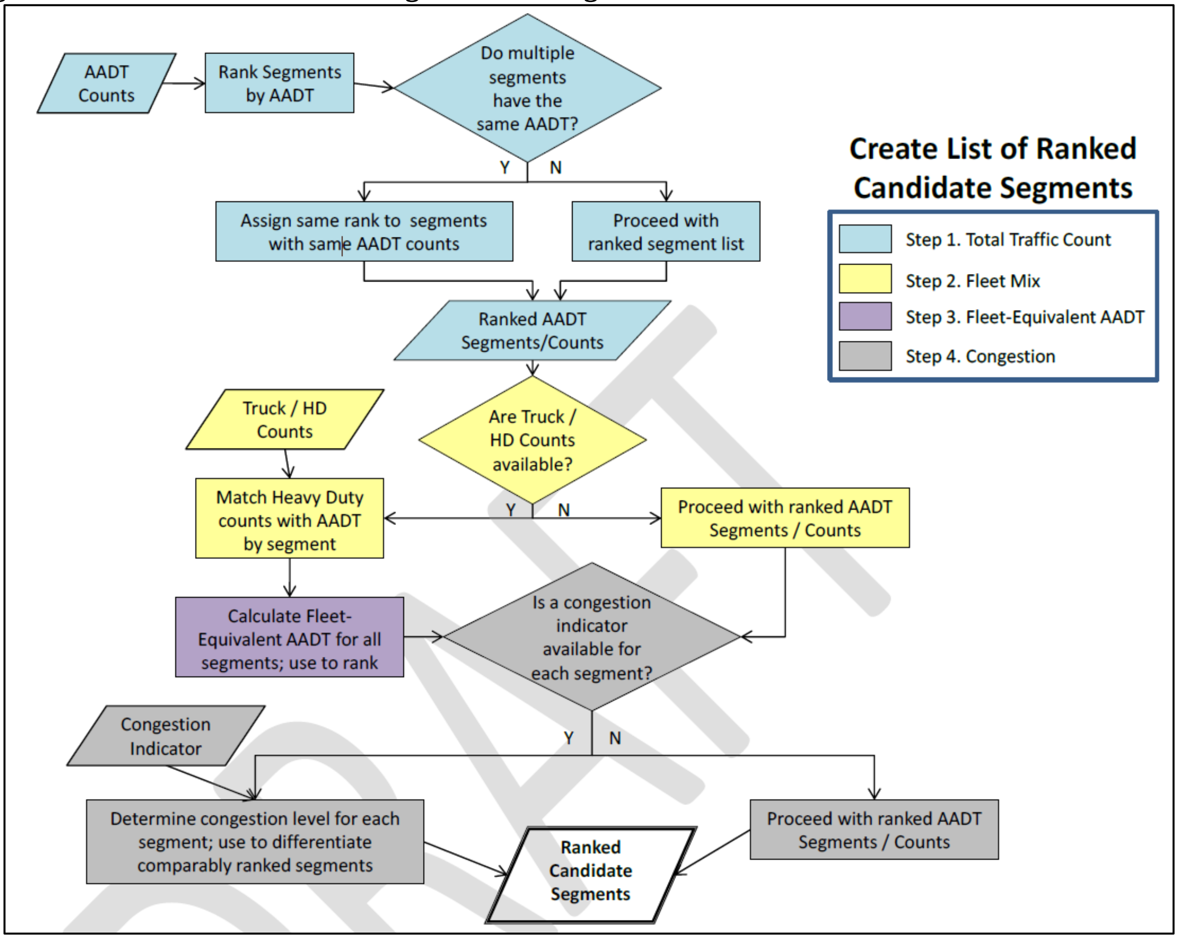
MnDOT Traffic Volume Data, 2010

[3] This segment was manually calculated based on two overlapping traffic segments.
[4] This segment is included in the merged I-94 and I-35W segment described in the top ranked traffic segment above.

Identifying Target Road Segments for Near-Road Monitoring

The EPA requires state and local air agencies to site near-road monitoring stations in locations where peak 1-hour NO_2 and CO concentrations are expected to be the highest in the near-road environment. To identify these locations, the EPA recommends that state and local air agencies utilize the most recent AADT counts to identify the most trafficked road segments. Factors such as fleet mix, roadway design, traffic congestion patterns, terrain or topography, and meteorology of candidate road segments can also be considered in identifying road segments for monitoring. Figure 1 describes EPA's recommended process for ranking candidate road segments.

Figure 1: Draft Candidate Road Segment Ranking Process



[Near-road NO_2 Monitoring Technical Assistance Document- Draft, December 21, 2011]

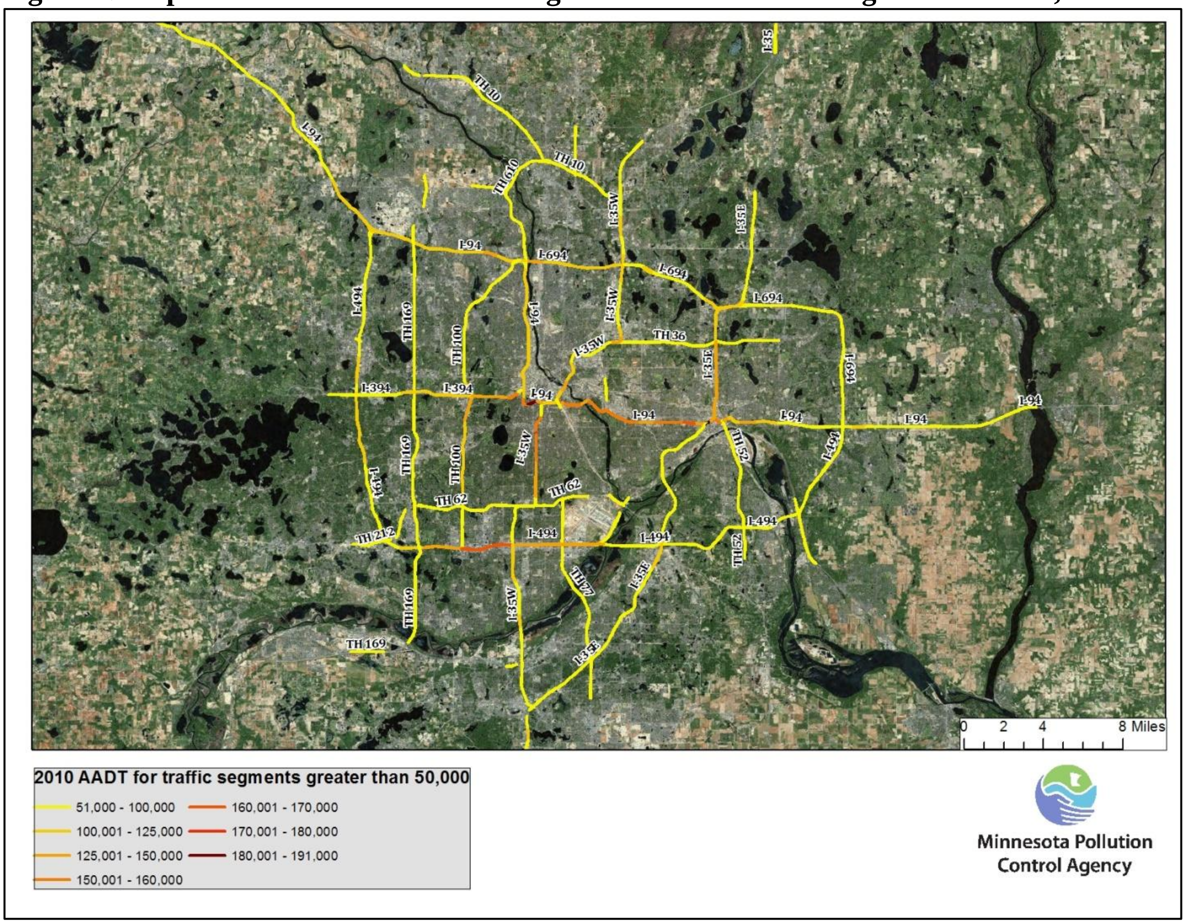
To complete the road segment ranking process, the Minnesota Pollution Control Agency (MPCA) has received 2010 traffic data for the Twin Cities metropolitan area from MnDOT. While two Wisconsin counties (St. Croix and Pierce) are included in the Minneapolis-St. Paul-Bloomington CBSA, traffic data from these counties are not included in this analysis. Based on population density and traffic data for the Minnesota road segments adjacent to the Wisconsin segments, the MPCA does not anticipate that road segments in the Wisconsin counties will have the highest peak 1-hour NO_2 and CO concentrations in the CBSA. Therefore, the exclusion of Wisconsin traffic data should not impact the results of the segment analysis.

