# APPENDIX E

## Air Quality Technical Report

# Air Quality Technical Report

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## Minneapolis-St. Paul International Airport
## 2020 Improvements
## Environmental Assessment/
## Environmental Assessment Worksheet

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# APPENDIX E
# Air Quality Technical Report

## INTRODUCTION

This Appendix contains detailed descriptions of the methodologies, data, assumptions, and other supporting information used and/or developed to conduct the air quality assessment of the MSP 2020 Improvements. The air quality assessment comprised six main elements:

- Emissions inventories of the United States Environmental Protection Agency (USEPA) criteria pollutants and their precursors;
- Dispersion analyses of carbon monoxide (CO) emissions for nearby macroscale receptors;
- Roadway intersection analysis of CO concentrations near roadway intersections;
- Construction activity emissions inventories; and
- Emissions inventories of greenhouse gases (GHG).

The emission inventories and dispersion modeling were conducted for the following scenarios and years:

- 2010 Baseline Condition;
- 2020 and 2025 No-Action Alternative;
- 2020 and 2025 Airlines Remain Alternative; and
- 2020 and 2025 Airlines Relocate Alternative.

The sources assessed in the emissions inventory and dispersion modeling included:

- Aircraft operations within ground taxi/delay, approach, climbout, takeoff and engine startup periods;
- Auxiliary power units (APU);
- Ground service equipment (GSE);
- Motor vehicles within on-airport roadways, in parking facilities and at terminal curbsides;

- Motor vehicle within off-airport roadways (e.g., I-494);
- Fuel storage and handling operations;
- Stationary combustion sources including boilers, generators, snowmelters and deicing activities; and
- Aircraft within the cruise mode to its destination, electrical consumption and refrigerant use (GHG emissions inventory only).

The emissions inventory of the USEPA criteria pollutants included CO, nitrogen oxides ($NO_X$), volatile organic compounds (VOC), sulfur oxides ($SO_X$), particulate matter measuring 10 micrometers or less in diameter ($PM_{10}$) and particulate matter measuring 2.5 micrometers or less in diameter ($PM_{2.5}$), and lead (Pb). The macroscale and roadway intersection dispersion analyses were conducted for CO.

Prior to completing the assessment, an Air Quality Assessment Protocol that describes the various methodologies, databases, and modeling assumptions to be used in the analysis was submitted to the U.S. USEPA and Minnesota Pollution Control Agency (MPCA) in June 2011. The Air Quality Assessment Protocol is included as **Attachment 1**.

The aircraft, APU/GSE, motor vehicle, and stationary source data and methodologies that were used in the air quality analysis are presented in Section 1. Section 2 includes the data used in the estimation of construction emissions. The CO dispersion modeling methodologies and detailed results are given in Section 3. Section 4 includes the GHG inventory methodology. Section 5 provides detailed emissions inventory results.

# 1 Operational Data

## 1.1 Introduction

In general terms, an emissions inventory is a quantification of the amount, or weight, of pollutants emitted from a source (or combination of sources) over a period of time. The outcome is a product of source activity levels (i.e., aircraft operations, vehicle volumes) combined with appropriate emission factors (i.e., grams of pollutant/operation). The results are segregated by pollutant type (i.e., CO, $NO_x$, VOC, and $PM_{10/2.5}$), emission source (i.e., aircraft, GSE, motor vehicles, etc.) and project milestone year(s) (2020 and 2025).

The sources of operational emissions at MSP that were analyzed include aircraft (both main engines and APUs); GSE; motor vehicles traveling to, from and moving about the airport site; motor vehicles within terminal curbsides and parking ramps/lots, stationary sources (i.e., boilers, generators, snowmelters, etc.), and fuel facilities.

Site-specific aircraft data were developed and used in the air quality analysis for the following scenarios: 2010 Baseline, the future No-Action and the Action Alternatives within the project opening year or 2020 as well as a future year or 2025.

Aircraft data were used in the emission inventory and ambient concentrations (dispersion modeling) analyses and included aircraft activity levels and fleet mix, operational temporal factors, average taxi-idle delay time, taxipath and aircraft speeds, aircraft engine emission factors, and runway utilization.

GSE and APU data were also used in the emission inventory and dispersion modeling analysis and included an inventory of the types of equipment, fuel type, and operating times.

Motor vehicle data were also used in the emission inventory and dispersion modeling analysis and included traffic volumes within on-airport roadways, within off-airport roadways (both associated with the Airport and background traffic), and activities within the terminal curbsides and parking ramps/lots. Other motor vehicle data included emission factors based on the USEPA MOBILE62 emissions models and operational temporal factors.

Stationary sources data included fuel usage and exhaust stack parameters for the terminal boilers and peaking generator. The fuel throughput for fuel storage tanks were also used in the air quality analysis.

## 1.2 Aircraft Activity Levels and Fleet Mix

Aircraft activity levels (aircraft arrival and departure operations) and aircraft assignments were based on analysis using SIMMOD; the Federal Aviation Administration (FAA) Airport and Airspace Simulation Model. Aircraft engine assignments were based on EDMS default values or airline specific information. The aircraft fleet/operational level data used in the air quality analysis are consistent with those data used to assess noise impacts for this project. **Table E.1.1** contains the annual operations by aircraft category used in the air quality assessment.

Table E.1.1

**Aircraft Fleet Mix**

| Aircraft Category | Aircraft Size | 2010 | 2020 | 2025 |
|---|---|---|---|---|
| Air Carrier | Narrow | 175,212 | 239,362 | 280,432 |
| Air Carrier | Wide | 4,738 | 8,120 | 10,598 |
| Air Carrier | Commuter | 82,712 | 111,874 | 112,802 |
| Air Taxi | Commuter | 127,544 | 77,496 | 73,536 |
| Cargo | | 16,732 | 16,882 | 16,832 |
| General Aviation | | 26,530 | 28,136 | 28,682 |
| Military | | 3,158 | 3,128 | 3,118 |
| **Total** | | **436,626** | **485,000** | **526,000** |

Note: Totals may differ from sum due to rounding.

Source: HNTB SIMMOD Analysis, 2011.

## 1.3 Aircraft Temporal Factors

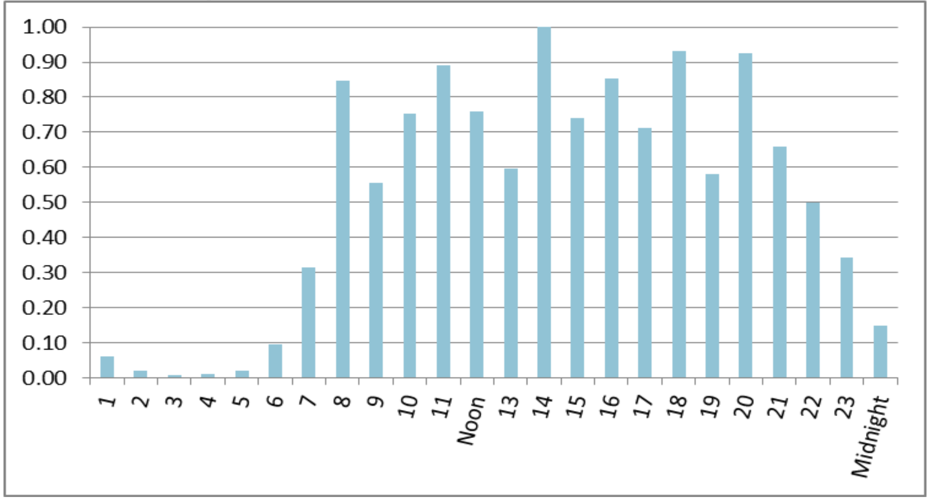
Temporal factors are used to describe the relationship of one period of time to another period of time (i.e., the relationship of the activity during 1-hour to the activity during a 24-hour period). In

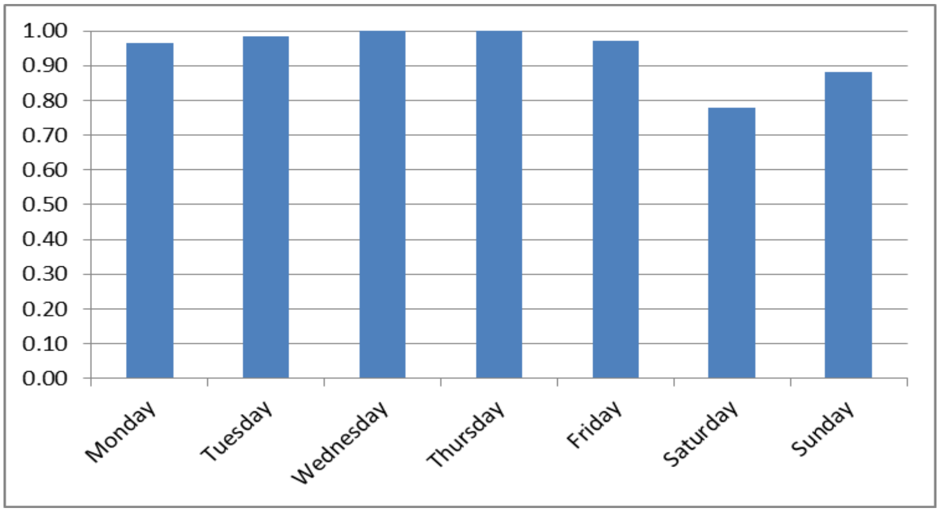
EDMS, temporal factors are applied to represent varying levels of activity as a fraction of a peak hour (a scale of 0 to 1). The use of temporal factors gives the model the ability to more accurately reflect real world conditions. The profiles are also used to evaluate the level of emissions that is expected to occur during a specific period within a year. In order to simulate aircraft activity at MSP throughout a calendar year, hour-of-day, day-of-week, and month-of-year factors will be developed.

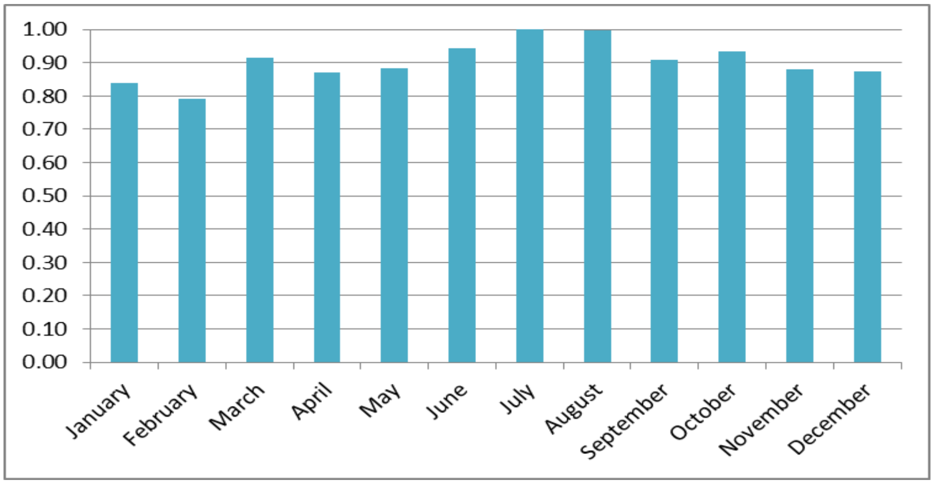
**Figure E.1-1** displays the aircraft operations temporal data (by hour, day and month) developed from the FAA Operation and Performance Database and used for this assessment. Based on FAA Operation and Performance Data from 2010, the peak of the aircraft and GSE activity occurs from 1 and 2 pm on a Thursday during July. The data presented is for all aircraft categories combined. However, more detailed operational profiles were used in the assessment as profiles were developed separately for air carrier, cargo, air taxi, general aviation, and military. Furthermore, quarter hour and hourly profiles were developed for both arrivals and departures.

Figure E.1-1

## Aircraft Operational Profiles – Hourly, Daily, and Monthly







## 1.4 Aircraft Emissions Factors

For commercial passenger airlines and cargo operators, the combinations of airline/aircraft type/engine types operating at MSP were derived using the *JP Airline-Fleets International* (JP Fleets) and other databases. These databases contain engine type information for each airline and cargo operator. If an aircraft category/airline/aircraft type was found to have more than one engine type, then a proportional distribution of engine types was used. For general aviation and military aircraft, the default engine type in EDMS was used. If EDMS did not have a default engine type, then the most common engine type for that particular aircraft type was used.

EDMS (Version 5.1.3) contains a database of aircraft/engine-specific criteria pollutant emission factors based on engine manufacturer, model, and operational mode. The level of aircraft-related emissions is reflective of the time that an aircraft operates in each of the operational modes with the entire cycle referred to as a landing/take-off (LTO) cycle. An LTO cycle consists of the following operational modes:

- “Taxi/idle” includes the time an aircraft taxis between the runway and a terminal, and all ground-based delay incurred through the aircraft route. The taxi/idle-delay mode includes the landing roll, which is the movement of an aircraft from touchdown through deceleration to taxi speed or full stop.

- “Approach” begins when an aircraft descends below the atmospheric mixing height and ends when an aircraft touches down on a runway.

- “Takeoff” begins when full power is applied to an aircraft and ends when an aircraft reaches approximately 500 to 1,000 feet. At this altitude, pilots typically power back for a gradual ascent.

- “Climb out” begins when an aircraft powers back from the takeoff mode and ascends above the atmospheric mixing height.

- Aircraft emissions (of VOC and GHG) also account for the period of engine startup which occurs within the gate terminal area prior to departure.

Although the Air Quality Assessment Protocol did not specify the inclusion of lead emissions in the air quality assessment, these calculations have been made. Piston aircraft fuel consumption for the MSP fleet was calculated using EDMS internal databases for all alternatives. This fuel consumption was factored with an aviation gasoline lead emissions factor of 2.12 grams per gallon to determine the total lead emissions. However, USEPA guidance states that approximately 5 percent of the lead is retained in the piston engine and engine oil, and accordingly the total lead emissions were adjusted to account for this retention.[1]

## 1.5 Aircraft Ground-based Taxi-delay and Queue Time and Airfield Capacity

Time-in-mode data are also used as input for the EDMS. With the exception of taxi-in, taxi-out, apron idling, and time spent in runway queues, the default operating times in EDMS were used. The results of a SIMMOD analysis provided MSP specific taxi-in, taxi-out, apron idling, and runway queue delay data for each condition and analysis year. The ground-based taxi time and queue delay used in the air quality assessment are shown in **Table E.1.2.** As shown, by 2025, the Action Alternatives would result in shorter travel times than in the No Action Alternative. These times do not take into account any single engine taxi procedure.

Table E.1.2

**Ground-based Taxi-delay and Queue Time (min)**

| Operation Type | 2010 | 2020 | | | 2025 | | |
|---|---|---|---|---|---|---|---|
| | Baseline | No Action | Airlines Remain | Airlines Relocate | No Action | Airlines Remain | Airlines Relocate |
| Arrival | 6.17 | 5.90 | 6.40 | 5.91 | 5.87 | 6.79 | 6.18 |
| Departure | 13.69 | 14.79 | 14.44 | 13.98 | 16.41 | 14.80 | 16.06 |
| Total | 19.86 | 20.68 | 20.84 | 19.89 | 22.28 | 21.58 | 22.24 |

Source: HNTB SIMMOD analysis, 2011 and Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

The taxi-delay and queue time is a function of the aircraft fleet mix, the number of gates available, the location of the gates within the airfield, the runway utilization, and subsequent taxipath to terminal/concourse assignment and the capacity of the airport. The differences between these parameters for each analysis year and alternative are reflective of the differences in the taxi-delay and queue time. **Appendix D** provides the Airfield Simulation Analysis Technical Report from which the taxi-delay and queue time are derived.

