



MEMORANDUM

TO: Charleen Zimmer

FROM: Gloria Chojnacki, CHMM *GC*

DATE: November 2, 2006

RE: Air Quality Dispersion Model - 7th/8th Street & Hennepin Avenue
SEH No. A-MPLS00418.00

Short Elliott Hendrickson Inc. (SEH[®]) has completed the air quality dispersion modeling for carbon monoxide (CO) emitted from mobile sources for the intersections of 7th Street and Hennepin Avenue and 8th Street and Hennepin Avenue in the City of Minneapolis, Minnesota. These two intersections are located in the downtown area of Minneapolis in Hennepin County. The project location can be seen on Figure 1, "Project Location Map." A current aerial view of the two intersections is found on Figure 2, "Project Location Aerial."

Project Background

Hennepin Avenue currently is operated as a one-way street for general traffic with three lanes of northbound traffic, a southbound transit-only lane, and a dedicated two-way bikeway located between the northbound and southbound motor vehicle lanes. This one-way configuration was adopted to address the CO "hot spot" intersection of 7th Street and Hennepin Avenue as part of the Minnesota State Implementation Plan (SIP). Prior to this change, traffic on Hennepin Avenue operated in both the north- and southbound directions.

The Clean Air Act (CAA) of 1970 and major amendments to the act in 1990 established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants, including CO. The primary NAAQS for CO, which is protective of human health, is set at 9 parts per million by volume (ppm_v) for an 8-hour averaging period and 35 ppm_v for a 1-hour averaging period. No secondary standards, which are protective of public welfare and the environment, are established for CO.

Each state has developed a SIP detailing the control measures and strategies implemented to attain and/or maintain compliance with the NAAQS. The SIP has been formally approved by the U.S. Environmental Protection Agency (EPA) and the state of Minnesota and its elements are enforceable under both state and federal law. Conversion of 1st Avenue North and Hennepin Avenue to one-way street pairs operation is considered a U.S. EPA approved traffic control measure under the 1979 SIP revision (Federal Register, Vol. 44, No. 229, p. 67679).

At this time, the City of Minneapolis is considering returning Hennepin Avenue to a two-way operation for all traffic. It is proposed that two-way operation would resume in the year 2008. In order to demonstrate continued compliance with the NAAQS for CO after the return to two-way operation, the City of Minneapolis has requested that dispersion modeling of the most likely impacted intersections be conducted. The worst-case intersections based on prior "hot spot" history and predicted future traffic volumes are 7th Street and Hennepin Avenue and 8th Street and Hennepin Avenue, respectively. The proposed intersection geometry for 7th Street and Hennepin Avenue is found on Figure 3. The proposed intersection geometry for 8th Street and Hennepin Avenue is found on Figure 4. These figures include proposed lane widths and stop line locations.

Air Quality Impact Evaluation

The dispersion model used in this evaluation is CAL3QHC, a DOS-based Gaussian model. CALRoads View, version 3.5, a preprocessing platform that allows running CAL3QHC from within Windows, is used for this project. CAL3QHC has been approved and accepted by the U.S. EPA for predicting CO concentrations near roadways and intersections. CAL3QHC is also an approved mobile source dispersion model by the Minnesota Pollution Control Agency (MPCA).

CAL3QHC Input Assumptions

Input assumptions to demonstrate compliance with both the 1-hour and 8-hour NAAQS for CO are as follows:

• Traffic Forecasting

Peak hour traffic projections and turning movements for this modeling effort were estimated for the year 2030 based on the 2030 regional transportation planning model and manual distribution of trips based on the proposed lane arrangements of the downtown street network. Turning movement counts for 2009 were created by applying a factor to the 2030 turning movement counts. The factor assumed a uniform growth rate based on the growth rates identified in the regional model from 2009 to 2030.

Year 2009 is modeled as one year after conversion to two-way operation and year 2030 is the predicted worst-case year in terms of future traffic volume. Peak hour traffic projections for 2009 and 2030 are found in Attachment A.

• Emission Factors

Emission factors for the current Minnesota vehicle fleet distribution data were provided by the Minnesota Department of Transportation (Mn/DOT). Emission factors were calculated for various speeds and years using MOBILE6.2. Default MOBILE6.2 input values were used with the following exceptions:

- Absolute Humidity: 75.0 grains/lb
- Altitude: low
- Evaluation month: January
- Evaluation Years: 2009 and 2030
- Speed Class: Uniform arterial speed of 30 mph
- Min/Max Temperature: 16.0 degrees Fahrenheit, 38.0 degrees Fahrenheit
- Fuel Program: Conventional Gasoline East
- Fuel Reid Vapor Pressure (RVP): 9.0 lb/square inch
- Oxygenated Fuels: alcohol blends with 99.9 percent market share and 2.7 percent oxygen content
- Vehicle Age: current default values for 16 vehicle classes based on August 9, 2004 MPCA provided information.