Step 1: Total Traffic Count

As described in Figure 1 above, the first step in the traffic data evaluation process is to satisfy the requirement in 40 CFR Part 58, Appendix D, section 4.3, to rank road segments in a CBSA based on the total traffic volume, represented by AADT. The near-road TAD instructs states and local air agencies to generate a list of road segments in the CBSA in descending order, where the segment with the highest AADT is ranked first. Table 2 above includes a ranked list of the top twenty traffic segments in the Minneapolis-St. Paul-Bloomington CBSA in 2010.

Figure 2 below provides a map of traffic segments in the Minneapolis-St. Paul-Bloomington CBSA with 2010 AADT counts greater than 50,000. In general, the most heavily trafficked segments are located within the urban core along I-94 between downtown Minneapolis and St. Paul. Traffic segments along I-35W in the area directly south of downtown Minneapolis and several segments along the I-94 bypass routes also experience heavy daily traffic volumes.

Figure 2: Map of Twin Cities Area Road Segments with 2010 AADT greater than 50,000



Step 2: Fleet Mix

While AADT describes the total volume of traffic on a road, fleet mix data provides specific counts of different types of vehicles that comprise the total traffic volume. Most commonly, fleet mix data differentiates between light-duty passenger vehicles and heavy-duty trucks. Understanding the number of heavy-duty vehicles within a traffic segment is important because the amount of air pollution emitted on a per vehicle basis between light-duty and heavy-duty vehicles vary greatly.

To assess the fleet mix of road segments within the Minneapolis-St. Paul-Bloomington CBSA, the MPCA utilized the 2010 Heavy Commercial Annual Average Daily Traffic (HCAADT) count data provided by MnDOT. Table 3 includes a ranked list of the top 20 road segments based on HCAADT counts. The table also includes the percentage of heavy-duty (HD) vehicles comprising the segment's total AADT, and the segment's AADT rank.

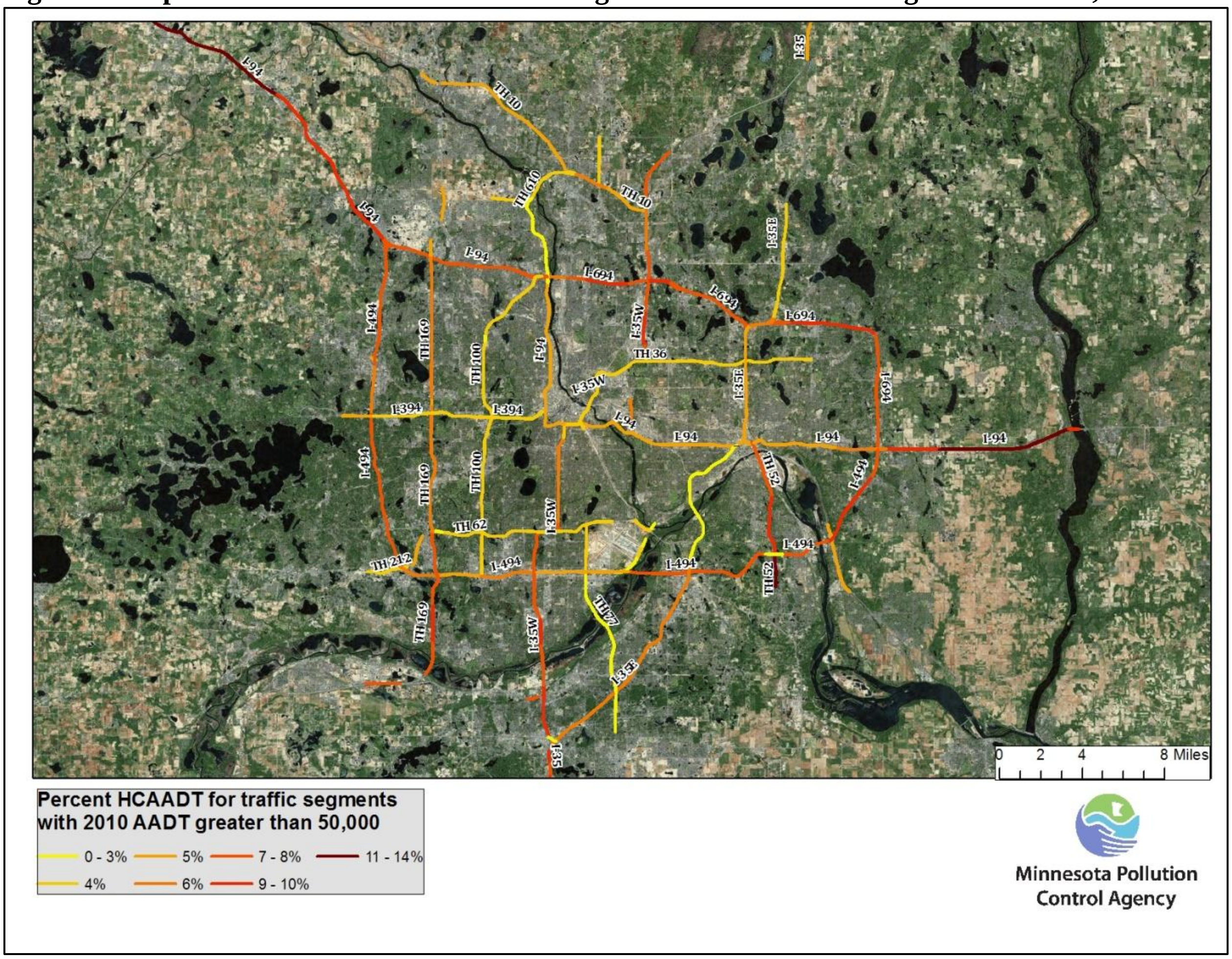
Table 3: Top 20 HCAADT Counts for Road Segments in the Twin Cities Metropolitan Area, 2010

SEQ NUM	ROUTE NAME	LOCATION	HCAADT	HCAADT RANK	PCT HD	AADT RANK
11256+ 11720	I-94 & I-35W	W OF HIAWATHA & E OF PORTLAND AV IN MPLS	10,850	1	4%	1
10790	I-94	NW OF I-494 IN MAPLE GROVE	10,200	2	9%	63
9859	I-94	342 ATR SE OF CSAH30 (95th AV N)	10,100	3	9%	69
10231	I-94	E OF I-694 & I-494	9,400	4	9%	89
10393	I-94	&TH52 NW OF CSAH30 (95th AV N) IN MAPLE GROVE	9,300	5	10%	136
11179	I-494	W OF CSAH32 (PENN AV) IN BLOOMINGTON	9,200	6	6%	5
9935	I-694	W OF SILVER LAKE ROAD	9,200	6	8%	63
11207	I-494	E OF TH100 IN BLOOMINGTON	9,100	8	6%	8
9846	I-494	321 ATR W OF I-35W	9,100	8	6%	9
11006	I-694	E OF CSAH44 (SILVER LAKE RD)	9,100	8	8%	72
11267	I-35W	S OF 31st ST E IN MPLS	9,000	11	5%	4
11692	I-694	W OF CSAH1 (EAST RIVER RD)	9,000	11	6%	26
10788	I-94	&TH52 W OF TH169 IN MAPLE GROVE	8,900	13	7%	59
11687	I-35W	N OF CO RD C	8,900	13	9%	107
10223	I-94	&12 AT ST CROIX RIVER BR	8,900	13	10%	136
10519	I-694	W OF TH47 IN FRIDLEY	8,800	16	6%	34
11760	I-94	&12 W OF CSAH19	8,800	16	10%	141
10917	I-35W	S OF CSAH88	8,600	18	9%	136
9861	I-94	354 ATR W OF CR 178 (LAKE ELMO AV)	8,500	19	10%	182
11730	I-35W	N OF CSAH3 IN MPLS	8,400	20	5%	10
11251	I-694	W OF CSAH77 (5th AVE NW)	8,400	20	8%	77
10791	I-94	&TH52 E OF I-494 IN MAPLE GROVE	8,400	20	8%	79
10225	I-94	&12 W OF TH95	8,400	20	11%	202
11700	I-35	S OF CSAH50	8,400	20	11%	223

MnDOT Traffic Volume Data, 2010

The traffic segment with the highest ranked HCAADT count in 2010 is located along I-94 and I-35W in downtown Minneapolis, and is also the highest ranked AADT segment. Approximately 10,850 heavy-duty vehicles travel this segment per day, comprising 4% of the total traffic volume along the segment. Across the Twin Cities metropolitan area, the percent of heavy-duty vehicles contributing to a road segment's total traffic volume ranges from 30% to less than 1%. Where HCAADT data is available, the average percentage of heavy-duty vehicles contributing to total traffic counts is 5%. Figure 3 provides a map of the percentage of heavy-duty vehicles on traffic segments with 2010 AADT counts greater than 50,000. As is expected, road segments along the outer ring of the Twin Cities metropolitan area have the highest proportion of heavy-duty vehicles to light-duty passenger vehicles.