A methodology[2] [3] [4] was developed to account for single engine taxi procedures during the taxi in or out modes. The single engine taxi operations were assigned to Delta operations only. Of note, single engine taxi challenges include 1) excessive thrust and associated issues, 2) maneuverability problems, particularly related to tight taxiways turns and weather, 3) problems starting the second engine, and 4) distractions and workload issues. Thus, single engine taxiing does not occur during each aircraft operation, and when it does occur, it does not occur during the entire operation, and it occurs far less often during taxi out. To account for these variances, the following assumptions were developed based on available information such as aircraft pilot surveys:

- Practiced during 75 percent of the arrivals. When practiced, conducted 3.1 minutes after landing (to account for engines cool down period).
- Thus, the 2010 Baseline taxi in time of 6.17 minutes would involve 3.1 minutes of required full engine usage, of the remaining 3.07 minutes; a single engine taxi procedure would be employed 75 percent of the aircraft operations. The resultant effective taxi in time would be 5.02 minutes.

- Practiced during ten percent of the departures. When practiced, conducted 4.6 minutes before takeoff (to account for engines warm up period).
- Thus, the 2010 Baseline taxi out time of 13.69 minutes would involve 4.6 minutes of required full engine usage, of the remaining 9.09 minutes; a single engine taxi procedure would be employed ten percent of the aircraft operations. The resultant taxi in time would be 13.23 minutes.
- Practiced with aircraft with two engines, but not aircraft with more than two engines.
- Applicable for Delta operations only.

The single engine ground-based taxi time and queue delay used in the air quality assessment are shown in **Table E.1.3**. There is effectively an eight percent decrease in total taxi time with the single engine procedure.

Table E.1.3

**Single Engine Ground-based Taxi-Delay and Queue Time (min)**

| Operation Type | 2010 | 2020 | | | 2025 | | |
|---|---|---|---|---|---|---|---|
| | Baseline | No Action | Airlines Remain | Airlines Relocate | No Action | Airlines Remain | Airlines Relocate |
| Arrival | 5.02 | 4.85 | 5.17 | 4.86 | 4.83 | 5.41 | 5.03 |
| Departure | 13.23 | 14.28 | 13.94 | 13.51 | 15.82 | 14.29 | 15.49 |
| Total | 18.25 | 19.13 | 19.11 | 18.36 | 20.65 | 19.69 | 20.51 |

Source: HNTB SIMMOD analysis, 2011 and Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Airfield capacity data (based on SIMMOD analysis) was used by EDMS to perform the dispersion modeling as part of its sequence modeling and simulation of queue activity. The capacity is defined by two points, the number of departures which can occur during the maximum number of arrivals and the number of arrivals which can occur during the maximum number of departures. **Table E.1.4** displays the airfield peak hour capacity used in the air quality assessment.

Table E.1.4

**Airfield Peak Hour Capacity**

| Operation Type | 2010<br>Baseline | 2020<br>No Action | 2020<br>Airlines Remain | 2020<br>Airlines Relocate | 2025<br>No Action | 2025<br>Airlines Remain | 2025<br>Airlines Relocate |
|---|---|---|---|---|---|---|---|
| Arrival Maximum | 67 | 77 | 74 | 74 | 79 | 78 | 77 |
| Departure | 13 | 17 | 18 | 15 | 26 | 23 | 27 |
| Departure Maximum | 74 | 81 | 80 | 80 | 81 | 79 | 80 |
| Arrival | 14 | 31 | 34 | 34 | 36 | 36 | 37 |

Source: HNTB SIMMOD analysis, 2011.

## 1.6 Assigned Taxipaths and Aircraft Speeds

Based on the SIMMOD data, aircraft ground-based speeds were designated as five knots within the terminal areas, 10 knots within taxiways with tight turns, 15 knots for most remaining taxiways, and 35 knots for high speeds runway exits. The EDMS default value is 15 knots.

Taxipaths (the arrival path from the end of the landing roll to the terminal and the departure path from the terminal to the runway end) were also designated based on SIMMOD analysis. The taxipaths are represented by a series of taxiway segments. The taxipath information, coupled with the runway utilization and the terminal/apron area assignments defines the movement of aircraft within the airfield.

**Figure E.1-2** displays the taxipath during north flow for aircraft going to/from Terminal 1-Lindbergh and the military apron. **Figure E.1-3** displays the taxipath during north flow for aircraft going to/from Terminal 2-Humphrey, general aviation, and the cargo areas. **Figure E.1-4** displays the taxipath during south flow for aircraft going to/from Terminal 1-Lindbergh and the military apron. **Figure E.1-5** displays the taxipath during south flow for aircraft going to/from Terminal 2-Humphrey, general aviation, and the cargo areas.