The assumptions used to derive the emission factors are standard for air quality modeling in Minnesota and were approved by the MPCA mobile source emissions contact. The emission factor table provided by Mn/DOT is found in Attachment B.

• Background CO Concentration

Background concentrations were provided by the MPCA for a monitoring station located in Fridley, Minnesota. The monitoring station is located at 6000 Moore Lake Road. CO is measured with an infrared

analyzer at this location. The 10 highest 1-hour averaged CO concentrations were provided for the 12-month 2005 period and the first six months of 2006. The two highest 8-hour averaged CO concentrations were provided for the 12-month 2005 period and the first six months of 2006. Because the highest background CO concentrations occur during July, the second highest CO concentrations for both the 1-hour and 8-hour averaging periods for 2005 were used as the background concentration for this modeling project. Monitoring data provided by the MPCA is found in Attachment C.

• **Meteorological Assumptions**

The following meteorological assumptions were made for this project:

Surface Roughness Length – Central Business District – 400 cm

Wind Speed – 1 meter/sec

Stability Class – D(4) – neutral

Mixing Height – 1000 meters

Multiple Wind Directions - 10-degree increments over a 360° field

• **Receptor Siting**

In general, building occupancy in the area can be described as ground floor commercial/retail with upper floor office and limited residential. Surface parking lots are located on the west side of Hennepin Avenue approximately mid-block between 7th Street and 8th Street and also between 8th Street and 9th Street. Surface parking lots are also located on the northeast and southeast corner of N. 8th Street and 1st Avenue N. Sidewalks border each street in this modeling project. Because the general public has access to the sidewalk as a whole on a continuous basis, receptors were placed on the sidewalk in the vicinity of highest traffic congestion and likely highest CO concentration.

All receptors were placed just beyond a three-meter distance from the edge of the closest traveled lane in order to account for vehicle turbulence. The model cannot make valid concentration estimates within this zone of vehicle turbulence. A receptor was placed on each of the four corners at each intersection. In addition, receptors were placed at 25 meters from the corner and at midpoint on the block on both sides of each street. The height of each receptor was placed at 1.8 meters. Receptor locations are shown in the intersection detail in Attachment D.

• **Posted Speed Limit & Signal Timing;**

Posted free flow traffic speeds in both directions on all approaches at both intersections is 30 mph.

Both the 7th Street and Hennepin Avenue and 8th Street and Hennepin Avenue intersections are controlled by pre-timed signals. Left turns will be permitted on the green ball indications. There will be no left turn arrows. The signal timing cycle for each intersection is 90 seconds with a clearance lost time of 4 seconds and a saturation flow rate of 1800 vehicles per hour per lane.

At the intersection of 7th Street and Hennepin Avenue, the average red time length on Hennepin is 41 seconds and the average red time length on 7th Street is 53.2 seconds.

At the intersection of 8th Street and Hennepin Avenue, the average red time length on Hennepin is 32.4 seconds and the average red time length on 8th Street is 62.1 seconds.

CAL3QHC Results Summary

Results of the mobile source dispersion model indicate that maximum predicted CO concentrations as the result of mobile source emissions near the two intersections are well below the NAAQS primary standards as shown below on Table 1:

Table 1
Predicted CO Concentrations
7th/8th Street & Hennepin Avenue

Intersection	7th & Hennepin				8th & Hennepin			
	2009		2030		2009		2030	
Averaging Period	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour
Highest CO Concentration (ppm _v)	5.5	4.5	5.0	4.0	5.0	4.0	4.7	3.7
Receptor location	7th St - E of intersection - both sides				Hennepin between 8th & 9th, NB side			
NAAQS - CO (ppm _v)	35	9	35	9	35	9	35	9
% of NAAQS	15.7%	50.0%	14.3%	44.4%	14.3%	44.4%	13.4%	41.1%

A copy of the CAL3QHC input and output files for the two intersections is included in Attachment E (7th and Hennepin Avenue) and Attachment F (8th and Hennepin Avenue). Graphical depictions of the CO concentration contours, as modeled by CAL3QHC, are also included in these attachments.