Figure 3: Map of Percent HCAADT for Road Segments with 2010 AADT greater than 50,000



Step 3: Fleet Equivalent AADT

Because it is difficult to directly compare the relative air quality impacts of traffic segments with high AADT counts versus those with a high percentage of HCAADT, the near-road TAD recommends the use of a unique metric that accounts for both total traffic volume and fleet mix. The Fleet Equivalent (FE) AADT integrates a road segment's AADT and HCAADT count into a single value. This is accomplished by applying a multiplier to the HCAADT count to reflect higher per vehicle air pollution emission rates. The near-road TAD's recommended formula for calculating a road segment's FE AADT is as follows:

$$\text{FE AADT} = (\text{AADT} - HD_c) + (HD_m * HD_c) \qquad \textbf{Equation 1}$$

Where AADT is the total traffic volume count for a particular road segment, the HD_c variable is the total number of heavy-duty vehicles for a particular road segment (HCAADT), and the HD_m variable is a multiplier that represents the heavy-duty to light duty NOx emission ratio for a particular road segment.

In assigning the appropriate heavy-duty vehicle emissions multiplier, state and local air quality agencies may develop site specific emissions factors or may utilize the national default heavy-duty to light duty vehicle emission ratio of 10. For the purpose of this analysis, the MPCA has chosen to utilize the national default ratio to calculate the FE AADT of road segments in the Minneapolis-St. Paul-Bloomington CBSA. Table 4 includes a ranked list of the top 20 road segments based on FE AADT counts.

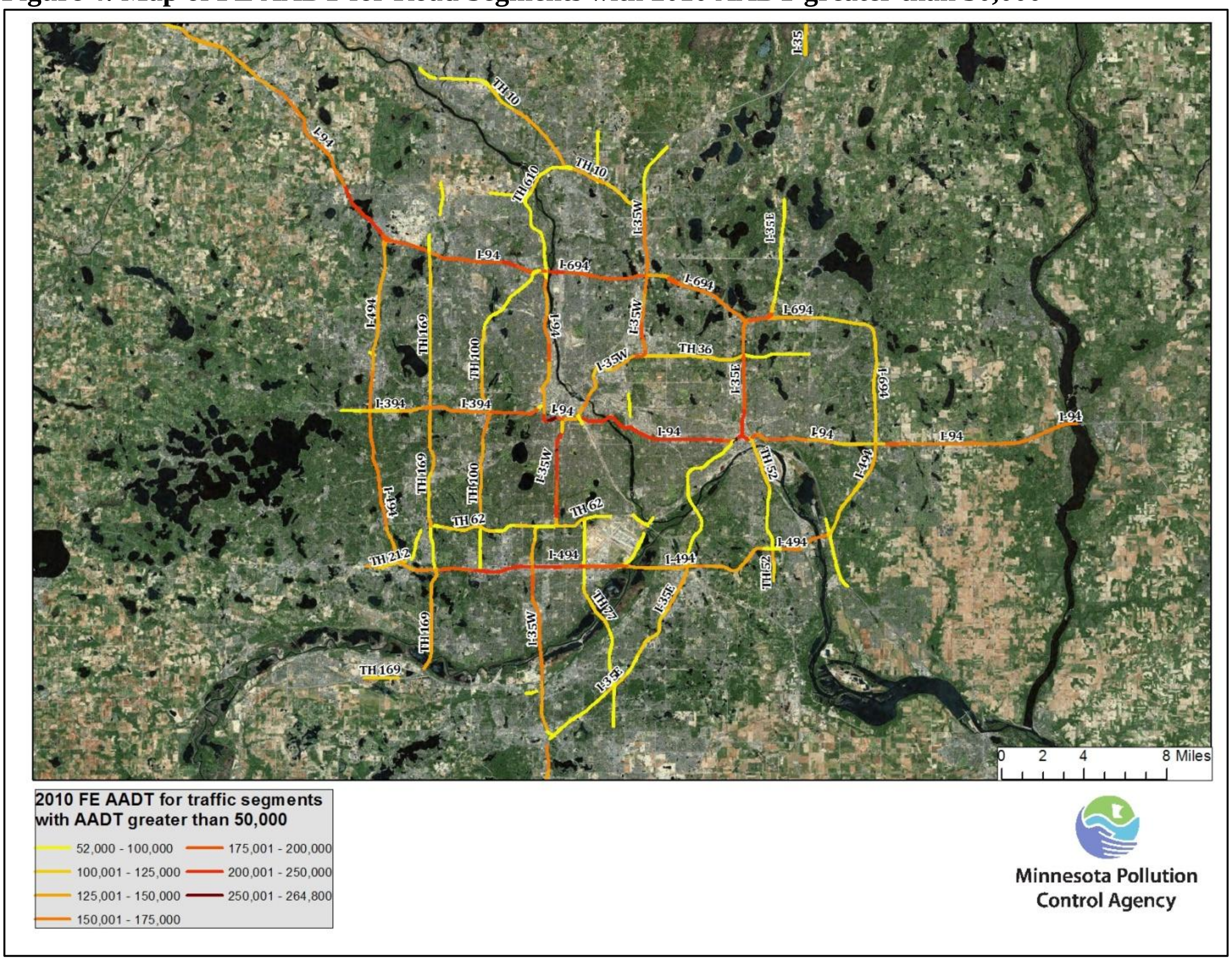
Table 4: Top 20 FE AADT Counts for Road Segments in the Twin Cities Metropolitan Area, 2010

SEQ NUM	ROUTE NAME	LOCATION	FE AADT	FE AADT Rank	AADT Rank	HCAADT RANK	PCT HD
11256 11720	I-94 & I-35W	W OF HIAWATHA & E OF PORTLAND AV IN MPLS	364,650	1	1	1	4%
10800	I-94	E OF HENNEPIN & LYNDALE AV IN MPLS	264,800	2	2	26	4%
11508	I-35E	BETWEEN E&W JCT OF I-94 ST PAUL	257,000	3	3	30	4%
11267	I-35W	S OF 31st ST E IN MPLS	256,000	4	4	11	5%
11179	I-494	W OF CSAH32 (PENN AV) IN BLOOMINGTON	247,800	5	5	6	6%
11207	I-494	E OF TH100 IN BLOOMINGTON	245,900	6	8	8	6%
9846	I-494	321 ATR W OF I-35W	244,900	7	9	8	6%
11730	I-35W	N OF CSAH3 IN MPLS	233,600	8	11	20	5%
9851 9838	I-35W	NB AND SB LANES OF I-35W S OF I-94	233,350	9	10	29	5%
10809	I-35W	N OF CSAH46 (46th ST E) IN MPLS	230,700	10	13	25	5%
11256	I-94	OVER TH55 BRIDGE IN MPLS	229,800	11	5	55	4%
11338	I-94	E OF CSAH53 (DALE ST) IN ST PAUL	229,800	11	5	55	4%
11692	I-694	W OF CSAH1 (EAST RIVER RD)	226,000	13	27	11	6%
10519	I-694	W OF TH47 IN FRIDLEY	220,200	14	35	16	6%
11257	I-94	W OF CSAH48 (25th AV/ RIVERSIDE AV)	219,100	15	11	68	4%
11336	I-94	E OF N JCT I-35E IN ST PAUL	215,000	16	19	65	5%
11347	I-94	&12 E OF TH280 IN ST PAUL	213,300	17	14	77	4%
9837	I-94	LOWRY HILL TUNNEL	213,300	17	14	77	4%
11348	I-94	&12 W OF TH51 (SNELLING AV) IN ST PAUL	213,300	17	14	77	4%
9834	I-94	301 ATR W OF VICTORIA ST IN ST PAUL	213,300	17	14	77	4%

MnDOT Traffic Volume Data, 2010

The traffic segment with the highest ranked FE AADT count in 2010 is located along I-94 and I-35W in downtown Minneapolis, and is also the highest ranked AADT and HCAADT segment. When adjusting for the increased emissions associated with heavy duty vehicle traffic, this segment has a fleet equivalent AADT of approximately 364,650 vehicles per day. Figure 4 provides a map of the 2010 FE AADT counts for traffic segment with a 2010 AADT greater than 50,000. Unlike the maps for the AADT and HCAADT counts, which respectively indicated a concentration of heavy traffic in the urban core or outer ring, the FE AADT data suggests that traffic related air quality impacts are fairly well distributed across the Twin Cities metropolitan area.