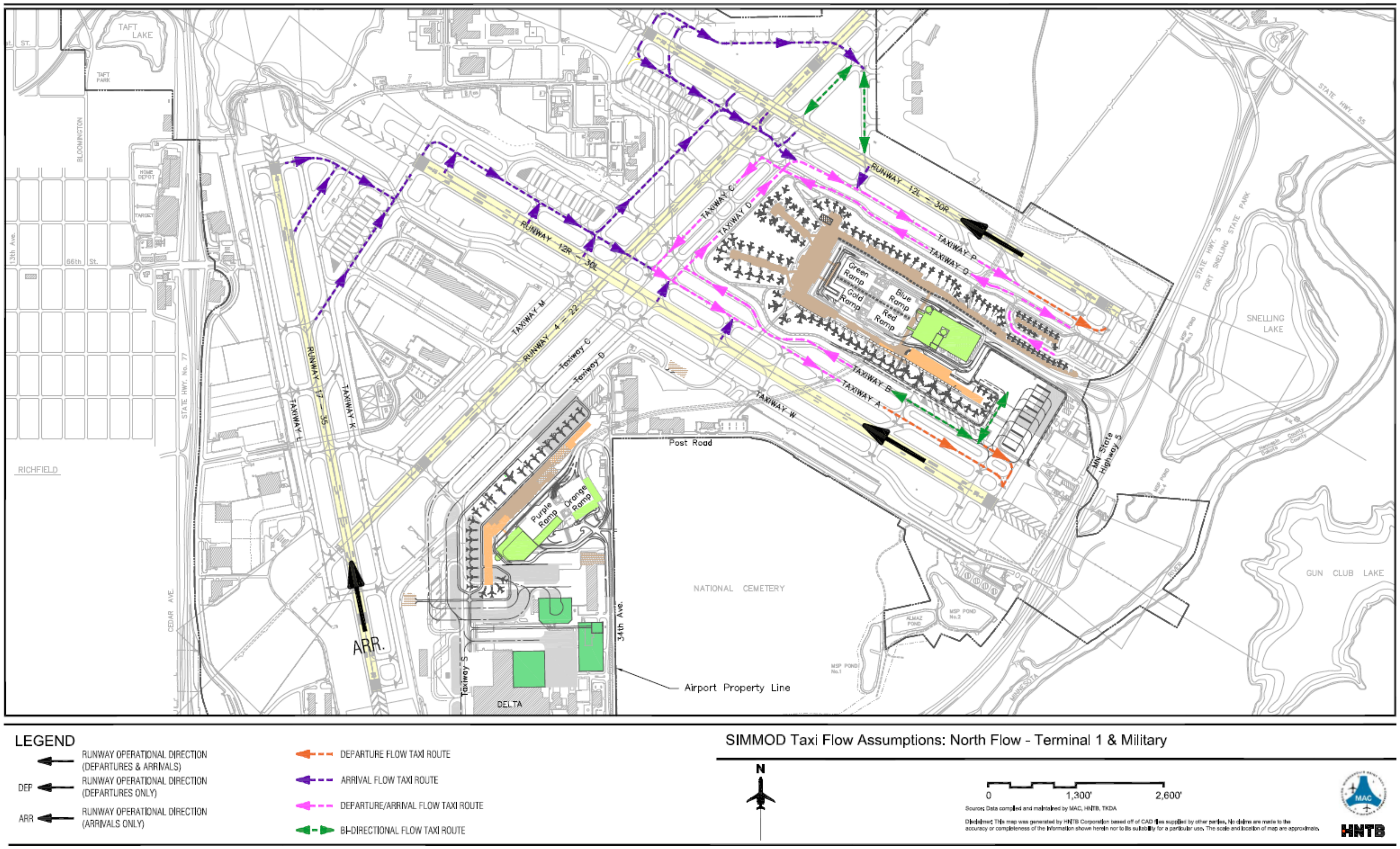


Figure E.1-2

**North Flow Taxipath – Terminal 1-Lindbergh and Military Apron**

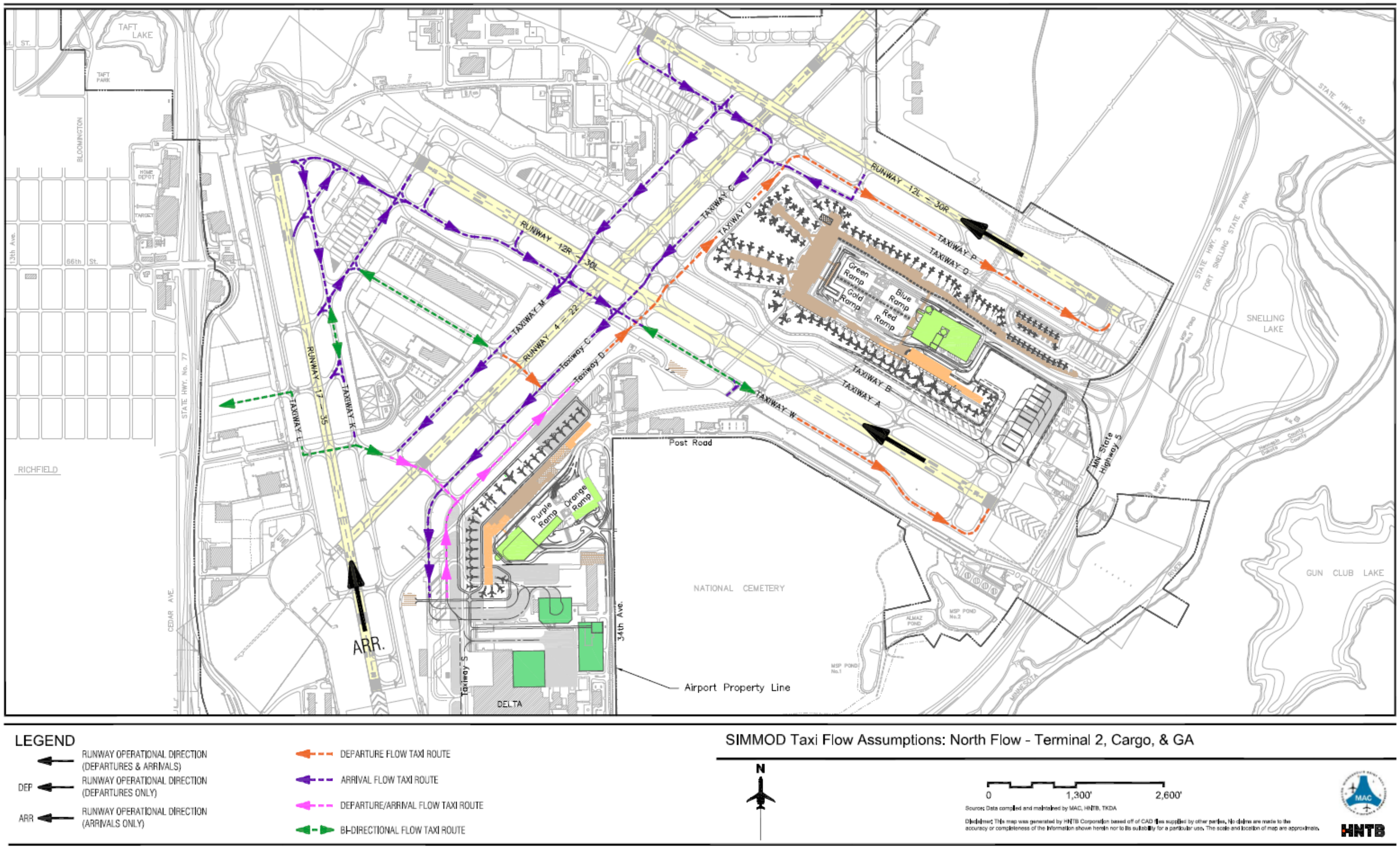


Figure E.1-3

North Flow Taxipath – Terminal 2-Humphrey, General Aviation, and Cargo Areas

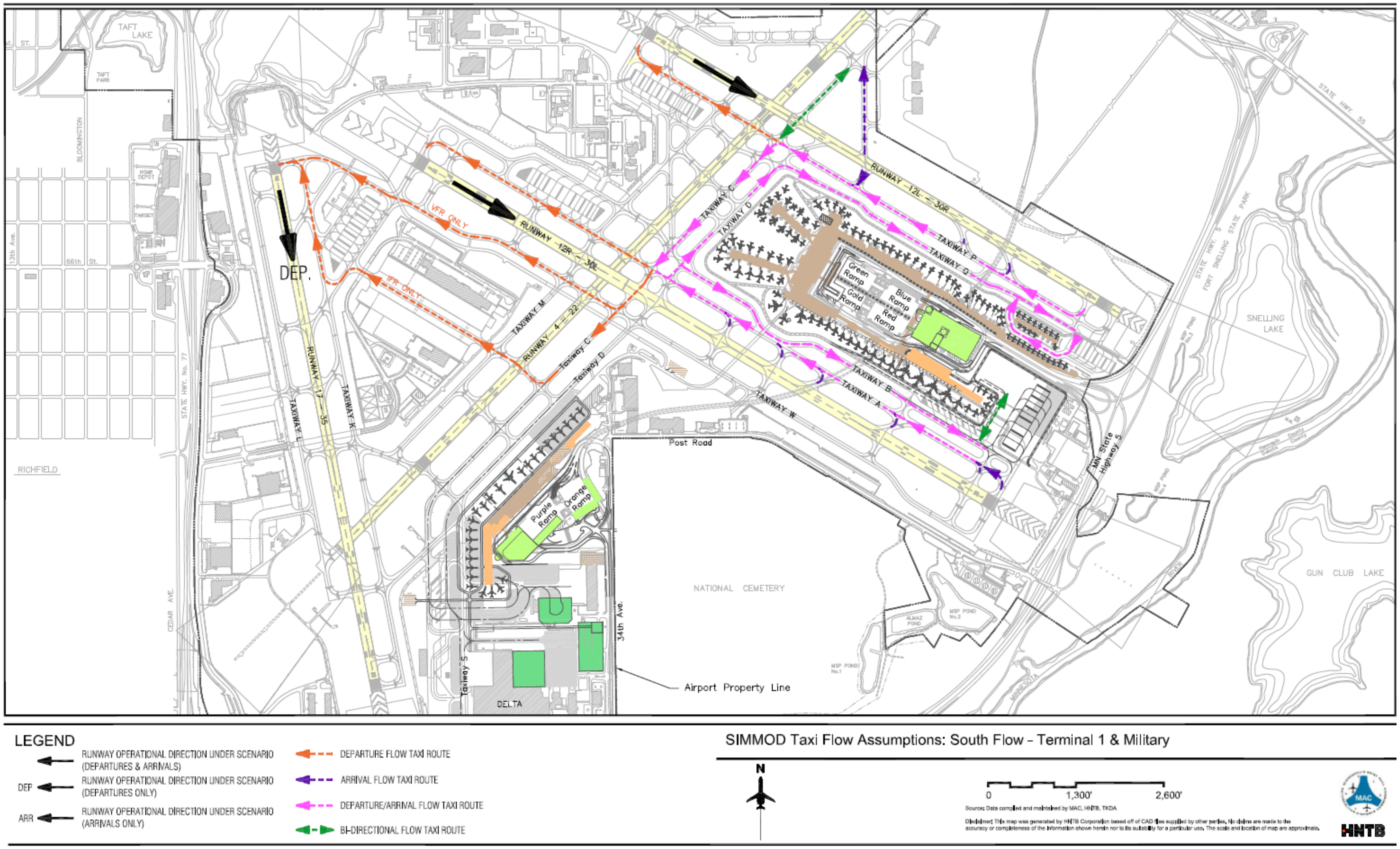
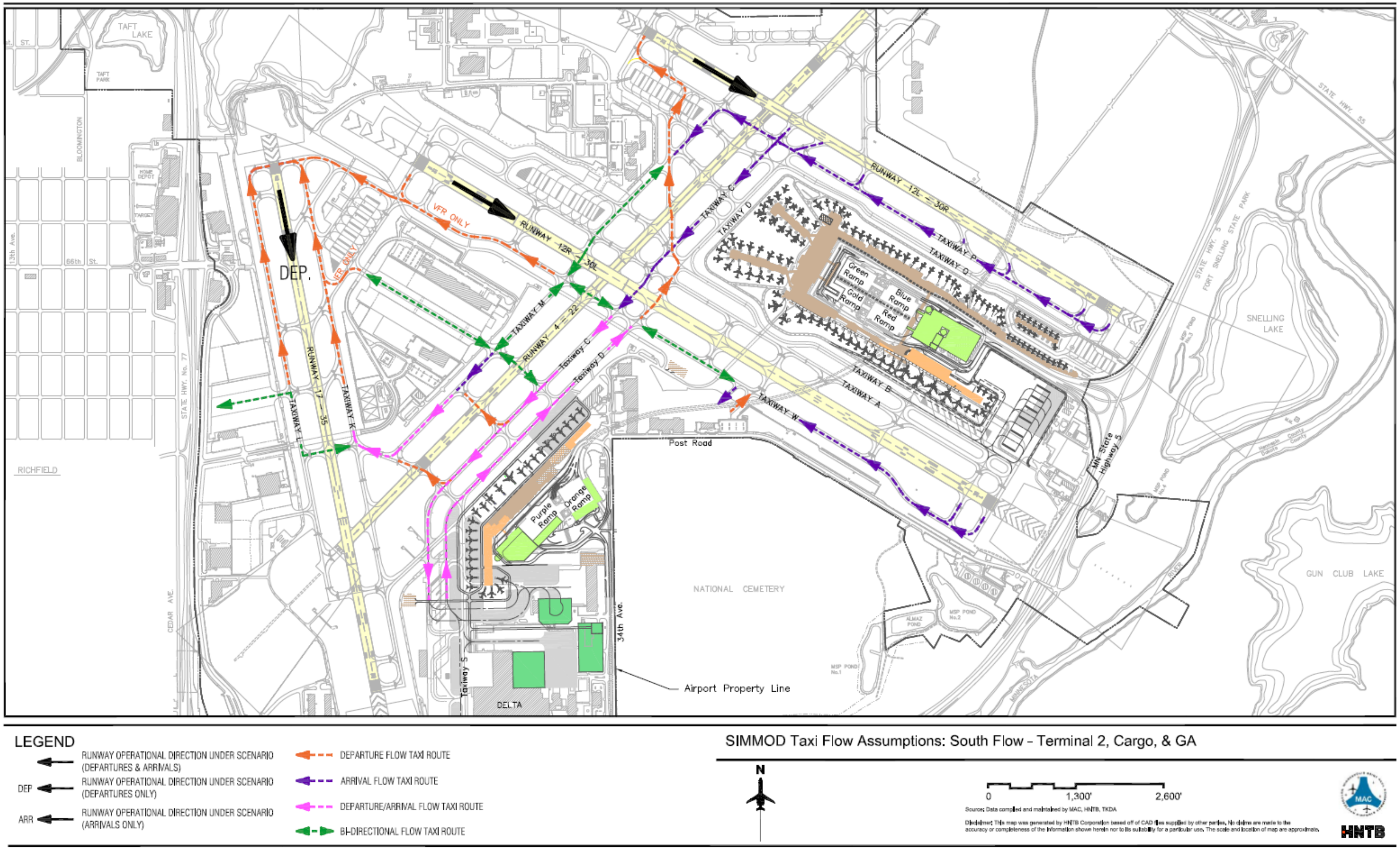


Figure E.1-4

**South Flow Taxipath – Terminal 1-Lindbergh and Military Apron**



Source: Data compiled and maintained by MAC, HNTB, TKDA

Disclaimer: This map was generated by HNTB Corporation based off of CAD files supplied by other parties. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of map are approximate.

Figure E.1-5

**South Flow Taxipath – Terminal 2-Humphrey, General Aviation, and Cargo Areas**

## 1.7 Runway Utilization

Departure/Arrival runway use percentages, or the percent of the time that the various runways are used for departures/arrivals, were based on the SIMMOD analysis data. These percentages were used to distribute the landing-takeoff cycles to each runway end point. To accommodate EDMS, the runway utilization is developed by aircraft size (small, large, and heavy). Generally, during north wind flow conditions, aircraft arrive and depart using Runways 30L and 30R and arrive on Runway 35. During south wind flow conditions, aircraft arrive and depart using Runways 12L and 12R and depart on Runway 17.

For the north flow for the Baseline Condition and No Action Alternative, **Table E.1.5** contains the runway utilization percentages (by runway and arrival/departure operation) used for the air quality assessment. For the south flow for the Baseline Condition and No Action Alternative, **Table E.1.6** contains the runway utilization percentages (by runway and arrival/departure operation).

For the north flow for the Action Alternatives, **Table E.1.7** contains the runway utilization percentages (by runway and arrival/departure operation) used for the air quality assessment. For the south flow for the Action Alternatives, **Table E.1.8** contains the runway utilization percentages (by runway and arrival/departure operation).

Table E.1.5

## Runway Utilization (percent) for North Flow for Baseline and No Action Alternative

| Aircraft Size | Runway | Baseline | | 2020 No Action | | 2025 No Action | |
|---|---|---|---|---|---|---|---|
| | | Arrival | Departure | Arrival | Departure | Arrival | Departure |
| Small | 12L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 12R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 30L | 22.33 | 28.01 | 26.00 | 30.97 | 28.08 | 30.89 |
| Small | 30R | 57.36 | 71.83 | 49.93 | 68.81 | 49.65 | 68.89 |
| Small | 4 | 0.02 | 0.14 | 0.02 | 0.20 | 0.02 | 0.20 |
| Small | 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 35 | 20.29 | 0.02 | 24.05 | 0.02 | 22.25 | 0.02 |
| Large | 12L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 12R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 30L | 33.78 | 47.18 | 34.52 | 46.83 | 34.78 | 47.20 |
| Large | 30R | 33.04 | 52.66 | 32.80 | 52.95 | 32.92 | 52.58 |
| Large | 4 | 0.02 | 0.14 | 0.02 | 0.20 | 0.02 | 0.20 |
| Large | 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 35 | 33.16 | 0.02 | 32.66 | 0.02 | 32.28 | 0.02 |
| Heavy | 12L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 12R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 30L | 27.62 | 69.96 | 23.81 | 71.68 | 24.52 | 75.08 |
| Heavy | 30R | 36.14 | 29.88 | 30.08 | 28.10 | 34.43 | 24.70 |
| Heavy | 4 | 0.02 | 0.14 | 0.02 | 0.20 | 0.02 | 0.20 |
| Heavy | 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 35 | 36.22 | 0.02 | 46.09 | 0.02 | 41.03 | 0.02 |

Source: HNTB SIMMOD analysis, 2011.

Table E.1.6

## Runway Utilization (percent) for South Flow for Baseline and No Action Alternative

| Aircraft Size | Runway | Baseline | | 2020 No Action | | 2025 No Action | |
|---|---|---|---|---|---|---|---|
| | | Arrival | Departure | Arrival | Departure | Arrival | Departure |
| Small | 12L | 65.54 | 53.99 | 59.59 | 49.78 | 60.96 | 49.76 |
| Small | 12R | 33.40 | 9.19 | 39.31 | 10.07 | 37.93 | 10.04 |
| Small | 17 | 0.15 | 35.86 | 0.16 | 38.94 | 0.16 | 39.07 |
| Small | 30L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 30R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 22 | 0.91 | 0.96 | 0.94 | 1.21 | 0.95 | 1.13 |
| Small | 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 12L | 46.82 | 26.98 | 46.56 | 28.50 | 46.10 | 29.51 |
| Large | 12R | 52.12 | 20.26 | 52.34 | 18.99 | 52.79 | 16.83 |
| Large | 17 | 0.15 | 51.88 | 0.16 | 51.39 | 0.16 | 52.61 |
| Large | 30L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 30R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 22 | 0.91 | 0.88 | 0.94 | 1.12 | 0.95 | 1.05 |
| Large | 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 12L | 41.62 | 16.61 | 31.42 | 10.62 | 34.94 | 14.56 |
| Heavy | 12R | 57.32 | 18.66 | 67.48 | 32.57 | 63.95 | 34.48 |
| Heavy | 17 | 0.15 | 63.45 | 0.16 | 54.94 | 0.16 | 49.33 |
| Heavy | 30L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 30R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 22 | 0.91 | 1.28 | 0.94 | 1.87 | 0.95 | 1.63 |
| Heavy | 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Source: HNTB SIMMOD analysis, 2011.

Table E.1.7

## Runway Utilization (percent) for North Flow for Alternative 1 - Airlines Remain and Alternative 2 - Airlines Relocate

| Aircraft Size | Runway | 2020 Airlines Remain |  | 2025 Airlines Remain |  | 2020 Airlines Relocate |  | 2025 Airlines Relocate |  |
|---|---|---|---|---|---|---|---|---|---|
|  |  | Arrival | Departure | Arrival | Departure | Arrival | Departure | Arrival | Departure |
| Small | 12L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 12R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 30L | 26.96 | 30.91 | 30.05 | 31.76 | 26.38 | 33.23 | 28.24 | 30.51 |
| Small | 30R | 49.64 | 68.87 | 49.79 | 68.02 | 49.70 | 66.56 | 49.83 | 69.28 |
| Small | 4 | 0.02 | 0.20 | 0.02 | 0.20 | 0.02 | 0.19 | 0.02 | 0.19 |
| Small | 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 35 | 23.38 | 0.02 | 20.14 | 0.02 | 23.90 | 0.02 | 21.91 | 0.02 |
| Large | 12L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 12R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 30L | 34.47 | 46.98 | 35.28 | 47.23 | 34.09 | 47.23 | 34.52 | 46.95 |
| Large | 30R | 32.94 | 52.80 | 32.90 | 52.55 | 32.91 | 52.55 | 32.87 | 52.84 |
| Large | 4 | 0.02 | 0.20 | 0.02 | 0.20 | 0.02 | 0.20 | 0.02 | 0.19 |
| Large | 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 35 | 32.57 | 0.02 | 31.80 | 0.02 | 32.98 | 0.02 | 32.59 | 0.02 |
| Heavy | 12L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 12R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 30L | 28.15 | 71.16 | 22.63 | 74.95 | 28.84 | 71.67 | 25.20 | 72.69 |
| Heavy | 30R | 29.38 | 28.62 | 34.64 | 24.83 | 29.03 | 28.12 | 33.71 | 27.10 |
| Heavy | 4 | 0.02 | 0.20 | 0.02 | 0.20 | 0.02 | 0.19 | 0.02 | 0.19 |
| Heavy | 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 35 | 42.45 | 0.02 | 42.71 | 0.02 | 42.11 | 0.02 | 41.07 | 0.02 |

Source: HNTB SIMMOD analysis, 2011.

Table E.1.8

**Runway Utilization (percent) for South Flow for Alternative 1 - Airlines Remain and Alternative 2 - Airlines Relocate**

| Aircraft Size | Runway | 2020 Airlines Remain | | 2025 Airlines Remain | | 2020 Airlines Relocate | | 2025 Airlines Relocate | |
|---|---|---|---|---|---|---|---|---|---|
| | | Arrival | Departure | Arrival | Departure | Arrival | Departure | Arrival | Departure |
| Small | 12L | 58.75 | 49.78 | 60.79 | 49.76 | 59.21 | 49.80 | 60.91 | 49.78 |
| Small | 12R | 40.14 | 10.07 | 38.10 | 10.04 | 39.68 | 10.10 | 37.98 | 10.04 |
| Small | 17 | 0.16 | 38.94 | 0.16 | 39.07 | 0.16 | 38.91 | 0.16 | 39.08 |
| Small | 30L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 30R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Small | 22 | 0.95 | 1.21 | 0.95 | 1.13 | 0.95 | 1.19 | 0.95 | 1.10 |
| Small | 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 12L | 46.32 | 28.51 | 46.05 | 29.53 | 46.26 | 28.42 | 46.14 | 29.52 |
| Large | 12R | 52.57 | 18.97 | 52.84 | 16.88 | 52.63 | 19.18 | 52.75 | 16.85 |
| Large | 17 | 0.16 | 51.40 | 0.16 | 52.54 | 0.16 | 51.29 | 0.16 | 52.61 |
| Large | 30L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 30R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Large | 22 | 0.95 | 1.12 | 0.95 | 1.05 | 0.95 | 1.11 | 0.95 | 1.02 |
| Large | 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 12L | 31.61 | 10.62 | 35.40 | 14.56 | 31.95 | 11.37 | 34.42 | 15.61 |
| Heavy | 12R | 67.28 | 32.57 | 63.49 | 34.48 | 66.94 | 32.30 | 64.47 | 34.09 |
| Heavy | 17 | 0.16 | 54.94 | 0.16 | 49.33 | 0.16 | 54.50 | 0.16 | 48.75 |
| Heavy | 30L | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 30R | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heavy | 22 | 0.95 | 1.87 | 0.95 | 1.63 | 0.95 | 1.83 | 0.95 | 1.55 |
| Heavy | 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Source: HNTB SIMMOD analysis, 2011.

## 1.8 Ground Support Equipment

Ground support equipment (GSE) is a term used to describe the vehicles that service aircraft after arrival and before departure at an airport. The number, types of GSE, fuel type, and operational times that are used to service each category of aircraft were based on information provided by the airlines and developed during a site visit. Emissions from these sources are based on the number and type of equipment used to service each aircraft along with the amount of time the equipment is in use per aircraft landing-takeoff cycle. The type of GSE at MSP includes aircraft tugs, baggage tugs, fuel trucks, food trucks, cargo trailers, water trucks, lavatory trucks, cabin service, belt loaders, and cargo loaders.

During May and June of 2011, airlines and cargo operators provided property inventories of their GSE. The information within the inventory typically included an identification number, the GSE type, the fuel type, horsepower, model year, and hours of operation.

A survey of GSE, including a survey of aircraft APUs, was also conducted at MSP on June 20 and 21, 2011. The purpose of this survey was to identify the types of GSE typically used at MSP, by aircraft type (narrow, wide, and commuter), and to record observed times-in-mode (TIMs) of each piece of equipment. TIMs are the time periods (in minutes) that each piece of GSE services an aircraft. The following aircraft were surveyed: B757-200, DC9, A330, B747, Saab 340, E175, CRJ200, and CRJ700/900. Cargo, general aviation and military operations were not surveyed and instead used default TIM data.

The operating times for each GSE type was distributed between gasoline, diesel and other fuels based on the survey data for that airline/equipment type. For example, if 85 percent of the baggage tractors were diesel-powered and 15 percent were gasoline- powered, and the observed operating time for a baggage tractor was 20 minutes, the diesel- powered baggage tractor was assumed to operate for 17 minutes and the gasoline- powered baggage tractor was assumed to operate for 3 minutes.

The observed GSE types and TIMs are summarized within **Table E.1.9** through **Table E.1.15**. The results of this survey were used to supplement the GSE database contained in EDMS with MSP-specific information.

In addition to GSE operating during aircraft arrival and departure, a number of GSE operate either outside of the typical LTOs cycle or do not specifically operate during every LTOs cycle (such as forklifts, air conditioners, and deicers). These GSE (designated as population-based GSE) were accounted for by including their estimated annual hours of operation. **Table E.1.16** and **Table E.1.17** present the population-based GSE data.