• **7th Street & Hennepin Avenue**

The 1-hour average predicted maximum concentration at the intersection of 7th Street & Hennepin Avenue is 5.5 ppm_v and the 8-hour average predicted maximum concentration is 4.5 ppm_v for the year 2009, one year after the proposed change to two-way operation. These concentrations are 15.7 percent (%) and 50%, respectively, of the NAAQS.

For the year 2030, the 1-hour average predicted maximum concentration is 5.0 ppm_v and the 8-hour average predicted maximum concentration is 4.0 ppm_v. These concentrations are 14.3% and 44.4%, respectively, of the NAAQS.

Maximum concentrations for 2009 for both averaging times are located on 7th Street, approximately 25 meters east of the intersection on both sides of the street. Maximum concentrations for 2030 for both averaging times are located on both sides and across the street mid-way between Hennepin Avenue and the mid-block traffic signal east of Hennepin Avenue.

• **8th Street & Hennepin Avenue**

The 1-hour average predicted maximum concentration at the intersection of 8th Street & Hennepin Avenue is 5.0 ppm_v and the 8-hour average predicted maximum concentration is 4.0 ppm_v for the year 2009, one year after the proposed change to two-way operation. These concentrations are 14.3% and 44.4%, respectively, of the NAAQS.

For the year 2030, the 1-hour average predicted maximum concentration is 4.7 ppm_v and the 8-hour average predicted maximum concentration is 3.7 ppm_v. These concentrations are 13.4% and 41.1%, respectively, of the NAAQS.

Maximum concentrations for both 2009 and 2030 for both averaging times are located on Hennepin Avenue mid-block between 8th Street and 9th Street on the east side of Hennepin Avenue.

Discussion

Since the current operation of 1st Avenue North and Hennepin Avenue as a one-way street pair is considered a U.S. EPA approved traffic control measure (TCM) of the Minnesota SIP, removing the TCM by returning Hennepin Avenue to a two-way operation would require a revision of the SIP. The MPCA SIP revision process is typically a large undertaking that involves the following:

- Formal letter of submittal to the U.S. EPA from the MPCA Commissioner. The initial request for the change to the MPCA is made by the City of Minneapolis with the Metropolitan Council notified of the request.
- Documentation that contains the enforceable emission limits and compliance requirements are gathered by the MPCA.
- Letters from the Attorney General's Office stating the legal authority for SIP implementation are obtained by the MPCA.
- Copies of the newspaper publications of a 30-day public notice of the proposed SIP revision are obtained by MPCA.
- A public hearing is conducted to gather comments after the 30-day public notice period. Typically the public hearing is a MPCA undertaking. However, if another state agency is having a public hearing on the changes, it is possible that the meeting can be counted as the SIP public hearing (note discussion below).
- MPCA must respond to any comments received from the public.
- Along with the request for SIP revision, the City of Minneapolis should submit an explanation of the proposed changes. These changes should include a detailed traffic and air quality modeling report demonstrating that conversion from a one-way pair system to two-way operation would not adversely affect CO levels or cause a violation of the NAAQS. The request should also include a history of air quality problems in the Twin Cities, emphasizing the Minneapolis area and why it was necessary to include the current one-way operation as a TCM in the Minnesota SIP. (The specific TCM that applies in this case is a CO attainment demonstration strategy that operation of 1st Avenue North and Hennepin Avenue as a one-way street pair is estimated to reduce CO by 160 kg/day.) A discussion comparing the 1979 fleet and emission rates to the current fleet and emission rates should be presented demonstrating marked improvements as the result of automobile technology improvements.
- If MPCA concurs with the report submitted by the City of Minneapolis and does not require further documentation of the change, MPCA will assemble all items above, submit to U.S. EPA, and request review and approval.

Based on discussion with the MPCA and a representative of the U.S. EPA, Michael Leslie, a portion of the above process may be avoided in this case. Vehicle air emission rates used to determine strategies for the demonstration of NAAQS attainment in 1979 were much higher than the current fleet mix emission rates and air quality in general has greatly improved since 1979. A SIP revision for removal of the TCM may require a much simpler administrative change process which will still require detailed modeling, but may not require a public hearing. The U.S. EPA representative indicated that review of the revision package is estimated to take three months before approval or comments are issued. Once the revision is approved, the project design may be constructed.

Research is currently being conducted by the U.S. EPA as to the SIP revision processes that have been allowed for similar projects. SEH will keep the City of Minneapolis informed of the required revision details as SIP revision information becomes available.

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Attachments

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