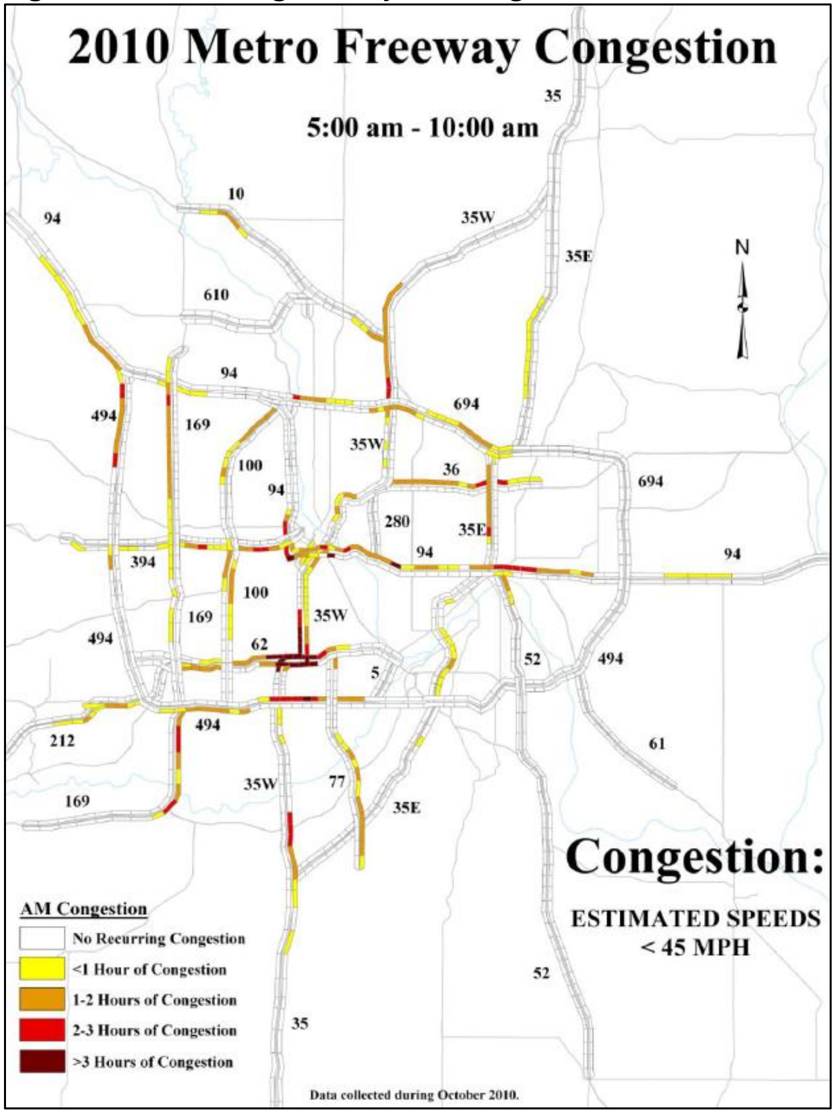
Figure 4: Map of FE AADT for Road Segments with 2010 AADT greater than 50,000

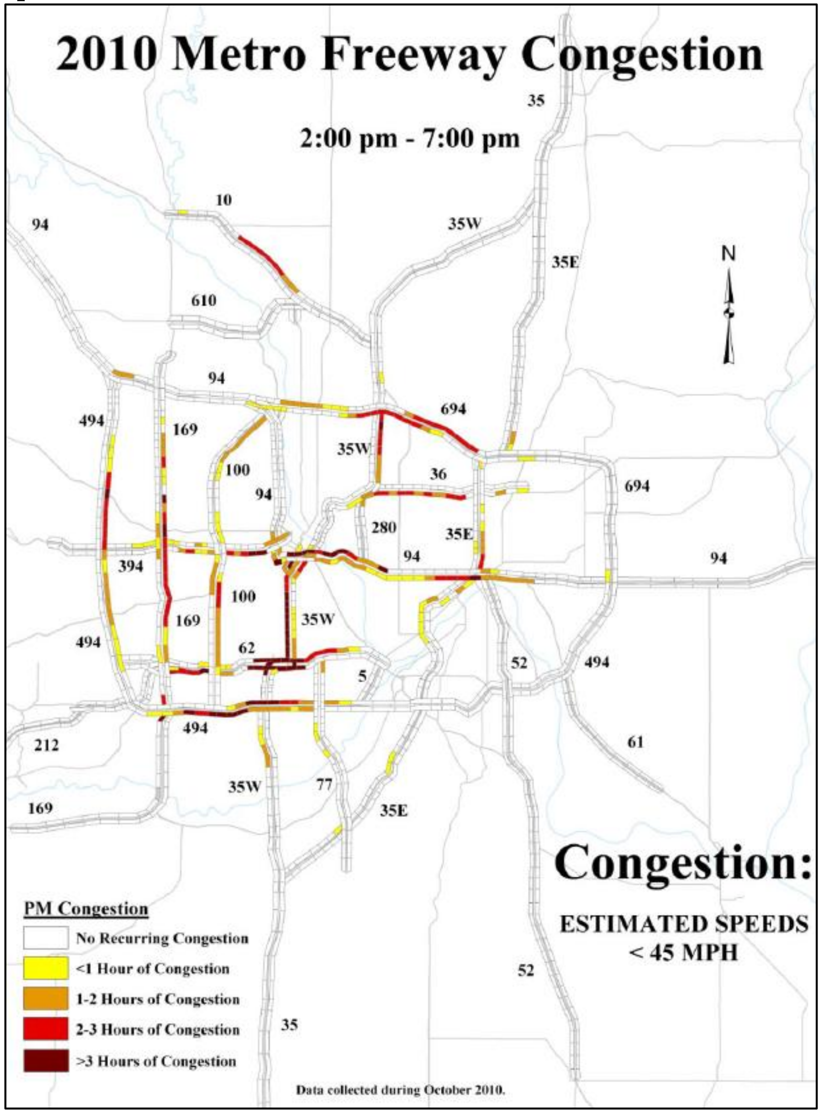


Step 4: Congestion

In addition to assessing the total traffic volume on road segments, the near-road TAD asks state and local air quality agencies to consider congestion patterns of candidate road segments. The frequent stopping and starting associated with highly congested roadways generally results in increased vehicle emissions. Figure 5 describes the morning and evening rush hour congestion patterns for traffic segments in the Twin Cities metropolitan area. A road segment is considered congested if estimated travel speeds fall below 45 miles per hour (MPH).The degree of congestion is identified by the number of hours during the rush hour period where travel speeds remain under 45 MPH

Figure 5: Traffic Congestion by Road Segment in the Twin Cities Metropolitan Area





Metropolitan Freeway System 2010 Congestion Report, MnDOT

The most heavily congested road segments in the Twin Cities metropolitan area in 2010 were located just south of downtown Minneapolis along the Crosstown at I-35W and Highway 62. However, in November of 2010, MnDOT completed a three-year construction project to ease congestion along this corridor. Congestion data following the completion of this project is not yet available. In general, traffic congestion in the Twin Cities metropolitan area is at its worst during the evening commute. For example the highest ranked AADT, HCAADT, and FE AADT segment along I-94 and I-35W in downtown Minneapolis experiences on average 1-2 hours of congestion during the morning commute, but over 3-hours of congestion in the evening. Directionally, morning congestion along this segment is fairly uniform, but evening congestion is most prominent in the west bound lanes of I-94 and the south bound lanes of I-35W.

Summary of Road Segment Analysis

In selecting a candidate road segment for the near-road air monitoring network, the MPCA analyzed MnDOT's 2010 AADT, HCAADT, and congestion data for the Twin Cities metropolitan area. Following the evaluation steps outlined in EPA's near-road TAD, a single road segment clearly emerges as the top candidate for near road monitoring in the Minneapolis-St. Paul-Bloomington CBSA. The I-94 and I-35W corridor in downtown Minneapolis ranks highest in AADT, HCAADT, and FE AADT. Figure 6 includes a map of this traffic segment and the surrounding area. Please note that the mapping files separate traffic counts for the I-94 and the I-35W portions of the traffic segment. Because these segments lay within the same traffic corridor, their traffic counts have been added together to complete the quantitative portions of the segment analysis.

Figure 6: Map of 2010 FE AADT near the Candidate Near-Road Air Monitoring Traffic Segment

While not required at this time, the segment analysis is less conclusive regarding potential locations for a second near-road air monitoring site in the Minneapolis-St. Paul-Bloomington CBSA. Based on 2010 FE AADT counts, the second, third, and fourth ranked segments are either adjacent to the target segment (I-94 E of Hennepin & Lyndale Ave in Mpls; I-35W S of 31st St in Mpls) or are located on the same route and feature nearly identical traffic characteristics (I-35E between the E&W JCT of I-94 in St. Paul). The fifth ranked segment located along the I-494 bypass at Penn Ave features a higher percentage of heavy duty vehicles and is one of the most congested roadways in the Twin Cities metropolitan area, but is relatively insulated from residential population exposure. If it becomes necessary for the MPCA to operate a second near-road monitoring site in the Minneapolis-St. Paul-Bloomington CBSA, MPCA staff will conduct a more detailed analysis of these traffic segments.