Lastly, due to limited gate positions, aircraft tugs are occasionally used to temporarily move aircraft from a gate position to allow for an arriving aircraft to allow passengers to depart. Once this is completed, the original aircraft is tugged back to a gate to allow passengers to board. These uses of aircraft tugs were accounted for based on the SIMMOD data. The data shows slightly greater use for these purposes during the No Action Alternatives than the Action Alternatives.

Table E.1.9

### GSE Time-in-Mode for Delta Wide Body Aircraft Operations at MSP

| GSE Name | Fuel | Percentage | HP | Departure (min) | Arrival (min) |
|---|---|---|---|---|---|
| Aircraft Tractor | D | 70.4 | 88 | 7.04 | 0.00 |
| | E | 14.8 | -- | 1.48 | 0.00 |
| | G | 14.8 | 83 | 1.48 | 0.00 |
| Baggage Tractor | D | 14.2 | 49 | 2.70 | 2.56 |
| | E | 0.25 | -- | 0.05 | 0.05 |
| | G | 85.3 | 49 | 16.21 | 15.35 |
| | P | 0.25 | 49 | 0.05 | 0.05 |
| Belt Loader | D | 19.0 | 49 | 0.95 | 0.95 |
| | G | 81.0 | 49 | 4.05 | 4.05 |
| Cargo Loader | D | 100.0 | 80 | 17.00 | 17.00 |
| Cargo Tractor | D | 7.0 | 88 | 1.26 | 1.19 |
| | G | 93.0 | 88 | 16.74 | 15.81 |
| Cabin Service | D | 41.0 | 71 | 2.05 | 2.05 |
| | G | 59.0 | 195 | 2.95 | 2.95 |
| Catering Truck | D | 100.0 | 210 | 7.00 | 0.00 |
| Hydrant Cart | E | 100 | -- | 30.00 | 0.00 |
| Lavatory Truck | G | 71.0 | 235 | 0.00 | 4.26 |
| | E | 29.0 | -- | 0.00 | 1.74 |
| Service Truck | D | 33.5 | 235 | 1.68 | 1.34 |
| | G | 66.5 | 235 | 3.33 | 2.66 |
| Water Service | G | 100.0 | 235 | 4.00 | 0.00 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.10

## GSE Time-in-Mode for Delta Narrow Body Aircraft Operations at MSP

| GSE Name | Fuel | Percentage | HP | Departure (min) | Arrival (min) |
|---|---|---|---|---|---|
| Aircraft Tractor | D | 70.4 | 88 | 6.34 | 0.00 |
| | E | 14.8 | -- | 1.33 | 0.00 |
| | G | 14.8 | 83 | 1.33 | 0.00 |
| Baggage Tractor | D | 14.2 | 49 | 1.56 | 1.42 |
| | E | 0.25 | -- | 0.03 | 0.03 |
| | G | 85.3 | 49 | 9.38 | 8.53 |
| | P | 0.25 | 49 | 0.03 | 0.03 |
| Belt Loader | D | 19.0 | 49 | 4.94 | 4.94 |
| | G | 81.0 | 49 | 21.06 | 21.06 |
| Cabin Service | D | 41.0 | 71 | 2.05 | 2.05 |
| | G | 59.0 | 195 | 2.95 | 2.95 |
| Catering Truck | D | 100.0 | 210 | 5.00 | 4.00 |
| Hydrant Cart | E | 100 | -- | 22.00 | 0.00 |
| Lavatory Truck | G | 71.0 | 235 | 0.00 | 2.84 |
| | E | 29.0 | -- | 0.00 | 1.16 |
| Service Truck | D | 33.5 | 235 | 1.68 | 1.34 |
| | G | 66.5 | 235 | 5.32 | 4.66 |
| Water Service | G | 100.0 | 235 | 4.00 | 0.00 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.11

## GSE Time-in-Mode for Other Narrow Body Aircraft Operations at MSP

| GSE Name | Fuel | Percentage | HP | Departure (min) | Arrival (min) |
|---|---|---|---|---|---|
| Aircraft Tractor | D | 100 | 127 | 8.00 | 0.00 |
| Baggage Tractor | D | 42.9 | 64 | 16.30 | 15.87 |
| | G | 57.1 | 123 | 21.70 | 21.13 |
| Belt Loader | D | 42.9 | 56 | 10.30 | 10.30 |
| | G | 57.1 | 108 | 13.70 | 13.70 |
| Cabin Service | D | 100.0 | 210 | 10.00 | 10.00 |
| Cargo Tractor | G | 100.0 | 95 | 18.00 | 17.00 |
| Catering Truck | G | 100.0 | 210 | 8.00 | 7.00 |
| Hydrant Cart | E | 100.0 | -- | 20.00 | 0.00 |
| Lavatory Truck | D | 100.0 | 248 | 0.00 | 15.00 |
| Service Truck | D | 100.0 | 235 | 8.00 | 7.00 |
| Water Service | G | 100.0 | 235 | 12.00 | 0.00 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.12

## GSE Time-in-Mode for Delta Commuter Aircraft Operations at MSP

| GSE Name | Fuel | Percentage | HP | Departure (min) | Arrival (min) |
|---|---|---|---|---|---|
| Aircraft Tractor | D | 70.4 | 88 | 5.63 | 0.00 |
| | E | 14.8 | -- | 1.18 | 0.00 |
| | G | 14.8 | 83 | 1.18 | 0.00 |
| Baggage Tractor | D | 14.2 | 49 | 1.70 | 1.56 |
| | E | 0.25 | -- | 0.03 | 0.03 |
| | G | 85.3 | 49 | 10.24 | 9.38 |
| | P | 0.25 | 49 | 0.03 | 0.03 |
| Belt Loader | D | 19.0 | 49 | 2.66 | 2.66 |
| | G | 81.0 | 49 | 11.34 | 11.34 |
| Cabin Service | D | 41.0 | 71 | 2.05 | 2.05 |
| | G | 59.0 | 195 | 2.95 | 2.95 |
| Hydrant Cart | E | 100 | -- | 12.00 | 0.00 |
| Lavatory Truck | G | 71.0 | 235 | 0.00 | 3.55 |
| | E | 29.0 | -- | 0.00 | 1.45 |
| Service Truck | D | 33.5 | 235 | 1.68 | 1.68 |
| | G | 66.5 | 235 | 3.33 | 3.33 |
| Water Service | G | 100.0 | 235 | 12.00 | 0.00 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.13

## GSE Time-in-Mode for Other Commuter Aircraft Operations at MSP

| GSE Name | Fuel | Percentage | HP | Departure (min) | Arrival (min) |
|---|---|---|---|---|---|
| Aircraft Tractor | D | 100 | 127 | 8.00 | 0.00 |
| Baggage Tractor | D | 42.9 | 64 | 7.72 | 7.29 |
| | G | 57.1 | 123 | 10.28 | 9.71 |
| Belt Loader | D | 42.9 | 56 | 6.44 | 6.44 |
| | G | 57.1 | 108 | 8.57 | 8.57 |
| Cabin Service | D | 41.0 | 71 | 5.00 | 5.00 |
| Hydrant Cart | E | 100.0 | -- | 12.00 | 0.00 |
| Lavatory Truck | D | 100.0 | 248 | 0.00 | 15.00 |
| Service Truck | D | 100.0 | 235 | 8.00 | 7.00 |
| Water Service | G | 100.0 | 235 | 12.00 | 0.00 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.14

### GSE Time-in-Mode for West Cargo Area Aircraft Operations at MSP

| GSE Name | Fuel | Percentage | HP | Departure (min) | Arrival (min) |
|---|---|---|---|---|---|
| Aircraft Tractor | D | 100.0 | 88 | 8 | 0 |
| Belt Loader | D | 33.5 | 107 | 6 | 5.7 |
|  | G | 66.5 | 107 | 12 | 11.3 |
| Cargo Loader | D | 100.0 | 80 | 40 | 40 |
| Cargo Tractor | G | 100.0 | 107 | 60 | 60 |
| Fuel Truck | D | 100.0 | 235 | 20 | 0 |
| GPU | D | 50.0 | 71 | 40 | 0 |
|  | G | 50.0 | 71 | 40 | 0 |
| Service Truck | G | 100.0 | 235 | 8 | 7 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.15

### GSE Time-in-Mode for Infield Cargo Area Aircraft Operations at MSP

| GSE Name | Fuel | Percentage | HP | Departure (min) | Arrival (min) |
|---|---|---|---|---|---|
| Air Start | D | 100.0 | 425 | 7 | 0 |
| Aircraft Tractor | D | 100.0 | 88 | 8 | 0 |
| Belt Loader | D | 14.0 | 107 | 2.5 | 2.4 |
|  | G | 86.0 | 107 | 15.5 | 14.6 |
| Cargo Loader | D | 86.0 | 80 | 34.4 | 34.4 |
|  | G | 14.0 | 80 | 5.6 | 5.6 |
| Cargo Tractor | D | 6.0 | 107 | 3.6 | 3.6 |
|  | G | 94.0 | 107 | 56.4 | 56.4 |
| Fuel Truck | D | 100.0 | 235 | 20 | 0 |
| GPU | D | 100.0 | 71 | 80 | 0 |
| Service Truck | G | 100.0 | 235 | 8 | 7 |
| Other | D | 45.5 | 140 | 5 | 5 |
|  | G | 36.8 | 140 | 5 | 5 |
|  | P | 18.2 | 140 | 5 | 5 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.16

### Operating Time for Delta Additional GSE at MSP

| GSE Name | Fuel | Pieces of Equipment | Hours per Equipment Piece | HP |
|---|---|---|---|---|
| Other | D | 60 | 932 | 150 |
| | E | 171 | 999 | 150 |
| | G | 72 | 725 | 150 |
| | LPG | 6 | 294 | 150 |
| Forklift | D | 5 | 84 | |
| | E | 15 | 234 | |
| | G | 11 | 191 | 30 |
| | LPG | 34 | 530 | 57 |
| GPU | D | 29 | 2,458 | 160 |
| | E | 25 | 3 | |
| Passenger Steps | D | 1 | 1 | |
| | G | 2 | 220 | |
| AC | D | 9 | 2,120 | 135 |
| Air Start | D | 6 | 505 | 260 |
| Deicing Truck | D | 31 | 736 | 260 |
| | G | 6 | 987 | |
| Lift | E | 32 | 488 | |
| | G | 5 | 496 | |
| | LPG | 7 | 134 | |
| Sweeper | LPG | 6 | 61 | |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.17

### Operating Time for Other Additional GSE at MSP

| GSE Name | Fuel | Pieces of Equipment | Hours per Equipment Piece | HP |
|---|---|---|---|---|
| AC | D | 2 | 329 | 143 |
| Air Start | D | 5 | 45 | 349 |
| Deicing Truck | D | 5 | 628 | 152 |
| | G | 1 | 500 | 210 |
| Forklift | G | 1 | 50 | 90 |
| | LPG | 2 | 581 | 49 |
| GPU | D | 4 | 784 | 145 |
| Other | D | 3 | 713 | 66 |
| | G | 4 | 630 | 171 |
| Stair Truck | D | 2 | 110 | 154 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## 1.9 Auxiliary Power Units

Auxiliary power units (APU) are small turbine engines used by many commercial jet aircraft to start the main engines; provide electrical power to aircraft radios, lights, and other equipment; and to power the onboard air conditioning (heating and cooling) system. When an aircraft arrives at a terminal gate, the pilot has the option of shutting off power to the main jet engines and operating the onboard APU, which is fueled by the aircraft's jet fuel. Alternately, an aircraft can receive 400 Hz gate power and pre-conditioned air (PCA) from mobile ground power unit (GPU) and air conditioning equipment, or receive electrical power and PCA from connections at the gate. In most cases, gate power connections are built into the passenger loading bridge used to connect the terminal building to the aircraft for loading and unloading passengers.

Based on information provided by the MAC, Concourses A, B, C, D, F, and H have gate power and PCA at all available gate positions. For Concourse E, six of the 16 gates have gate power and PCA. For Concourse G, 24 of 26 gates have gate power and PCA. Gates with gate power and PCA would tend to use APU less. Based on default estimates, gates without gate power and PCA would require APU to operate for a minimum of 13 minutes on arrival and 13 minutes on departure.

However, gates with gate power and PCA would require APU to operate for a minimum of 3.5 minutes on arrival and 3.5 minutes on departure. Based on a survey of operations at MSP, APUs were determined to operate the minimum values plus an additional 4 to 6 minutes depending on concourse. **Table E.1.18** presents the APU operating times used in the air quality analysis. For general aviation, cargo, and military operations, default APU operating times were assumed; where applicable. Of note, many general aviation aircraft do not have APU.

Table E.1.18

**Auxiliary Power Unit Operating Times during Arrivals/Departures (min)**

| | 2010 | 2020/2025 | | |
|---|---|---|---|---|
| Location | Baseline | No Action | Airlines Remain | Airlines Relocate |
| Concourse A | 9.50 | 9.50 | 9.50 | 9.50 |
| Concourse B | 9.50 | 9.50 | 9.50 | 9.50 |
| Concourse C | 9.50 | 9.50 | 9.50 | 9.50 |
| Concourse D | 9.50 | 9.50 | 9.50 | 9.50 |
| Concourse E | 15.44 | 15.44 | 15.44 | 15.44 |
| Concourse F | 9.50 | 9.50 | 9.50 | 9.50 |
| Concourse G | 10.23 | 10.23 | 10.00 | 10.11 |
| Concourse H | 7.50 | 7.50 | 7.50 | 7.50 |
| General Aviation | 13.00 | 13.00 | 13.00 | 13.00 |
| Infield Cargo | 13.00 | 13.00 | 13.00 | 13.00 |
| Military | 13.00 | 13.00 | 13.00 | 13.00 |
| West Cargo | 13.00 | 13.00 | 13.00 | 13.00 |

Source: HNTB SIMMOD analysis, 2011 and Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## 1.10 Roadways

The level of emissions that would result from the daily operation of airport-related motor vehicles with or without the MSP 2020 Improvements depends on several factors including the volume of vehicles, the vehicle fleet mix, the motor vehicle emission rates, travel distance, speed, the level of congestion/delay, the year of analysis, and meteorological factors. Motor vehicle emissions for all on- and off-airport roadways were based on the emission factors corresponding to the roadway speed, the year of analysis, and the vehicle-miles-traveled on those roadways.

**Table E.1.19** contains the peak daily traffic volumes within the roadways for the 2010 Baseline condition, and 2020 and 2025 No Action and Action Alternatives. The values are airport-related traffic volumes only. Background traffic volume also occurs within TH5, I-494, TH77, and TH62. These background traffic volumes were not included in the emissions inventory (as these sources are not airport-related). However, the sources were included in the CO macroscale dispersion analysis, as these sources impact air quality in the study area.