Locating a Near-Road Monitoring Site within the Candidate Road Segment

The MPCA has identified the I-94 and I-35W corridor in downtown Minneapolis as the candidate road segment to meet the EPA's near-road air monitoring requirements in the Minneapolis-St. Paul-Bloomington CBSA. This traffic segment spans three-quarters of a mile, is approximately 100 meters wide, and is bounded by Portland Ave on the west and by the Hiawatha Ave, I-94, I-35W interchange on the east. Excluding entrance and exit lanes, the traffic corridor includes eleven traffic lanes, which are situated in a shallow street canyon. The grade of the street canyon increases from east to west, with the eastern boundary featuring grassy terrain and the western boundary featuring a concrete retaining wall. Figure 7 provides a Google Earth rendering of the candidate road segment.

Figure 7: Google Earth Rendering of the Candidate Near-Road Air Monitoring Traffic Segment

According to the near-road TAD, once a candidate road segment is identified, the selected segment should be further evaluated to determine adequacy for a near-road monitoring station. Specifically, candidate road segments should be inspected to account for roadway design, terrain, and meteorological factors. State and local air quality agencies should also assess safety and logistic considerations, and population exposure potential. Table 5 includes a summary of the characteristics to consider in selecting a near-road monitoring site as described in the near-road TAD.

Table 5: Summary of Physical Considerations for Near-Road Candidate Sites

Physical Site Component	Impact on Site Selection	Desirable Attributes	Less Desirable Attributes
Roadway design or configuration	Feasibility of monitor placements; affects pollutant transport and dispersion	At grade with surrounding terrain	Deep cut-sections/significantly below grade; significantly above grade (fill or bridge).
Roadside structures	Feasibility of monitor placement; affects pollutant transport and dispersion	No barriers present beside low (<2 m in height) safety features such as guardrails	Presence of sound walls, high vegetation, obstructive buildings
Terrain	Affects pollutant dispersion, local atmospheric stability	Flat or gentle terrain, within a valley or along road grade	Along mountain ridges or peaks, hillsides or other naturally windswept areas
Meteorology	Affects pollutant transport and dispersion	Relative downwind locations – winds from road to monitor	Strongly predominant upwind positions

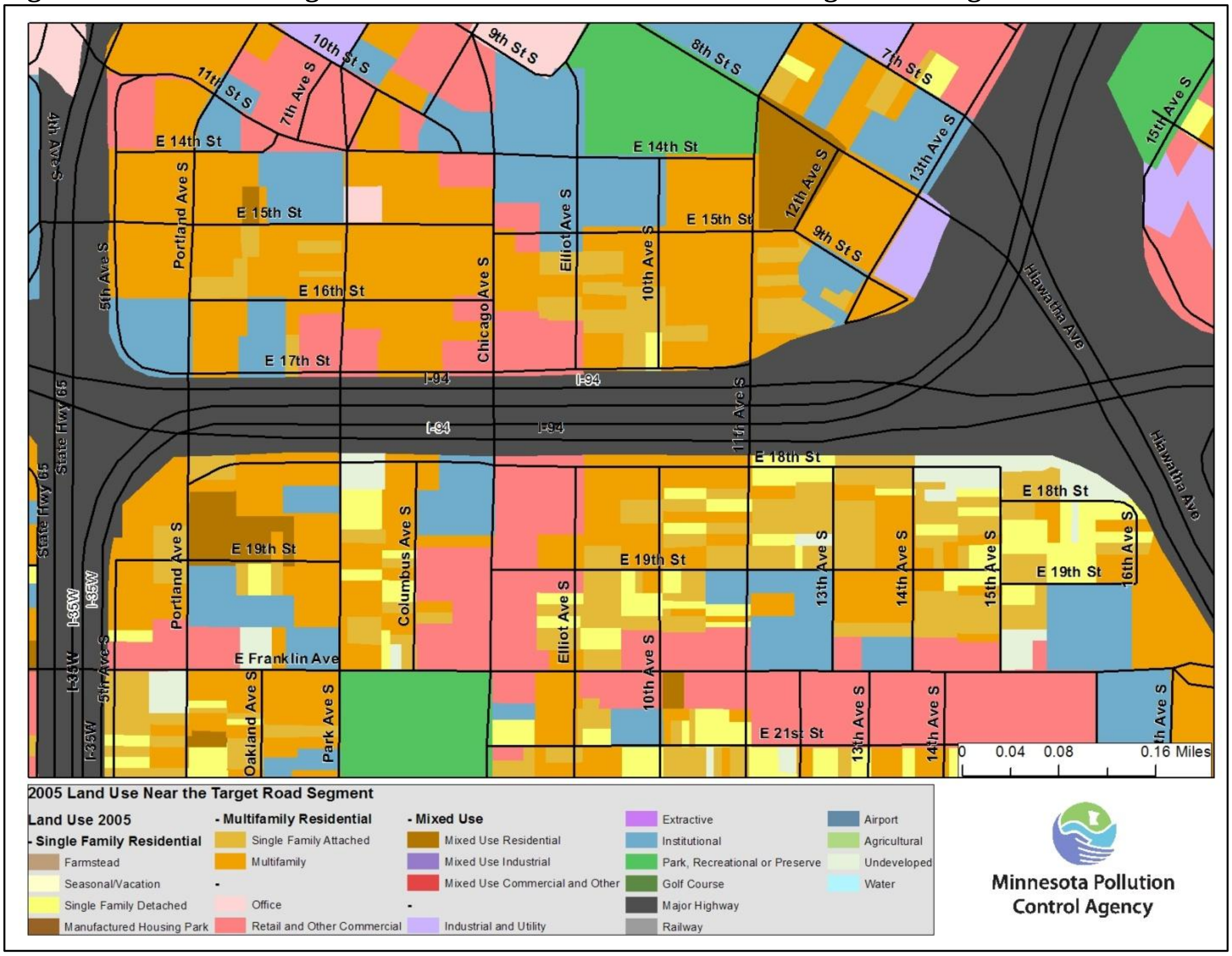
In addition to the criteria described above, 40 CFR Part 58, Appendix E includes specific siting criteria for near-road air monitors. Table 6 includes a summary of these criteria.

Table 6: Summary of Key Near-Road Siting Criteria

Criteria	Description
Horizontal spacing	Monitors should be placed as near as practicable to the outside nearest edge of the traffic lanes of the target road segment; but shall not be located at a distance greater than 50 meters, in the horizontal, from the outside nearest edge of the traffic lanes of the target road segment. **The recommended target distance for near-road NO_2 monitor probes from the target road is within 20 meters whenever possible.**
Vertical spacing	Microscale near-road NO_2 monitoring sites are required to have sampler inlets between 2 and 7 meters above ground level.
Spacing from supporting structures	The probe must be at least 1 meter vertically or horizontally away from any supporting structure, walls parapets, penthouses, etc, and away from dusty or dirty areas.
Spacing from obstructions	For near-road NO_2 monitoring stations, the monitor probe shall have an unobstructed air flow, where no obstacles exist at our above the height of the monitor probe, between the monitor probe and the outside nearest edge of the traffic lanes of the target road segment.

Based on 2005 land use data generated by the Metropolitan Council, land use in the area surrounding the candidate traffic segment is primarily multi-family residential. The area also includes institutional and retail/commercial properties. As a result, the MPCA believes that air monitoring in the target traffic segment meets the requirements to monitor in areas with the potential for high population exposure. Figure 8 provides a map of land use definitions in the area surrounding the candidate traffic segment as defined in 2005 by the Metropolitan Council.

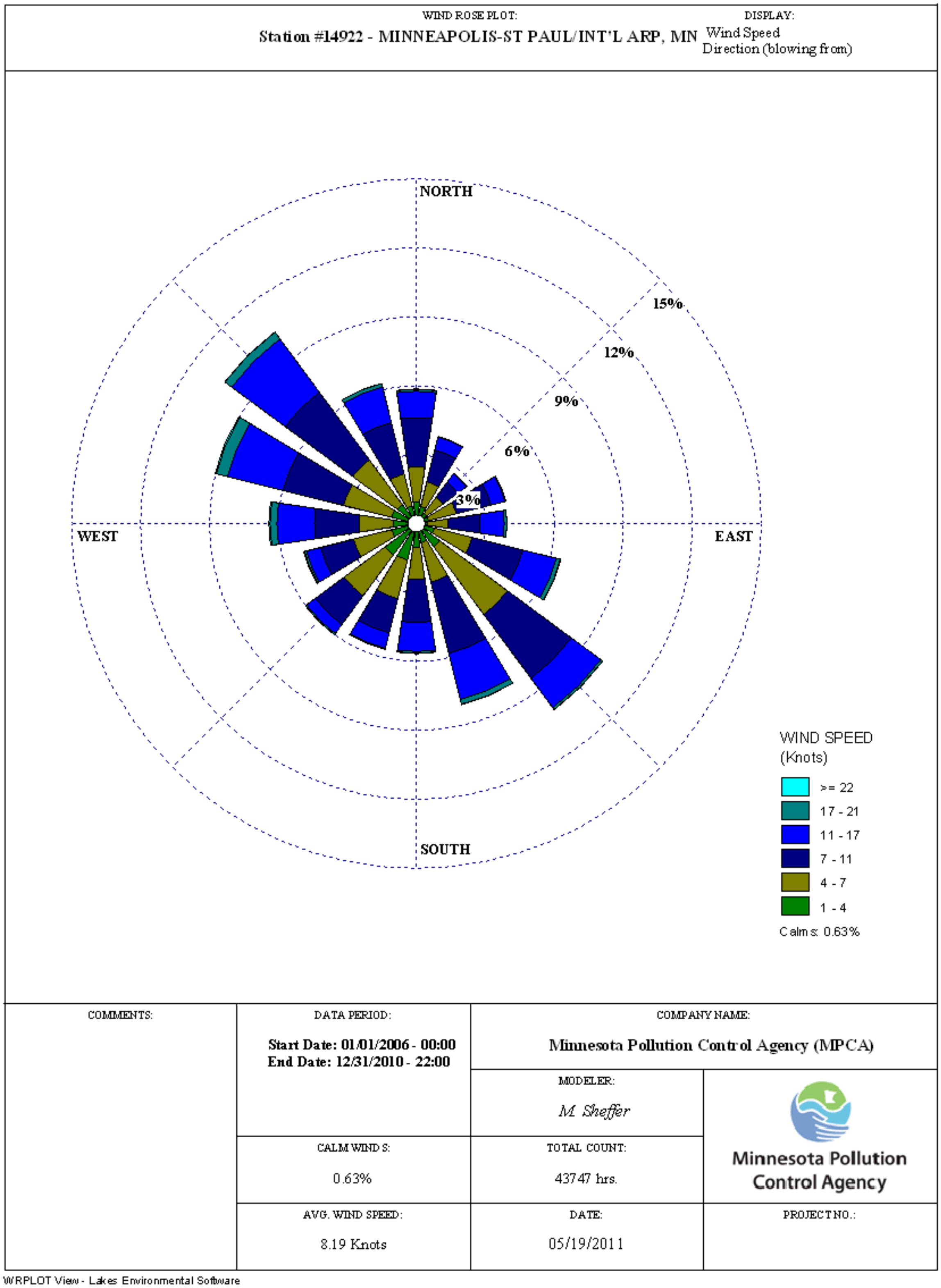
Figure 8: Land Use Along the Candidate Near-Road Air Monitoring Traffic Segment



To assess likely wind conditions along the candidate road segment, the MPCA utilized meteorological data from the Minneapolis-St. Paul International Airport (MSP), which was collected between January 1, 2006 and December 31, 2010. The MSP airport is located approximately 5-miles southeast of the candidate road segment. Consistent with historical data, wind directions at MSP airport during this period are most prominent from the northwest and southeast. Winds are least prominent from the northeast. Figure 9 provides a wind rose for data collected at the MSP airport from 2006-2010.

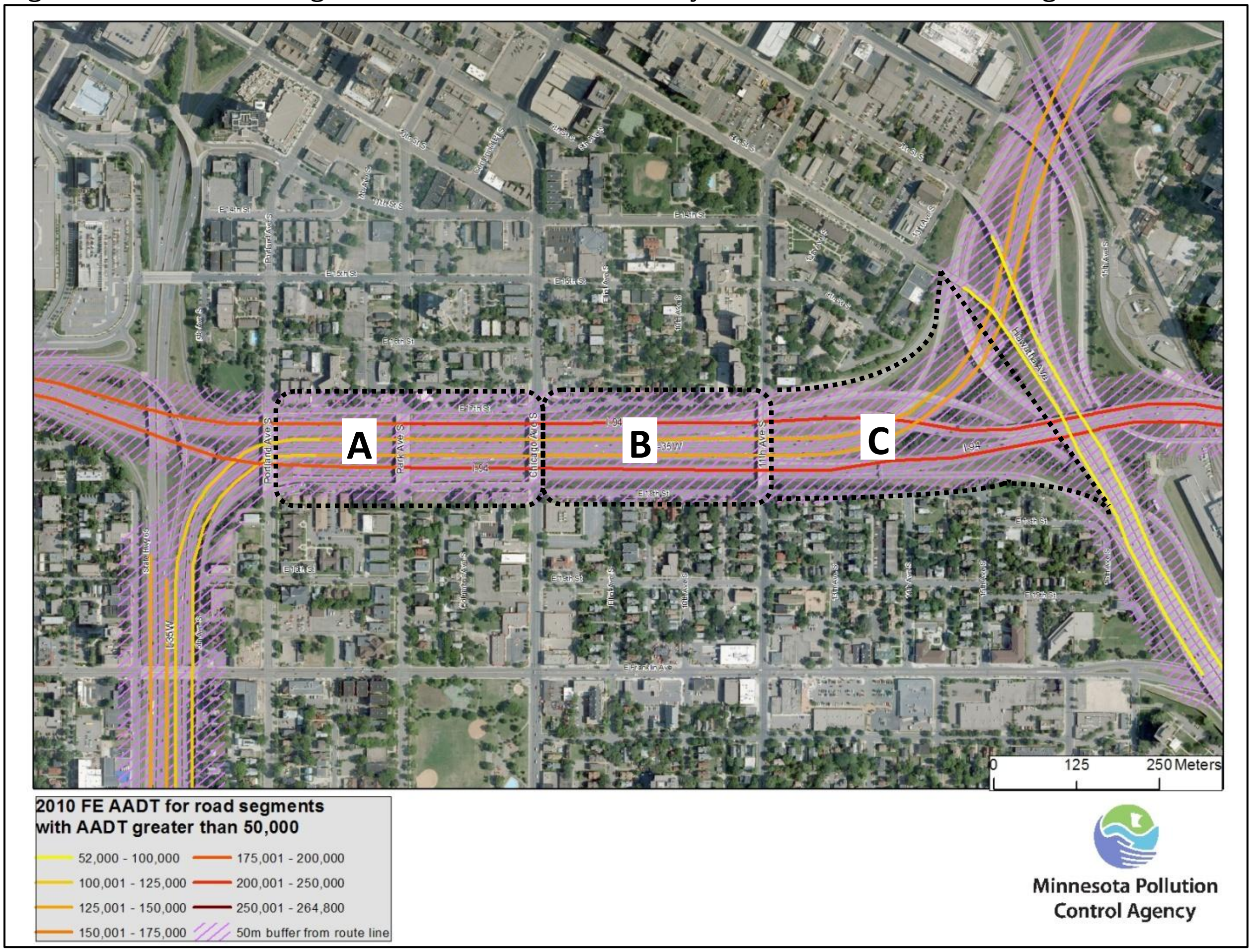
Because the candidate road segment runs from east to west and is situated in a shallow street canyon, the wind data from the MSP airport is informative but does not provide a clear picture of what areas of the target road segment are likely to have the highest pollutant concentrations. As a result, based on wind rose data, the MPCA cannot definitively identify the area of highest pollutant concentration, and therefore has not categorized the upwind-downwind nature of potential monitoring locations within the target road segment.

Figure 9: Wind Rose for the Minneapolis-St. Paul International Airport, 2006-2010



To more easily apply the siting criteria described in tables 5 and 6 the MPCA has divided the road segment into three smaller segments. The MPCA utilized terrain characteristics and bridge locations to determine the boundaries of each sub-traffic segment. Figure 10 highlights these boundaries and also identifies locations that will meet the 50 meter maximum distance requirement for near-road monitoring sites. Please note that the 50 meter boundary identified by the purple hashing on the map is approximate, as it was drawn based on the location of the traffic count line which does not uniformly represent the distance from the nearest traffic lane.

Figure 10: Sub-traffic Segments and 50-meter Boundary for the Candidate Road Segment



Sub-traffic Segment A

Sub-traffic segment A is located on the western boundary of the candidate road segment and is bounded by Portland Ave S on the west and Chicago Ave S on the east. The roadway-design of sub-traffic segment A can be characterized as a steep grade cut-section featuring poured retaining walls on the northern and southern boundaries. The at-grade surface streets adjacent to the freeway corridor are narrow one-way frontage roads with a minimal buffer between the drop off to the freeway and developed property. As described in figure 8 on page 14, land use in the surrounding area is primarily multi-family residential, but also features some institutional and commercial parcels. Figure 11 provides a zoomed aerial view of sub-traffic segment A, and figure 12 provides a 360-degree Google Street View of the sub-traffic segment.