Table E.1.19

**Roadway Motor Vehicle Daily Volumes (Airport-related)**

| | | **2010** | **2020** | | | **2025** | | |
|---|---|---|---|---|---|---|---|---|
| **Roadway** | **Segment** | **Baseline** | **No Action** | **Airlines Remain** | **Airlines Relocate** | **No Action** | **Airlines Remain** | **Airlines Relocate** |
| TH 5 | A | 35,400 | 44,500 | 44,200 | 47,800 | 53,200 | 52,800 | 56,500 |
| TH 5 | B | 44,800 | 54,800 | 55,800 | 42,700 | 63,000 | 64,200 | 50,600 |
| TH 5 | C | 40,900 | 48,400 | 49,300 | 37,400 | 57,400 | 58,500 | 46,000 |
| Post Road | F | 7,800 | 10,300 | 10,600 | 21,300 | 11,200 | 10,900 | 21,600 |
| 34th North | G | 16,600 | 24,600 | 22,100 | 49,800 | 31,500 | 29,000 | 58,800 |
| 34th South | H | 30,600 | 37,500 | 35,000 | 59,000 | 45,000 | 42,500 | 68,500 |
| I-494 | I | 40,100 | 47,900 | 48,200 | 43,800 | 57,700 | 58,100 | 53,400 |
| I-494 | J | 45,600 | 54,400 | 54,100 | 58,500 | 64,400 | 64,000 | 68,800 |
| I-494 | K | 44,200 | 53,100 | 52,800 | 57,400 | 63,200 | 62,800 | 67,300 |
| TH 77 | L | 3,900 | 5,500 | 5,300 | 8,300 | 6,800 | 6,600 | 9,800 |
| TH 77 | M | 3,600 | 5,000 | 4,800 | 7,700 | 6,400 | 6,100 | 9,400 |
| TH 77 | N | 2,500 | 3,500 | 3,200 | 7,400 | 4,900 | 4,500 | 8,600 |
| TH 62 | O | 12,800 | 14,800 | 15,100 | 11,400 | 17,000 | 17,300 | 13,400 |
| TH 62 | P | 13,000 | 15,000 | 15,300 | 11,500 | 17,300 | 17,600 | 13,800 |
| Terminal 1 Incoming | | 30,643 | 41,102 | 43,163 | 29,119 | 46,940 | 48,851 | 32,706 |
| Terminal 1 Upper Level | | 11,400 | 15,941 | 17,278 | 11,635 | 18,334 | 19,472 | 13,022 |
| Terminal 1 Lower Level | | 7,600 | 10,627 | 11,519 | 7,756 | 12,223 | 12,982 | 8,681 |
| Terminal 1 Outgoing | | 33,885 | 39,923 | 42,054 | 28,824 | 45,917 | 47,381 | 31,882 |
| Terminal 2 Incoming | | 8,298 | 14,278 | 11,970 | 25,934 | 17,465 | 15,948 | 31,814 |
| Terminal 2 | | 4,200 | 7,181 | 7,276 | 15,933 | 8,729 | 9,389 | 19,458 |
| Terminal 2 Outgoing | | 8,912 | 15,302 | 13,450 | 26,313 | 17,479 | 16,230 | 32,042 |
| Longfellow | | 3,627 | 5,038 | 4,836 | 7,758 | 6,448 | 6,146 | 9,471 |
| Cargo | | 1,022 | 1,419 | 1,363 | 2,186 | 1,817 | 1,732 | 2,669 |

Source: KHA Traffic analysis, 2011 and Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## 1.11 Terminal Curbsides and Parking Ramps/Lots

Emissions occurring at terminal curbsides were calculated using estimates of the amount of time a vehicle spends idling at the curbside and the type of vehicle (shuttle, taxi, private auto, etc.). Emissions due to parking facilities were based on three components: 1) the amount of time a vehicle spends idling at the parking facility, 2) the distance a vehicle travels within the parking facility at a given speed, and 3) the type of vehicle. **Table E.1.20** contains the peak daily traffic volumes within the terminal curbsides and parking ramps/lots for the 2010 Baseline condition, and 2020 and 2025 No Action and Action Alternatives.

Table E.1.20

**Terminal Curbsides and Parking Ramps/Lots Daily Volumes**

| | | 2010 | 2020 | | | 2025 | | |
|---|---|---|---|---|---|---|---|---|
| **Roadway** | **Segment** | **Baseline** | **No Action** | **Airlines Remain** | **Airlines Relocate** | **No Action** | **Airlines Remain** | **Airlines Relocate** |
| Terminal 1 | Blue | 1,750 | 2,277 | 1,500 | 1,326 | 2,619 | 1,689 | 1,486 |
| Terminal 1 | Blue RAC | 2,150 | 2,713 | 2,684 | 1,549 | 2,953 | 3,132 | 1,786 |
| Terminal 1 | Gold | 1,750 | 2,277 | 1,500 | 1,326 | 2,619 | 1,689 | 1,486 |
| Terminal 1 | Green | 1,750 | 2,277 | 1,500 | 1,326 | 2,619 | 1,689 | 1,486 |
| Terminal 2 | Orange | 1,250 | 2,037 | 769 | 1,550 | 2,278 | 1,020 | 1,849 |
| Terminal 2 | Purple | 1,250 | 2,037 | 769 | 1,550 | 2,278 | 1,020 | 1,849 |
| Terminal 2 | Purple RAC | 1,800 | 3,024 | 3,157 | 5,352 | 4,180 | 4,518 | 6,810 |
| Terminal 1 | Red | 1,750 | 2,277 | 1,500 | 1,326 | 2,619 | 1,689 | 1,486 |
| Terminal 1 | Red RAC | 2,150 | 2,713 | 2,684 | 1,549 | 2,953 | 3,132 | 1,786 |
| | Terminal 1 Lower | 7,600 | 10,627 | 11,519 | 7,756 | 12,223 | 12,982 | 8,681 |
| | Terminal 1 Upper | 11,400 | 15,941 | 17,278 | 11,635 | 18,334 | 19,472 | 13,022 |
| | Terminal 2 | 4,200 | 7,181 | 7,276 | 15,933 | 8,729 | 9,389 | 19,458 |
| Building F | | 1,127 | 1,127 | 1,127 | 1,127 | 1,127 | 1,127 | 1,127 |
| Building C North | | 2,186 | 2,186 | 2,186 | 2,186 | 2,186 | 2,186 | 2,186 |
| Building C South | | 1,703 | 1,703 | 1,703 | 1,703 | 1,703 | 1,703 | 1,703 |
| Building B | | 749 | 749 | 749 | 749 | 749 | 749 | 749 |
| New A | | | | 1,500 | 1,326 | | 1,689 | 1,486 |
| New B | | | | 1,500 | | | 1,689 | |
| New C | | | | | 1,550 | | | 1,849 |

Source: KHA Traffic analysis, 2011 and Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## 1.12 Motor Vehicle Temporal Factors

For on-airport roadways and parking ramps/lots, the motor vehicles used the same operational profiles for the hourly, daily, and monthly periods. For off-airport roadways, the operational profiles were based on traffic counts conducted by Minnesota Department of Transportation. **Table E.1.21** contains the operational profiles for off-airport roadways.

Table E.1.21

**Off-Airport Roadway Operational Profiles – Hourly, Daily, and Monthly**

| Hour | Profile | Day | Profile | Month | Profile |
|---|---|---|---|---|---|
| 1 | 0.1549 | Monday | 0.9198 | January | 0.8474 |
| 2 | 0.0923 | Tuesday | 0.9513 | February | 0.7931 |
| 3 | 0.0715 | Wednesday | 0.9789 | March | 0.9528 |
| 4 | 0.0681 | Thursday | 0.9776 | April | 0.9338 |
| 5 | 0.1299 | Friday | **1.0000** | May | 0.9586 |
| 6 | 0.3495 | Saturday | 0.8260 | June | 0.9602 |
| 7 | 0.6976 | Sunday | 0.7263 | July | 0.9775 |
| 8 | 0.8784 | | | August | **1.0000** |
| 9 | 0.8648 | | | September | 0.9398 |
| 10 | 0.8400 | | | October | 0.9751 |
| 11 | 0.8398 | | | November | 0.8675 |
| Noon | 0.9114 | | | December | 0.8389 |
| 1 | 0.9438 | | | | |
| 2 | 0.9519 | | | | |
| 3 | 0.9800 | | | | |
| 4 | **1.0000** | | | | |
| 5 | 0.9694 | | | | |
| 6 | 0.9170 | | | | |
| 7 | 0.8811 | | | | |
| 8 | 0.6743 | | | | |
| 9 | 0.5899 | | | | |
| 10 | 0.5355 | | | | |
| 11 | 0.3917 | | | | |
| Midnight | 0.2498 | | | | |

Source: Minnesota Department of Transportation, http://www.dot.state.mn.us/traffic/data/html/volumes.html, 2011.

## 1.13 Motor Vehicle Emission Factors

The MOBILE6.2 program was used to determine volatile organic compounds (as hydrocarbons), sulfur dioxide, particulate matter, nitrogen oxides, and carbon monoxide emission factors for free-flowing motor vehicles. MOBILE6.2 input parameters were selected in accordance with guidance provided by the MPCA. Idle emission factors were calculated using the MOBILE6.2 program and the recommended procedure for idle factors contained in the MOBILE5 Information Sheet #2 (dated July 30, 1993). Particulate matter emissions include tire and brake wear. MPCA has focused primarily on CO emissions, so that default parameters associated with winter conditions for most variables other than vehicle age distribution are used. General data (provided by MPCA) for the calculation of motor vehicle emission factors through MOBILE6.2 included the following:

- Reid vapor pressure of 13.4;
- Stage II refueling program applies;
- Low altitude location;

- Ambient temperature range of 16 and 38 Fahrenheit (winter);
- 95 percent absolute humidity;
- Gasoline sulfur content of 129 parts per million; and
- Diesel sulfur content of 15 parts per million.

Based on this information, the motor vehicle emission factors for 2010, 2020, and 2025 contained in **Tables E.1.22** through **E.1.24** were developed. For the Cargo Road, the vehicle fleet mix was adjusted to reflect a greater number of cargo vans which frequent the roadway. Emission factors generally decrease with future years and generally decrease with vehicle speeds up to 35 mph and then increase with higher speeds.

Table E.1.22

**2010 Motor Vehicle Emission Factors (grams/mile or grams/idle-hour)**

| Speed | CO | NOx | VOC | PM10 | PM2.5 | SOx |
|---|---|---|---|---|---|---|
| Idle | 99.4 | 5.99 | 9.50 | 0.106 | 0.066 | 0.024 |
| 2.5 | 39.8 | 2.40 | 3.80 | 0.042 | 0.026 | 0.009 |
| 5 | 26.4 | 2.14 | 1.77 | 0.042 | 0.026 | 0.009 |
| 10 | 19.6 | 1.79 | 1.11 | 0.042 | 0.026 | 0.009 |
| 15 | 17.4 | 1.56 | 0.90 | 0.042 | 0.026 | 0.009 |
| 20 | 16.2 | 1.43 | 0.79 | 0.042 | 0.026 | 0.009 |
| 25 | 15.6 | 1.36 | 0.72 | 0.042 | 0.026 | 0.009 |
| 30 | 15.3 | 1.31 | 0.68 | 0.042 | 0.026 | 0.009 |
| 35 | 15.3 | 1.30 | 0.65 | 0.042 | 0.026 | 0.009 |
| 40 | 15.7 | 1.33 | 0.64 | 0.042 | 0.026 | 0.009 |
| 45 | 16.1 | 1.38 | 0.62 | 0.042 | 0.026 | 0.009 |
| 50 | 16.6 | 1.51 | 0.61 | 0.042 | 0.026 | 0.009 |
| 55 | 17.1 | 1.61 | 0.60 | 0.042 | 0.026 | 0.009 |
| 60 | 17.7 | 1.75 | 0.59 | 0.042 | 0.026 | 0.009 |
| 65 | 18.2 | 1.94 | 0.59 | 0.042 | 0.026 | 0.009 |
| Cargo Rd (35) | 14.3 | 1.47 | 0.62 | 0.050 | 0.032 | 0.009 |

Source: USEPA MOBILE6.2, Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.23

### 2020 Motor Vehicle Emission Factors (grams/mile or grams/idle-hour)

| Speed | CO | NOx | VOC | PM10 | PM2.5 | SOx |
|---|---|---|---|---|---|---|
| Idle | 71.7 | 2.20 | 5.03 | 0.075 | 0.037 | 0.024 |
| 2.5 | 28.7 | 0.88 | 2.01 | 0.030 | 0.015 | 0.010 |
| 5 | 19.4 | 0.78 | 0.96 | 0.030 | 0.015 | 0.010 |
| 10 | 14.6 | 0.65 | 0.60 | 0.030 | 0.015 | 0.010 |
| 15 | 13.0 | 0.57 | 0.49 | 0.030 | 0.015 | 0.010 |
| 20 | 12.2 | 0.52 | 0.43 | 0.030 | 0.015 | 0.010 |
| 25 | 11.7 | 0.49 | 0.39 | 0.030 | 0.015 | 0.010 |
| 30 | 11.5 | 0.48 | 0.37 | 0.030 | 0.015 | 0.010 |
| 35 | 11.5 | 0.47 | 0.36 | 0.030 | 0.015 | 0.009 |
| 40 | 11.8 | 0.48 | 0.35 | 0.030 | 0.015 | 0.009 |
| 45 | 12.1 | 0.50 | 0.34 | 0.030 | 0.015 | 0.009 |
| 50 | 12.5 | 0.53 | 0.34 | 0.030 | 0.015 | 0.009 |
| 55 | 12.9 | 0.56 | 0.33 | 0.030 | 0.015 | 0.009 |
| 60 | 13.3 | 0.60 | 0.33 | 0.030 | 0.015 | 0.009 |
| 65 | 13.7 | 0.65 | 0.33 | 0.030 | 0.015 | 0.009 |
| Cargo Rd (35) | 11.2 | 0.48 | 0.33 | 0.032 | 0.016 | 0.009 |

Source: USEPA MOBILE6.2, Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.24

### 2025 Motor Vehicle Emission Factors (grams/mile or grams/idle-hour)

| Speed | CO | NOx | VOC | PM10 | PM2.5 | SOx |
|---|---|---|---|---|---|---|
| Idle | 69.9 | 1.79 | 4.80 | 0.072 | 0.035 | 0.024 |
| 2.5 | 28.0 | 0.72 | 1.92 | 0.029 | 0.014 | 0.010 |
| 5 | 18.9 | 0.64 | 0.90 | 0.029 | 0.014 | 0.010 |
| 10 | 14.3 | 0.53 | 0.56 | 0.029 | 0.014 | 0.010 |
| 15 | 12.7 | 0.46 | 0.46 | 0.029 | 0.014 | 0.010 |
| 20 | 11.9 | 0.42 | 0.40 | 0.029 | 0.014 | 0.010 |
| 25 | 11.4 | 0.40 | 0.37 | 0.029 | 0.014 | 0.010 |
| 30 | 11.2 | 0.38 | 0.35 | 0.029 | 0.014 | 0.010 |
| 35 | 11.2 | 0.38 | 0.33 | 0.029 | 0.014 | 0.009 |
| 40 | 11.5 | 0.39 | 0.32 | 0.029 | 0.014 | 0.009 |
| 45 | 11.9 | 0.40 | 0.32 | 0.029 | 0.014 | 0.009 |
| 50 | 12.2 | 0.42 | 0.31 | 0.029 | 0.014 | 0.009 |
| 55 | 12.6 | 0.44 | 0.31 | 0.029 | 0.014 | 0.009 |
| 60 | 13.0 | 0.46 | 0.31 | 0.029 | 0.014 | 0.009 |
| 65 | 13.4 | 0.50 | 0.31 | 0.029 | 0.014 | 0.009 |
| Cargo Rd (35) | 11.0 | 0.36 | 0.30 | 0.030 | 0.015 | 0.009 |

Source: USEPA MOBILE6.2, Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## 1.14 Stationary Sources

For stationary sources at MSP, such as fuel storage and handling, the heating/cooling plants, emergency generators, and snowmelters, the emissions were based on an amount of annual fuel use. The air quality assessment included the four main boilers within Terminal 1 - Lindbergh and the three main boilers within Terminal 2-Humphrey. The HT PMO peak shaving generator was also included. The Terminal 1-Lindbergh and Terminal 2-Humphrey boilers and HT PMO peak shaving generator were included in the emissions inventory as well as the dispersion modeling. Additionally, numerous snowmelters, miscellaneous boilers, emergency generators were included in the emission inventory but not the dispersion modeling. Stationary source emissions are based on values reported in the MAC 2010 Air Emissions Inventory for Option D Registration Permittees dated March 24, 2011.

Baseline fuel usage was based on MSP records for 2010. Fuel usage for future years were based on engineering estimates as a function of the proposed size and type of terminal expansion. The ratio of the existing actual fuel usage to rated capacity of existing equipment was multiplied by the projected capacity increase in combustion equipment resulting from the terminal expansion to determine future actual projected fuel usages. Future aircraft fuel usage was based on EDMS estimates resulting from changes in aircraft fleet mix and number of operations as well as taxi times. Future GSE fuel usage was based on EDMS estimates accounting for future aircraft fleet mix and number of operations.