Due to the physical characteristics of sub-traffic segment A, deploying a near-road air monitoring site is not feasible within 50 meters of this sub-traffic segment. The steep grade of the traffic cut-section prohibits monitor siting within the traffic corridor. Opportunities for siting a monitor at grade within this sub-traffic segment are also limited due to the density and height of existing buildings. A monitoring site located within this traffic segment would likely violate the near-road siting criteria described in table 6.

Figure 11: Zoomed Aerial View of Sub-traffic Segment A

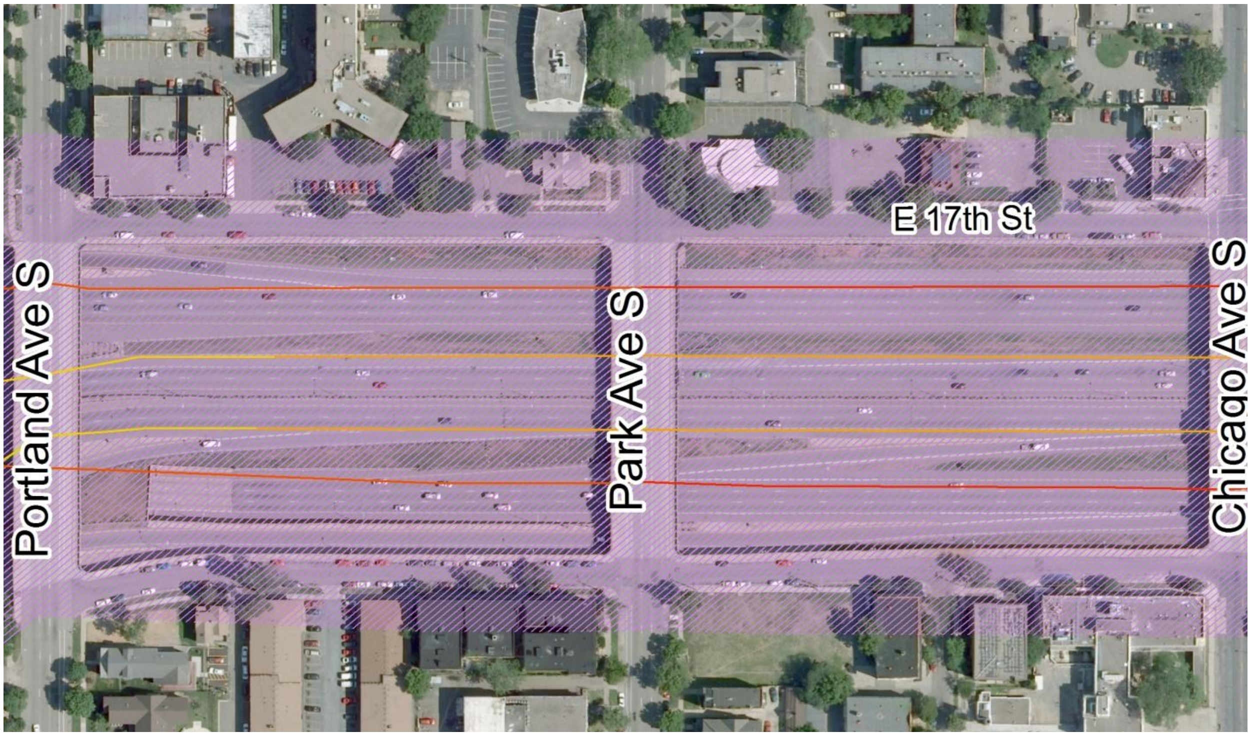


Figure 12: Sub-traffic Segment A, 360-degree Google Earth Street View

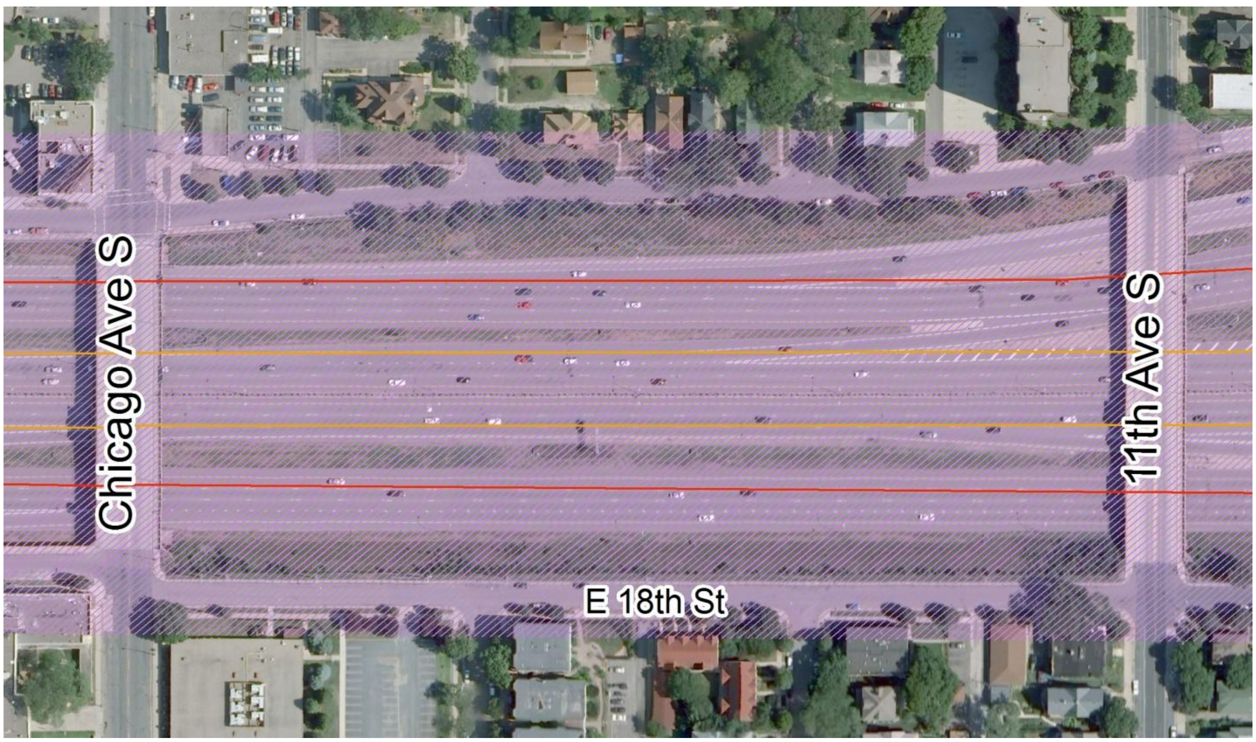
West

East

Sub-traffic Segment B

Sub-traffic segment B is located in the center of the candidate road segment and is bounded by Chicago Ave S on the west and 11th Ave S on the east. The roadway-design of sub-traffic segment B can be characterized as a steep grade cut-section bordered by grassy berms on the northern and southern boundaries. At grade, large bushes along the fenceline serve as a barrier between the surface street and the traffic corridor. Similar to sub-traffic segment A, the at-grade surface streets adjacent to the freeway corridor are narrow one-way frontage roads featuring little to no buffer-zone between the drop off to the freeway and developed property. As described in figure 8 on page 14, land use in the surrounding area is primarily multi-family residential, but also features some retail and commercial parcels. Figure 13 provides a zoomed aerial view of sub-traffic segment B, and figure 14 provides a 360-degree Google Street View of the sub-traffic segment.

Figure 13: Zoomed Aerial View of Sub-traffic Segment B



Due to the physical characteristics of sub-traffic segment B, deploying a near-road air monitoring site within the traffic corridor is not feasible. Opportunities for siting a monitor at grade within this sub-traffic segment are also limited due to the density and height of existing buildings. Within the 50-meter buffer zone of sub-traffic segment B, the MPCA has identified one building which may meet the near-road monitor siting requirements. The US Social Security Administration (SSA) operates a service center in a one-story building on the corner of Chicago Ave S and E 18th St. The northern side of the SSA building is located approximately 40 meters from the nearest traffic lane of the target road segment. The vertical height of the building meets siting criteria when compared to the surface street, but is more than seven meters above the traffic lanes of the target road segment. Logistically, the SSA building also presents monitoring challenges, including a lack of a climate-controlled penthouse and reliable roof-top access.

As a result of the above mentioned challenges, the MPCA does not believe near-road monitoring is feasible within sub-traffic segment B.

Figure 14: Sub-traffic Segment B, 360-degrees Google Earth Street View

Sub-traffic Segment C

Sub-traffic segment C is located on the eastern edge of the candidate road segment and is bounded by 11th Ave S on the west and the Hiawatha Ave, I-94, I-35W interchange on the east. The western edge of the sub-traffic segment features a steep grassy berm that becomes increasingly shallow when moving toward the eastern boundary. Within sub-traffic segment C, the I-35W and I-94 traffic lanes begin to diverge, increasing the horizontal distance of the traffic corridor and creating variable lane heights. The surface streets on the northern boundary of the target traffic segment remain elevated above the traffic corridor, while the southern boundary is at or near-grade with the I-94 eastbound and Hiawatha Ave southbound traffic lanes. Due to these physical characteristics, the MPCA has identified the southeastern portion of sub-traffic segment C as the most viable location for near-road air monitoring. Figure 15 provides a zoomed aerial view of sub-traffic segment C, and figure 16 provides a 360-degree Google Street View of the sub-traffic segment.