**Table E.1.25** presents the estimated fuel usage for the terminal boilers and peaking generator (those units expected to change as result of the terminal expansions). **Table E.1.26** presents the exhaust parameters using in the dispersion modeling for the terminal boilers and peaking generator. **Table E.1.27** presents the fuel throughput to determine the fuel storage emissions.

Table E.1.25

**Stationary Source Fuel Usage**

| Location | Source | Fuel | 2010 Baseline | No Action | Airlines Remain | Airlines Relocate |
|---|---|---|---|---|---|---|
| Terminal 1 | Boiler #1 | Natural Gas | 89,093,128 | 89,093,128 | 95,366,834 | 94,066,584 |
| Terminal 1 | Boiler #2 | Natural Gas | 89,093,128 | 89,093,128 | 95,366,834 | 94,066,584 |
| Terminal 1 | Boiler #3 | Natural Gas | 89,093,128 | 89,093,128 | 95,366,834 | 94,066,584 |
| Terminal 1 | Boiler #4 | Natural Gas | 74,910,141 | 74,910,141 | 80,185,118 | 79,091,859 |
| Terminal 2 | Boiler #1 | Natural Gas | 15,982,877 | 15,982,877 | 16,669,299 | 21,635,768 |
| Terminal 2 | Boiler #2 | Natural Gas | 15,982,877 | 15,982,877 | 16,669,299 | 21,635,768 |
| Terminal 2 | Boiler #3 | Natural Gas | 3,198,056 | 3,198,056 | 3,335,404 | 4,329,158 |
| Terminal 1 | Boiler #1 | Jet A | 1,045 | 1,045 | 1,118 | 1,103 |
| Terminal 1 | Boiler #2 | Jet A | 1,045 | 1,045 | 1,118 | 1,103 |
| Terminal 1 | Boiler #3 | Jet A | 1,045 | 1,045 | 1,118 | 1,103 |
| Terminal 1 | Boiler #4 | Jet A | 878 | 878 | 940 | 927 |
| Terminal 2 | HT PMO Generator | No 2 Oil | 5,140 | 5,140 | 5361 | 6958 |

Notes: Units – Natural Gas in cubic feet, Jet A in gallons, and No 2 Oil in gallons.

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.26

**Stationary Source Exhaust Parameters**

| Location | Source | Fuel | Stack Height (m) | Stack Diameter (m) | Exit Temperature (F) | Exit Velocity (m/s) |
|---|---|---|---|---|---|---|
| Terminal 1 | Boiler #1 | Natural Gas | 13.1 | 1.3 | 250 | 15 |
| Terminal 1 | Boiler #2 | Natural Gas | 13.1 | 1.3 | 250 | 15 |
| Terminal 1 | Boiler #3 | Natural Gas | 13.1 | 1.3 | 250 | 15 |
| Terminal 1 | Boiler #4 | Natural Gas | 15.8 | 1.2 | 250 | 15 |
| Terminal 2 | Boiler #1 | Natural Gas | 13.7 | 0.3 | 250 | 15 |
| Terminal 2 | Boiler #2 | Natural Gas | 13.7 | 0.3 | 250 | 15 |
| Terminal 2 | Boiler #3 | Natural Gas | 13.7 | 0.2 | 250 | 15 |
| Terminal 1 | Boiler #1 | Jet A | 13.1 | 1.3 | 250 | 15 |
| Terminal 1 | Boiler #2 | Jet A | 13.1 | 1.3 | 250 | 15 |
| Terminal 1 | Boiler #3 | Jet A | 13.1 | 1.3 | 250 | 15 |
| Terminal 1 | Boiler #4 | Jet A | 15.8 | 1.2 | 250 | 15 |
| Terminal 2 | HT PMO Generator | No 2 Oil | 25.9 | 0.4 | 800 | 60 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.1.27

**Fuel Storage Throughput (gallons)**

|  | 2010 | 2020 | 2025 | 2020 | 2025 | 2020 | 2025 |
|---|---|---|---|---|---|---|---|
| Fuel | Baseline | No Action | No Action | Airlines Remain | Airlines Remain | Airlines Relocate | Airlines Relocate |
| Jet A | 307,688,143 | 378,578,694 | 417,185,179 | 378,245,272 | 416,887,552 | 377,697,170 | 417,458,751 |
| Avgas | 19,795 | 20,373 | 19,522 | 19,960 | 19,648 | 19,988 | 19,277 |
| Diesel | 862,013 | 1,104,633 | 1,243,800 | 1,080,503 | 1,225,234 | 1,080,483 | 1,209,042 |
| Gasoline | 1,850,175 | 2,489,830 | 2,828,063 | 2,500,134 | 2,799,972 | 2,497,137 | 2,785,024 |
| Propane | 8,710 | 9,164 | 9,164 | 9,171 | 9,171 | 9,171 | 9,176 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

# 2 Construction Emissions Inventory

## 2.1 Introduction

For this assessment, construction-related emissions are primarily associated with the exhaust from heavy equipment (i.e., backhoes, bulldozers, graders, etc.), delivery trucks (i.e., cement trucks, dump trucks, etc.) and construction worker vehicles getting to and from the site; dust from site preparation, land clearing, material handling, equipment movement on unpaved areas, and demolition activities, and fugitive emissions from the storage/transfer of raw materials. These emissions are temporary in nature (during the construction period only) and generally confined to the construction site and the access/egress roadways.

## 2.2 Construction Project Elements and Schedule

Construction projects would include upgrades to Terminal 1-Lindbergh and Terminal 2-Humphrey, expanded parking facilities, roadway improvements, and modifications to the hub tram expansion and ground transportation center. The construction activities are expected to occur between 2012 through 2020, and include the following major projects:

Improvements to Terminal 1-Lindbergh:

- Reconfigure Ground Level Green/Gold Parking Ramp to provide additional arrival curb
- Remodel the ticketing and baggage claim areas and Concourse E
- Relocate a number of Concourse G Gates to Concourse E
- Extend Concourse G for an expanded and new international terminal/Customs Border Protection facility including approximately 10 new gates, jet bridges, apron improvements, hydrant fueling, site utility improvements, and necessary support facilities
- Construct a new parking ramp east of the current Red-Blue Ramp

Improvements to Terminal 2-Humphrey:

- Construct approximately 17 new gates including jet bridges, apron improvements, hydrant fueling, and site utility improvements
- Provide quick turn-around auto rental facilities
- Expand parking
- Improve the roadway system including the 34th Avenue/Interstate 494 interchange and
- State Highway 5/Post Road Interchange

The particular construction project size, scope, and schedule would be different between the Airlines Remain Alternative and the Airlines Relocate Alternative.

## 2.3 Offroad Construction Equipment

Emissions from construction activities were estimated based on the projected construction activity schedule for the MSP 2020 Improvements, the number of pieces of equipment, the types of equipment/type of fuel used, equipment utilization rates (per day and per year), deployment period of equipment (days, weeks, or months), horsepower, load factor (percent of full throttle), and the year construction occurs. Data regarding the number of pieces and types of construction equipment to be used on the project, the deployment schedule of equipment, and the approximate daily operating time (including power level or usage factor) were assumed for each individual construction project based on a schedule of construction activity. The construction activity data were provided by construction schedulers experienced at these estimates. When data was unavailable, reasonable assumptions were used.

**Table E.2.1** provides a list of construction equipment expected to be used for the MSP 2020 Improvements. All equipment was assumed to be diesel-powered. The emission inventories for off-road (non-highway) equipment were calculated using emission factors obtained from the USEPA's NONROAD2008 emissions model. Emission factors for each equipment type were applied to the anticipated equipment work output (horsepower-hours of expected equipment use). Operating times for the equipment were based on a five-day workweek and an eight-hour workday during which the equipment may be operating.

Table E.2.1

**Offroad Equipment**

| Equipment | SCC | NONROAD Description |
|---|---|---|
| Backhoe | 2270002066 | Tractors/Loaders/Backhoes |
| Batch Plant | 2270002042 | Cement & Mortar Mixers |
| Belt Placer | 2270002081 | Other Construction Equipment |
| Bit Paver | 2270002021 | Paving Equipment |
| Breaker | 2270002006 | Tampers/Rammers |
| Crane | 2270002045 | Cranes |
| Excavator | 2270002036 | Excavator |
| Dozer | 2270002069 | Crawler Tractors/Dozers |
| Finish Blade | 2270002024 | Surfacing Equipment |
| Grader | 2270002048 | Graders |
| Loader | 2270002060 | Rubber Tire Loaders |
| Other | 2270002081 | Other Construction Equipment |
| Paver | 2270002003 | Pavers |
| Roller | 2270002015 | Rollers |
| Scissor Lift | 2270002081 | Other Construction Equipment |
| Skid Steer | 2270002003 | Skid Steer Loaders |
| Tractor | 2270002075 | Off-Highway Tractors |
| Water Truck | 2270002051 | Off-Highway Trucks |

Source: USEPA NONROAD2008, Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

A usage factor accounting for the percentage of daily operation and a load factor accounting for the average throttle setting relative to capacity were used. That is, a usage factor of 0.75 equates to six hours of operation and a load factor of 0.60 equates to 60 percent of throttle capacity during operation. For the off-road equipment SOx and particulate matter emission factors, a diesel sulfur content of 15 parts per million (ultra-low sulfur diesel fuel) was assumed, based on USEPA mandated regulations effective June 2010.

The following equation was used to obtain annual emission rates for off-road equipment:

*Emission Rate (tons/year) = Emission Factor (g/hp-hr) * size (hp) * 8 hours per day*

** days/year * Load Factor * Usage Factor *453.59 (g/lb)/2000 (lb/ton)*

## 2.4 On-Road Construction Trucks and Employee Vehicles

Activity levels and assignments for on-road construction vehicles have been developed based on a schedule of planned construction activities for the project, including vehicle miles of travel and idling time estimates for on-road construction vehicles. Additionally, emissions due to construction employee commutes to and from the work site were calculated, assuming an average commute distance, and a mixture of gasoline and diesel vehicles. Project delivery trucks, concrete trucks and other haul trucks were also included. Medium heavy duty and heavy-heavy duty trucks were assumed to be diesel powered.

Emission factors for on-road (highway) pickup, dump trucks, concrete trucks, employee vehicles, and other on-road regulated vehicles were obtained from the MOBILE6.2 emission model. Emission factors for on-road vehicles were developed for each construction year. Emission factors for on-road construction trucks were based upon heavy duty diesel vehicle emissions. Emissions for employee vehicles were based upon light duty gasoline trucks (70 percent) and light duty diesel trucks (30 percent). The number of truck trips and on-site employees for each of the construction activities were also provided by construction schedulers along with off-road equipment requirements.

Average trip length for on-road construction trucks was assumed to be 10 miles each way (20 mile round trip) with an average travel speed of 40 mph. Average trip length for employee trips to and from the construction sites was assumed to be 15 miles each way (30 mile round trip) with an average trip speed of 40 mph.

The following equation was used to obtain annual emission rates for on-road vehicles:

*Emission Rate (tons/year) = Emission Factor (g/mile) * trips per day * miles per trip * days/year * 453.59 (g/lb)/2000 (lb/ton)*

# 3 CO Roadway Intersection and Macroscale Dispersion Analysis

## 3.1 CO Roadway Intersection Analysis

A dispersion modeling analysis of CO concentrations at roadway intersections was prepared for the following scenarios: 2010 Baseline, the future No Action and the Action Alternatives within the project opening year or 2020 as well as a future year (2025).

The assessment of roadway intersections with the potential for elevated CO levels was conducted in areas of high motor vehicle traffic volumes following guidelines and methodology developed by the USEPA. For this analysis, existing and future year traffic volumes on roadways and intersections were evaluated. The selection criteria included airport-related traffic volumes, intersection level of service (LOS), presence of sensitive receptors and/or the modification of existing roadways or intersection as a result of the alternative being analyzed. Two intersections were chosen for analysis: I-494 Interchange with 34th Avenue including Airport Lane, and 34th Street at American Boulevard. I-494 mainline traffic was also included in the Interchange analysis since it passed over 34th Avenue on a bridge between the on- and off-ramps with 34th Avenue.

The CAL3QHC dispersion model was used for CO roadway intersection analysis. This model is the USEPA-preferred model for the assessment of CO concentrations near roadways and intersections. Emissions factors were obtained from MOBILE6.2 based upon MPCA input parameters for vehicle fleet mix, ambient temperatures and other inputs. Approach speeds to signalize intersections were assumed to be 25 mph in all cases to ensure conservative estimates. Worst-case meteorological conditions (i.e., low wind speed of 1 m/s and an atmospheric stability Class D or neutral) were assumed and background CO levels were added to the project concentrations.

Traffic data, including traffic volumes, turning movements, signalized cycle times and red light times were developed for each of the intersections based on output from the Highway Capacity Model (HCM) for each scenario.

At American Boulevard and 34th Avenue, receptors were located in the Embassy Suites parking area south of the hotel (northeast quadrant), at the façade of the Crown Plaza Hotel Suites (southeast quadrant), in the open landscaped area (southwest quadrant) and at the parking lot attendant building (northwest quadrant). At the I-494 Interchange with 34th Avenue, receptor were located in the Fort Snelling National Cemetery (northeast quadrant), at the Embassy Suites (southeast quadrant), at the attendant building in the off-airport parking lot (southwest quadrant) and at the Delta Air Lines building entry (northwest quadrant). These are shown in **Figure E.3-1**.

Maximum 1-hour concentrations were identified using a screening technique. Eight-hour concentrations for the I-494 Interchange with 34th Avenue were assumed to be identical to the 1-hour concentrations based upon hourly traffic flow data on I-494. Eight-hour concentrations at the American Boulevard and 34th Avenue intersection were assumed to be 80 percent of the 1-hour values.

Figure E.3-1

**CO Roadway Intersection Dispersion Modeling Receptors**

## 3.2 CO Macroscale Dispersion Analysis

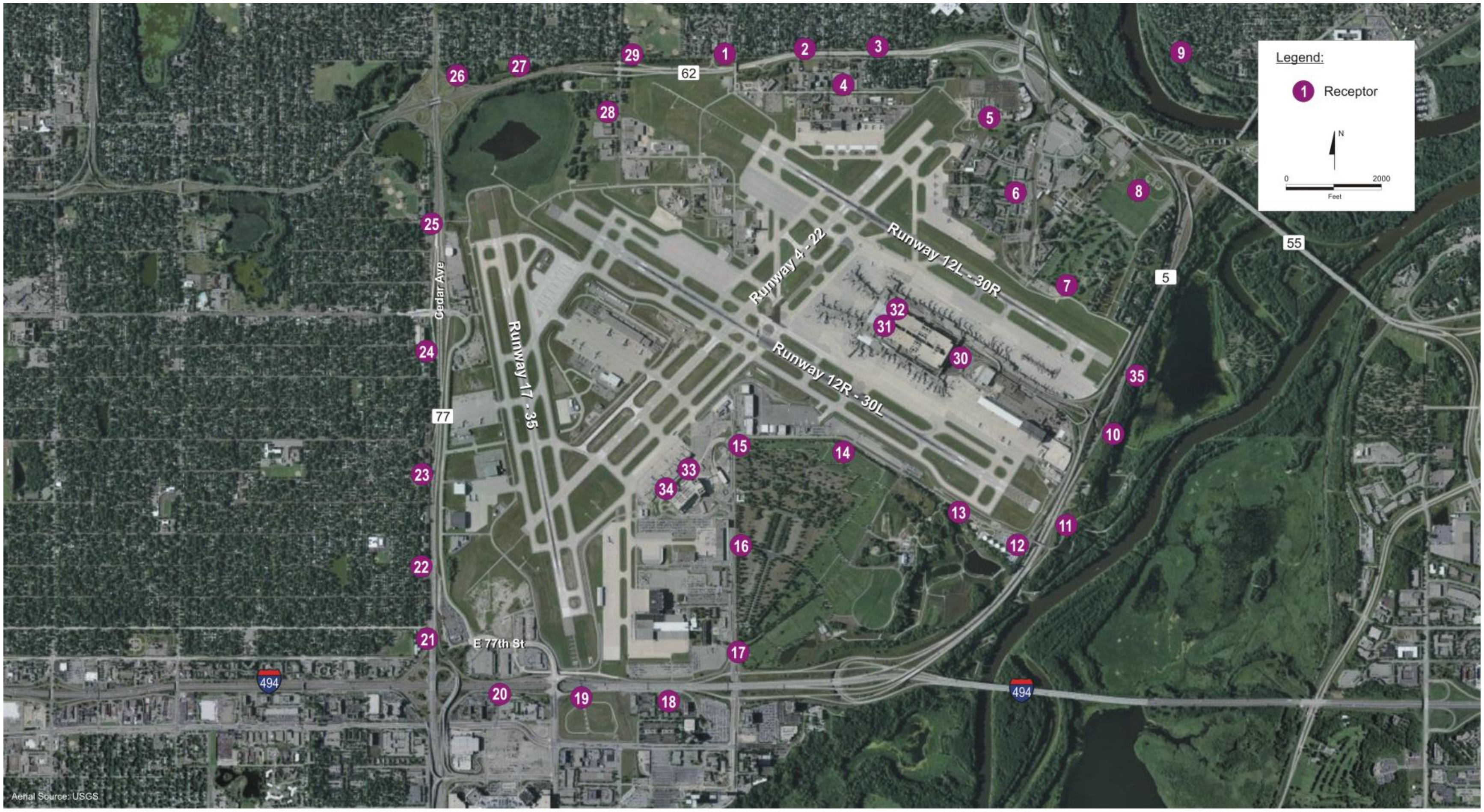
Dispersion is the process by which atmospheric pollutants disseminate due to wind and vertical stability. The results of a dispersion analysis are used to assess pollutant concentrations at or near an airport. The base data for the dispersion analysis are the emission inventories. Dispersion modeling also uses hourly averaged meteorological data, terrain elevation data and emissions and source release data to compute downwind pollutant concentrations over averaging periods ranging from one hour to one year. The results of the analysis allow a direct comparison of predicted concentrations of pollutants to the NAAQS/MAAQS.

The AERMOD dispersion model (Version 09292) was used for the macroscale analysis. AERMOD is the USEPA preferred dispersion model for general industrial sources. The model can simulate point, area, volume, and line sources. The AERMOD model is the appropriate model for this analysis based on the coverage of simple, intermediate, and complex terrain. It also predicts both short-term and long-term (annual) average concentrations. The model was executed using the regulatory default options (stack-tip downwash, buoyancy-induced dispersion, final plume rise), default wind speed profile categories, default potential temperature gradients, and no pollutant decay.

The selection of the appropriate dispersion coefficients depends on the land use within three kilometers (km) of the project site. The land use typing was based on the classification method defined by Auer (1978); using pertinent United States Geological Survey (USGS) 1:24,000 scale (7.5 minute) topographic maps of the area. If the Auer land use types of heavy industrial, light-to-moderate industrial, commercial, and compact residential account for 50 percent or more of the total area, the Guideline on Air Quality Models recommends using urban dispersion coefficients; otherwise, the appropriate rural coefficients were used. Based on recommendations from MPCA, urban dispersion coefficients were applied in the analysis.

Pollutant concentrations were predicted at a sufficient number of receptor locations to identify the maximum concentrations. The term *receptor* generically describes outdoor land uses or activities where the public can reasonably be expected to occupy for a period ranging from one hour to one year. Because EDMS is designed to handle only a moderate number of receptors, a strategy was developed to help limit the run time of the model while optimizing the results. This involved the identification of sensitive receptors and the use of polar grid receptors. Overall, the dispersion analysis includes 40 receptors (see **Figure E.3-2**) for each alternative evaluated, selected as follows:

- **Boundary receptors –** Boundary receptors were located in areas along the airport boundary at a spacing of approximately 10 degrees.
- **Sensitive receptors –** Sensitive receptors include schools, parks, residential areas and health-/day-care centers located in the vicinity of MSP based on current and future land use plans.
- **Worst-case receptors –** Worst-case receptors were selected in close proximity to air emissions sources such as near runway ends, terminal area access/egress roads, and off-site roadway intersections. These receptors represent sites where the pollutant concentrations are expected to be the highest and the public has access.



Minneapolis - St. Paul International Airport

Figure E.3-2

**CO Macroscale Dispersion Receptors**

Receptors were placed at a height of 1.8 meters (typical breathing height). Terrain elevations for receptor locations were used (i.e., complex terrain) based on available USGS Digital Elevation Model (DEM) for the area. AERMAP (Version 11103) was used to develop the terrain elevations.

Air quality is a function of both the rate and location of pollutant emissions under the influence of meteorological conditions and topographic features affecting pollutant movement and dispersal. Atmospheric conditions such as wind speed, wind direction, atmospheric stability, and air temperature gradients interact with the physical features of the landscape to determine the movement and dispersal of air pollutants, and consequently affect air quality.

Due to its location in the northern and central portion of the US, the Twin Cities has the coldest average temperature of any major metropolitan area in the nation. Winters can be very cold, summers are warm to hot and frequently humid, snowfall is common in the winter and thunderstorms with heavy rainfall occur during the spring, summer and autumn.

The average annual temperature is 45.4 °F. The average January temperature is 13.1 °F and the average July temperature is 73.2 °F.[5] The summer months of June, July and August account for nearly half of the annual precipitation, while snow, sleet, freezing rain and (occasionally) rain occur during the winter. The average annual snowfall is 53.7 inches.

Hourly meteorological data were provided by MPCA (by Melissa Sheffer on April 14, 2011). Five years of data (2005 through 2009) were obtained and represents MSP (surface data) and Chanhassen (upper air data). The meteorological data was processed using AERMET (Version 06341). Mixing height data was obtained from the National Climatic Data Center (NCDC), the annual average mixing height is 2,671 feet. **Figure E.3-3** displays the five-year wind rose. As shown, the average wind speed at the airport is 10.4 miles per hour and the wind direction varies but is predominantly from the northwest and southeast.

A worst case meteorological data analysis was conducted for this project to determine which of the five years of meteorological data would result in the highest predicted CO concentrations during the 2010 Baseline Condition. This worst case year was then used for all future year scenarios. As shown in **Table E.3.1**, the year 2008 meteorological data caused the highest concentrations for CO (1-hour and 8-hour). Thus, meteorological data from 2008 was considered the worst-case conditions and used in all further modeling.

Table E.3.1

**Worst Case Meteorological Data Analysis**

| Averaging Period | NAAQS/ MAAQS | Maximum Concentration | | | | |
|---|---|---|---|---|---|---|
| | | 2005 | 2006 | 2007 | 2008 | 2009 |
| 1 hour | 35/30 | 26.4 | 21.2 | 26.8 | **28.4** | 24.0 |
| 8-hour | 9/9 | 8.0 | 6.5 | 7.4 | **8.0** | 6.9 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

**Table E.3.2** and **Table E.3.3** provide the detailed CO macroscale dispersion modeling results at each receptor. Generally, the maximum impacts occur at Receptor 10, which is located to the southeast of the Terminal 1-Lindbergh.

Figure E.3-3

**Meteorological Wind Rose for MSP**

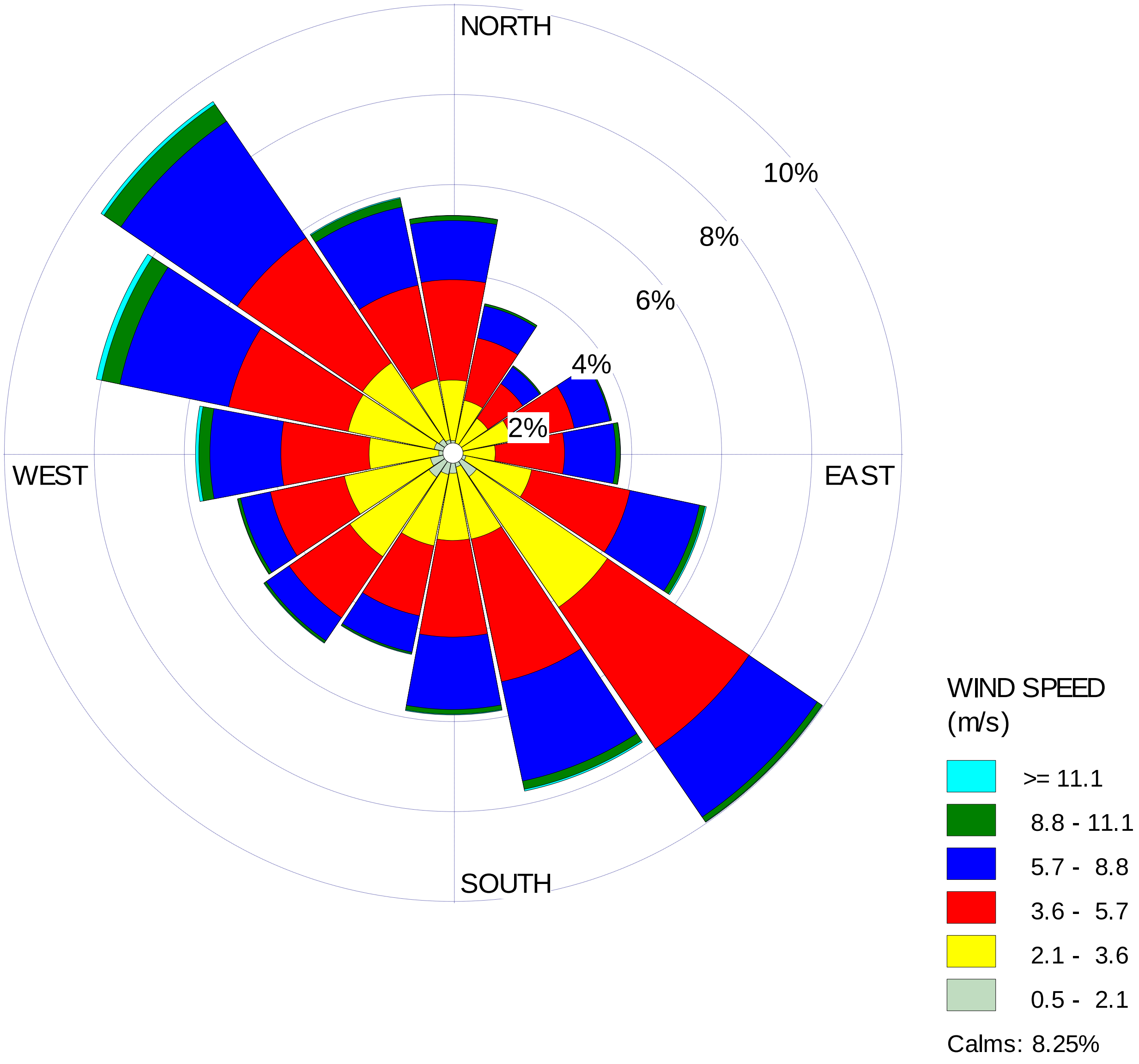


Table E.3.2

## Maximum CO Concentrations for Baseline and No Action Alternatives

| Receptor ID | 2010 Baseline | | 2020 No Action | | 2025 No Action | |
|---|---|---|---|---|---|---|
| | 1-Hour | 8-Hour | 1-Hour | 8-Hour | 1-Hour | 8-Hour |
| 01 | 9.7 | 4.0 | 6.4 | 3.3 | 6.4 | 3.3 |
| 02 | 8.5 | 3.7 | 6.3 | 3.1 | 6.3 | 3.2 |
| 03 | 9.7 | 4.2 | 6.6 | 3.4 | 6.5 | 3.3 |
| 04 | 9.1 | 4.4 | 6.4 | 3.3 | 6.4 | 3.2 |
| 05 | 11.3 | 4.6 | 7.0 | 3.4 | 7.2 | 3.5 |
| 06 | 12.6 | 5.3 | 7.9 | 3.7 | 7.7 | 3.8 |
| 07 | 14.1 | 5.5 | 7.4 | 3.6 | 7.5 | 3.5 |
| 08 | 12.2 | 4.3 | 7.4 | 3.3 | 7.3 | 3.3 |
| 09 | 9.5 | 4.0 | 6.7 | 3.2 | 7.1 | 3.3 |
| 10 | 28.4 | 8.0 | 11.9 | 4.8 | 11.4 | 4.4 |
| 11 | 11.1 | 4.7 | 6.6 | 3.5 | 6.6 | 3.5 |
| 12 | 10.6 | 4.0 | 7.3 | 3.2 | 7.6 | 3.2 |
| 13 | 11.1 | 4.8 | 7.1 | 3.5 | 7.2 | 3.4 |
| 14 | 10.0 | 4.4 | 6.5 | 3.4 | 6.6 | 3.4 |
| 15 | 9.8 | 4.3 | 6.8 | 3.3 | 6.5 | 3.3 |
| 16 | 7.7 | 3.5 | 6.0 | 3.1 | 6.0 | 3.1 |
| 17 | 7.1 | 3.3 | 5.6 | 3.0 | 5.6 | 3.0 |
| 18 | 6.5 | 3.2 | 5.7 | 3.0 | 5.7 | 3.0 |
| 19 | 7.4 | 3.3 | 6.0 | 3.0 | 5.8 | 3.0 |
| 20 | 6.4 | 3.1 | 6.2 | 3.1 | 6.0 | 3.1 |
| 21 | 6.2 | 3.0 | 5.3 | 2.9 | 5.5 | 2.9 |
| 22 | 6.5 | 3.0 | 5.5 | 2.9 | 5.5 | 2.9 |
| 23 | 6.7 | 3.4 | 5.5 | 3.0 | 5.7 | 3.1 |
| 24 | 7.3 | 3.3 | 5.9 | 3.0 | 5.8 | 3.0 |
| 25 | 8.3 | 3.8 | 6.5 | 3.2 | 6.2 | 3.3 |
| 26 | 7.8 | 3.8 | 6.3 | 3.3 | 5.7 | 3.2 |
| 27 | 9.5 | 3.8 | 7.0 | 3.2 | 6.8 | 3.1 |
| 28 | 13.3 | 4.2 | 7.6 | 3.3 | 7.8 | 3.2 |
| 29 | 11.5 | 4.1 | 7.6 | 3.3 | 7.1 | 3.2 |
| 30 | 14.0 | 6.1 | 7.6 | 4.0 | 8.0 | 4.0 |
| 31L | 14.0 | 6.0 | 8.2 | 4.0 | 9.1 | 4.0 |
| 31U | 6.4 | 3.3 | 5.6 | 3.1 | 5.6 | 3.0 |
| 32L | 14.8 | 7.0 | 8.8 | 4.1 | 8.3 | 4.3 |
| 32U | 6.4 | 3.3 | 5.6 | 3.1 | 5.7 | 3.1 |
| 33 | 9.6 | 4.2 | 6.4 | 3.4 | 6.2 | 3.3 |
| 34 | 8.9 | 4.2 | 6.7 | 3.4 | 6.2 | 3.4 |
| 35 | 12.8 | 5.4 | 7.8 | 3.8 | 8.5 | 3.7 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.3.3