Figure 15: Zoomed Aerial View of Sub-traffic Segment C

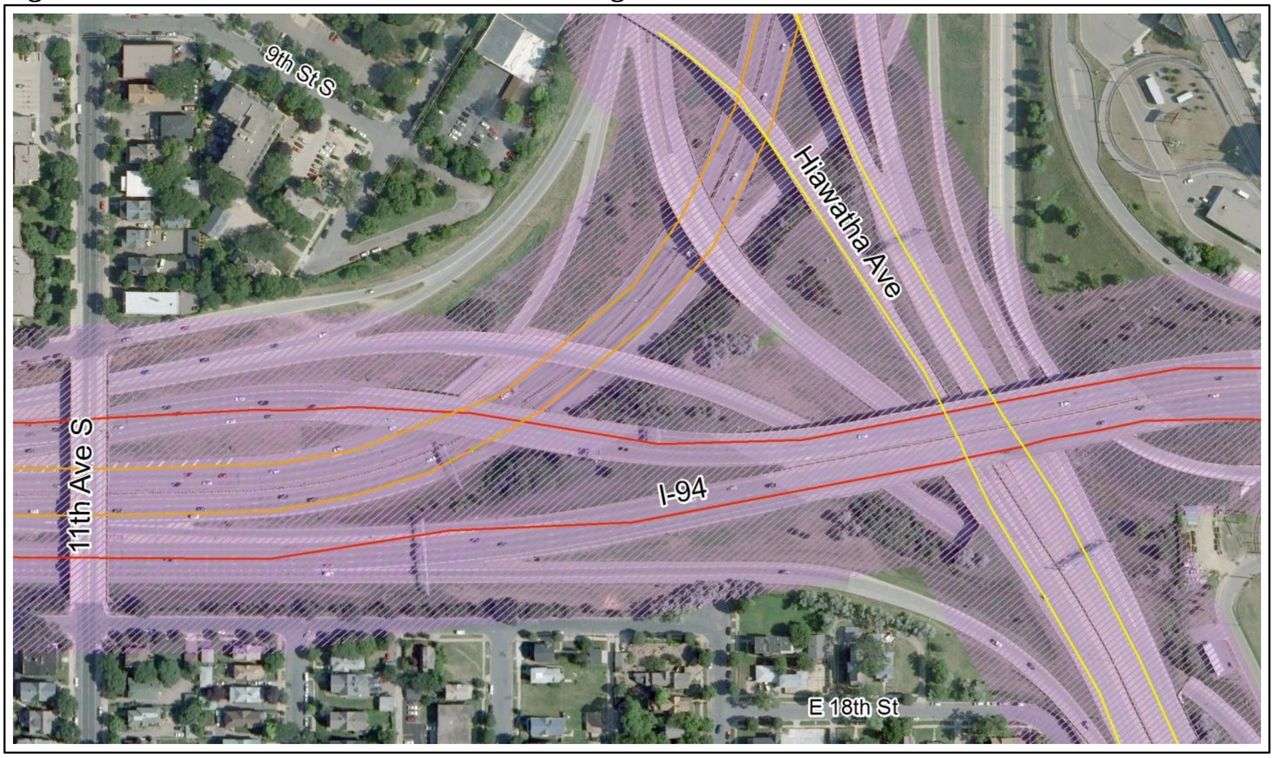


Figure 16: Sub-traffic Segment C, 360-degrees Google Earth Street View

Identifying a Candidate Near-Road Monitoring Site

Having narrowed the potential locations for a near-road air monitoring site down to sub-traffic segment C, the MPCA air monitoring staff and representatives from MnDOT visited the traffic segment to assess potential monitoring locations. In identifying a candidate monitoring site, the MPCA aimed to meet the siting requirements established in 40 CFR Part 58, Appendix E, while also considering the safety of the ambient monitoring staff and air monitoring equipment in the near-road environment and the long term viability of the monitoring site.

Based on these criteria the MPCA and MnDOT have identified a candidate near-road monitoring site located on the southeastern corner of the target road segment. Figure 17 provides and aerial view of sub-traffic segment C, where the yellow arrow identifies the location of the candidate near-road monitoring site. Figures 18 and 19 provides a Google Street view images of the proposed site from the adjacent surface street and the Hiawatha Ave exit lane.

Figure 17: Aerial View of Proposed Near-Road Monitoring Site

Figure 18: Google Street View of Proposed Near-Road Monitoring Site from E 18th St

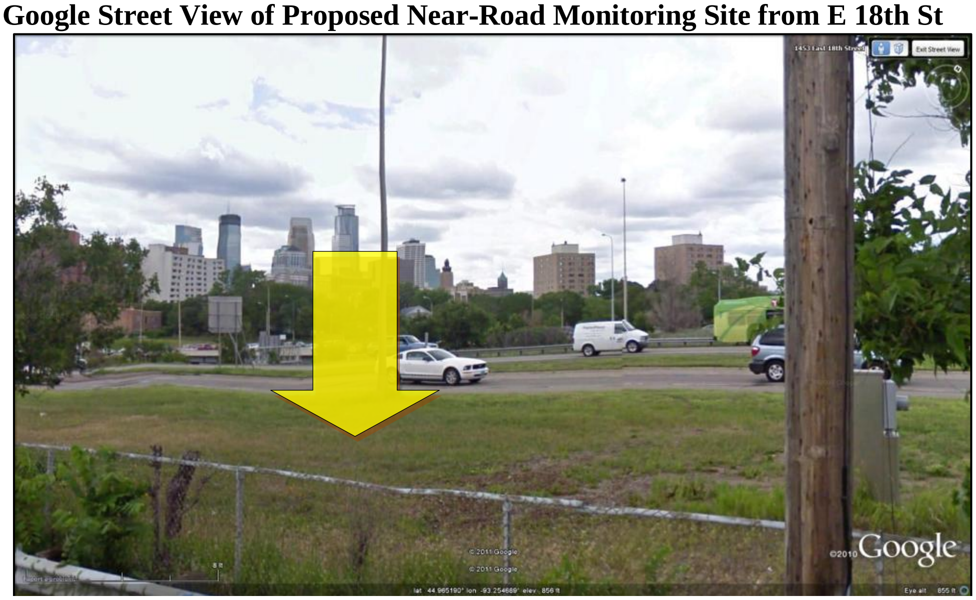


Figure 19: Google Street View of Proposed Near-Road Monitoring Site from Hiawatha Ave Exit Lane

The proposed monitoring site meets all aspects of the near-road monitoring siting criteria. The proposed site is within 20 meters of the target road segment, and is adjacent to the I-94, I-35W, and Hiawatha Ave interchange. Specifically, the proposed site is located along the southbound Hiawatha Ave exit lane, and is at grade with the east and westbound lanes of I-94 and southbound I-35W. The northbound lanes of I-35W are located in a cut-section below the proposed site. At present the site is relatively free of obstructions, but the site may require some tree removal along the fenceline to meet obstruction spacing requirements.

Table 7: Summary of Proposed Near-Road Monitoring Site

CBSA	Minneapolis-St. Paul-Bloomington, MN-WI
Target Segment	I-94 & I-35W Corridor, Downtown Minneapolis
County	Hennepin
City	Minneapolis
Proposed Site Location	Adjacent to E 18th St & the alley between 14th Ave S and 15th Ave S
Proposed Site Coordinates	44.965313,-93.255137
2010 AADT	267,000
2010 HCAADT	10,850
2010 FE AADT	364,650
Distance from Traffic Lane	< 20 meters
Terrain	Flat and at grade with adjacent lanes; I-35W northbound lanes are below grade of proposed site.
Road-side Structures and obstructions	Area near proposed site features a fence with a natural vegetative boundary. Trees in the surrounding area have been cut back to accommodate existing power lines. Some additional tree removal may be required to meet siting requirements
Meteorology	Microscale wind directions have not been characterized for this site. Wind data from the Minneapolis-St. Paul International Airport indicate that the most prominent wind directions are from the northwest and southeast. The proposed site is located in the southeast corner of the traffic segment.
Safety	The proposed site is located in the right of way along the exit lane for Hiawatha Ave S. The posted speed limit on the exit ramp is 55 MPH and is reduced to 45 MPH as traffic merges south onto Hiawatha Ave. Based on a MnDOT assessment, the proposed site will meet clear zone requirements. Site access will be available from the surface street and the site will be fully fenced.