## Maximum CO Concentrations for Action Alternatives

| | 2020 Airlines Remain | | 2025 Airlines Remain | | 2020 Airlines Relocate | | 2025 Airlines Relocate | |
|---|---|---|---|---|---|---|---|---|
| **Receptor ID** | **1-Hour** | **8-Hour** | **1-Hour** | **8-Hour** | **1-Hour** | **8-Hour** | **1-Hour** | **8-Hour** |
| 01 | 6.4 | 3.2 | 6.1 | 3.3 | 6.1 | 3.1 | 6.2 | 3.2 |
| 02 | 6.5 | 3.2 | 6.1 | 3.1 | 6.2 | 3.2 | 6.0 | 3.1 |
| 03 | 6.7 | 3.2 | 6.5 | 3.3 | 6.4 | 3.2 | 6.2 | 3.2 |
| 04 | 6.4 | 3.3 | 6.1 | 3.2 | 6.2 | 3.2 | 6.0 | 3.2 |
| 05 | 7.1 | 3.4 | 7.0 | 3.4 | 7.0 | 3.4 | 7.2 | 3.3 |
| 06 | 7.6 | 3.7 | 7.7 | 3.7 | 7.8 | 3.7 | 7.7 | 3.7 |
| 07 | 7.2 | 3.6 | 7.0 | 3.6 | 7.2 | 3.6 | 7.1 | 3.6 |
| 08 | 7.8 | 3.3 | 7.1 | 3.3 | 7.2 | 3.2 | 6.9 | 3.3 |
| 09 | 6.9 | 3.2 | 6.8 | 3.2 | 6.9 | 3.3 | 7.0 | 3.2 |
| 10 | 11.5 | 4.8 | 11.9 | 4.5 | 10.6 | 4.5 | 10.7 | 4.4 |
| 11 | 6.9 | 3.4 | 7.1 | 3.5 | 6.5 | 3.3 | 6.1 | 3.3 |
| 12 | 7.0 | 3.2 | 7.1 | 3.2 | 6.6 | 3.1 | 6.8 | 3.1 |
| 13 | 7.1 | 3.4 | 6.7 | 3.3 | 6.7 | 3.3 | 6.4 | 3.2 |
| 14 | 6.5 | 3.3 | 6.2 | 3.4 | 6.0 | 3.3 | 5.9 | 3.3 |
| 15 | 6.9 | 3.1 | 6.7 | 3.4 | 6.7 | 3.3 | 6.7 | 3.4 |
| 16 | 5.8 | 3.0 | 5.8 | 3.0 | 6.0 | 3.2 | 6.1 | 3.3 |
| 17 | 5.5 | 3.0 | 5.4 | 3.0 | 5.8 | 3.1 | 5.7 | 3.1 |
| 18 | 5.6 | 3.1 | 5.5 | 3.0 | 5.5 | 3.1 | 5.7 | 3.1 |
| 19 | 6.1 | 3.0 | 5.7 | 3.0 | 5.9 | 3.1 | 6.0 | 3.0 |
| 20 | 5.6 | 3.1 | 6.1 | 3.1 | 6.5 | 3.1 | 7.2 | 3.1 |
| 21 | 5.2 | 2.9 | 5.6 | 3.0 | 5.3 | 2.9 | 5.5 | 3.0 |
| 22 | 5.5 | 2.9 | 5.6 | 2.9 | 5.7 | 2.9 | 5.7 | 2.9 |
| 23 | 5.5 | 3.0 | 5.6 | 3.1 | 5.5 | 3.0 | 5.6 | 3.0 |
| 24 | 6.0 | 3.0 | 5.8 | 3.0 | 5.8 | 3.1 | 5.8 | 3.0 |
| 25 | 6.4 | 3.3 | 6.2 | 3.2 | 6.2 | 3.4 | 6.0 | 3.3 |
| 26 | 5.9 | 3.2 | 5.9 | 3.2 | 5.8 | 3.2 | 5.9 | 3.1 |
| 27 | 7.0 | 3.2 | 6.6 | 3.2 | 6.6 | 3.2 | 6.3 | 3.2 |
| 28 | 7.8 | 3.2 | 7.5 | 3.2 | 7.6 | 3.2 | 7.3 | 3.2 |
| 29 | 7.6 | 3.3 | 6.9 | 3.2 | 6.9 | 3.2 | 6.6 | 3.3 |
| 30 | 7.7 | 4.0 | 7.6 | 3.9 | 7.3 | 3.8 | 7.1 | 3.7 |
| 31L | 8.3 | 3.9 | 8.7 | 3.8 | 8.1 | 3.7 | 8.1 | 3.6 |
| 31U | 5.9 | 3.0 | 5.6 | 3.1 | 5.5 | 3.0 | 5.6 | 3.0 |
| 32L | 7.9 | 4.2 | 8.0 | 4.1 | 7.9 | 4.0 | 7.9 | 3.9 |
| 32U | 5.7 | 3.0 | 5.7 | 3.1 | 5.5 | 3.1 | 5.6 | 3.1 |
| 33 | 6.2 | 3.2 | 6.3 | 3.3 | 7.5 | 3.6 | 7.5 | 3.7 |
| 34 | 6.1 | 3.2 | 6.4 | 3.4 | 7.1 | 3.6 | 7.8 | 3.6 |
| 35 | 7.7 | 3.6 | 7.8 | 3.7 | 7.1 | 3.6 | 7.6 | 3.6 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## 3.3 Background Concentrations

The dispersion modeling performed for the air quality analysis cannot represent all pollutant sources in proximity to the airport that contribute to total pollutant levels. Therefore, background concentrations were developed to reflect the emissions from nearby sources. When background concentrations are added to the airport dispersion modeling results, the results represent total pollutant concentrations at the receptor sites. These background levels (**Table E.3.4**) were based on monitoring data collected by MPCA between 2008 and 2010 (**Table E.3.5**). The CO roadway intersection and macroscale dispersion modeling used background concentrations of 4.4 ppm and 2.6 ppm for the 1-hour and 8-hour averaging periods respectively, based on monitoring data from the 1088 West University Avenue station in Saint Paul.

Table E.3.4

**Air Quality Background Concentrations**

| Pollutant | Averaging Period | Background Concentration |
|---|---|---|
| CO | 1-Hour | 4.4 ppm (5,133 µg/m$^3$) |
|  | 8-Hour | 2.6 ppm (2,889 µg/m$^3$) |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.3.5

### Air Monitoring Data in the MSP Area (2008-2010)

| Site Name & ID | Pollutant | Averaging Period | NAAQS | Year[1] | | |
|---|---|---|---|---|---|---|
| | | | | 2008 | 2009 | 2010 |
| 12821 Pine Bend Trail<br>Rosemount<br>027-037-0020 | CO | 8-hour | 9 ppm | 0.4 | 0.7 | 0.9 |
| | | 1-hour | 35 ppm | 0.6 | 1.0 | 1.6 |
| | $SO_2$ | Annual | 0.03 ppm | 0.000936 | 0.000638 | 0.000780 |
| | | 24-hour | 0.14 ppm | 0.0067 | 0.0060 | 0.0058 |
| | | 3-hour | 0.5 ppm | 0.0126 | 00206 | 0.0146 |
| | | 1-hour | 0.075 ppm | 0.021 | 0.029 | 0.025 |
| | $NO_2$ | Annual | 0.053 ppm | 0.00923 | 0.00859 | 0.00972 |
| | | 1-hour (98th) | 0.10 ppm | 0.037 | 0.037 | 0.044 |
| 528 Hennepin Avenue<br>Minneapolis Arts Center<br>027-053-0954 | CO | 8-hour | 9 ppm | 0.9 | 1.9 | 2.0 |
| | | 1-hour | 35 ppm | 2.0 | 2.6 | 2.8 |
| | $SO_2$ | Annual | 0.03 ppm | 0.00114 | 0.00102 | 0.000538 |
| | | 24-hour | 0.14 ppm | 0.0146 | 0.0295 | 0.0111 |
| | | 3-hour | 0.5 ppm | 0.0403 | 0.0456 | 0.0250 |
| | | 1-hour | 0.075 ppm | 0.043 | 0.050 | 0.053 |
| 2142 120th Street<br>Inver Grove Heights<br>027-037-0423 | CO | 8-hour | 9 ppm | 0.3 | 1.5 | 1.7 |
| | | 1-hour | 35 ppm | 0.5 | 1.5 | 1.8 |
| | $SO_2$ | Annual | 0.03 ppm | 0.000496 | 0.000643 | 0.000679 |
| | | 24-hour | 0.14 ppm | 0.006 | 0.005 | 0.012 |
| | | 3-hour | 0.5 ppm | 0.014 | 0.007 | 0.012 |
| | | 1-hour | 0.075 ppm | 0.018 | 0.012 | 0.016 |
| | $NO_2$ | Annual | 0.053 ppm | 0.00525 | 0.00527 | 0.00645 |
| | | 1-hour (98th) | 0.100 ppm | 0.032 | 0.029 | 0.040 |
| 1088 West University Avenue. St. Paul<br>027-037-0423 | CO | 8-hour | 9 ppm | 2.4 | 2.1 | 2.6 |
| | | 1-hour | 35 ppm | 3.2 | 2.6 | 4.4 |
| HC Anderson School<br>2727 10th Avenue. Mpls.<br>027-053-0963 | $PM_{2.5}$ | Annual | 15 $\mu g/m^3$ | 9.97 | 10.1 | 9.19 |
| | | 24-hour (98th) | 35 $\mu g/m^3$ | 25.9 | 38.7 | 28.4 |
| | Pb | 3 Month | 0.15 $\mu g/m^3$ | 0.0032 | 0.0031 | 0.0031 |
| Ramsey Health Center<br>555 Cedar Street<br>St. Paul<br>027-123-0868 | $PM_{10}$ | 24-hour | 150 $\mu g/m^3$ | 46 | 65 | 77 |
| | $PM_{2.5}$ | Annual | 15 $\mu g/m^3$ | 11.1 | 10.5 | 9.99 |
| | | 24-hour (98th) | 35 $\mu g/m^3$ | 32.0 | 39.7 | 35.9 |
| 917 Dakota Street<br>Shakopee<br>027-139-0505 | $O_3$ | 8-hour | 0.075 ppm | 0.067 | 0.063 | 0.075 |

Note:

(1) Indicates highest reading recorded for the year, unless indicated otherwise.

ppm = parts per million

$\mu g/m^3$ = micrograms/cubic meter

Source: USEPA AIRExplorer, 2011.

# 4 GHG Emissions Inventory

## 4.1 Introduction

This section discusses the methodology and approach used to complete the GHG emissions inventory. Greenhouse gases were inventoried in accordance with Airport Cooperative Research Program (ACRP) Guidebook on Preparing Airport Greenhouse Gas Emission Inventories (ACRP Report 11)[6], MPCA's General Guidance for Carbon Footprint Development in Environmental Review,[7] and FAA guidance.[8] The GHG emissions inventory considers the six Kyoto Protocol GHGs – carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$), measured in terms of equivalents of carbon dioxide ($CO_2e$). In general, the emission sources were:

- Aircraft: aircraft operations above (within the cruise mode to its destination) and below 3,000 feet above ground level (AGL), and on the ground. Includes engine startup and auxiliary power units (APU).
- Stationary/Facilities: boilers, chillers, heating units, and emergency generators located at MSP and operated by the MAC.
- Electricity: indirect emissions associated with power generation for all electricity purchased by the MAC for use at MSP.
- Ground Access Vehicles (Landside Vehicles): vehicle traffic coming and going on MSP Airport property (e.g., passenger and MSP employee vehicles [employees of the MAC, airlines, tenants, etc.], delivery trucks, taxis, shuttles buses, etc.).
- Ground Support Equipment/Fleet Vehicles: tenant ground support equipment (GSE) and other fleet vehicles dedicated for use on MSP Airport property by tenants and the MAC.
- Off Airport Vehicles: vehicle traffic associated with MSP on off-airport roadways.

The primary source of guidance and emission factors used in this GHG inventory is from the recommendations included in the ACRP *Guidebook* which references protocols based on the USEPA Climate Leaders program, The Climate Registry, and the World Resources Institute (WRI). The WRI is an environmental think tank, in collaboration with the World Business Council for Sustainable Development, which has developed comprehensive guidance to assist with preparation of GHG emission inventories.

GHG emissions were categorized by ownership and control in the following manner: (1) emissions related to MAC activities were assigned to the Airport category; (2) emissions related to airport tenants were assigned to the tenant category; and (3) emissions related to the public, such as private automobiles, were assigned to the public category.

- Category 1 – GHG emissions from sources that are owned and controlled by the reporting entity (e.g., MAC). Category 1 typically represents sources which are owned by the entity - or sources which are not owned by the entity, but over which the entity can exert control. At MSP, these sources include airport-owned and controlled stationary sources (e.g., boilers, generators, etc.), fleet vehicles and purchased electricity. On-airport ground transportation is included as Category 1 emissions as they are partly controlled by the airport.

- Category 2 – This category comprises sources owned and controlled by airlines and airport tenants, and include aircraft (on-ground, within the LTO up to 3,000 feet, within the cruise mode), GSE/APU and electrical consumption.

- Category 3 – This category generally comprises GHG emissions associated with passenger ground access vehicles. These include public automobiles, taxis, limousines, buses, shuttle vans, etc. operating on the off-airport roadway network.

Consistent with the ACRP *Guidebook*, once the ownership categories are determined, the operational boundaries were also set, reflecting the Scope of the emission source. These Scopes include:

- Scope 1 / Direct – GHG emissions from sources that are owned and controlled by the reporting entity (e.g., MAC) such as stationary sources and airport-owned fleet motor vehicles. Of note, the airport-owned fleet motor vehicles were included as Scope 3 On-airport Roadway emissions. These emissions are a small percentage of the On-airport Roadway emissions.
    - Natural gas, Jet-A, fuel oil #2, and propane combustion and refrigerant usage in MAC-owned and MAC-occupied facilities *(Stationary/Facilities-facility power)*
    - Diesel fuel combustion in MAC-owned emergency back-up power generators *(Stationary/Facilities-combustion)*
    - Gasoline, E85 and diesel fuel consumption in MAC-owned airport maintenance vehicles and equipment on airport roadways *(GSE/Fleet)*

- Scope 2 / Indirect – GHG emissions associated with the generation of purchased electricity.
    - Electricity consumption in MAC-owned and MAC-occupied facilities (*Stationary/Facilities-purchased power*)
    - Electricity consumption from MSP tenants occupying MAC-owned facilities who reimburse the MAC for their electrical power needs (*Stationary/Facilities-purchased power*)

- Scope 3 / Indirect and Optional – GHG emissions that are associated with the activities of the reporting entity (e.g., MAC), but are associated with sources that are owned and controlled by others. These include aircraft-related emissions, emissions from airport tenant’s activities, as well as ground transportation to and from the airport.

  - Gasoline, E85 and diesel fuel consumption in tenant vehicles on airport roadways *(GSE/Fleet)*
  - MAC employee vehicles driving to offices and facilities while on MSP property and other public vehicles (shuttles, taxis, personal vehicles, buses) visiting the airport while on airport roads *(Ground Access Vehicles, public)*
  - Aircraft emissions on the ground, at or below 3,000 feet AGL, above 3,000 feet AGL
  - Aircraft emissions from engine startup and APU associated with aircraft
  - MSP tenant natural gas and propane combustion for facility use (tenants occupying MAC-owned facilities who reimburse the MAC for their natural gas and propane needs) *(Stationary/Facilities-combustion)*
  - Diesel fuel combustion in emergency back-up power generators known to be operated by MSP tenants *(Stationary/Facilities-combustion)*
  - Tenant employee public vehicle use while on MSP property (employees, passengers, cargo delivery, etc.) *(Ground Access Vehicles, public)*
  - Gasoline and diesel fuel consumption from on-airport vehicles, GSE, and other equipment used by MSP tenants *(GSE/Fleet)*

The MAC prepares a GHG Emissions Inventory for MSP on a biannual basis (i.e., 2005, 2007 and 2009) as a means of quantifying the airport's carbon footprint and tracking short- and long-term trends.

### 4.1.1 Air Quality Assessment

This section describes the approach, methodologies, models, data sources and other supporting information that was used in conducting the air quality assessment.

## 4.2 Approach

As provided by the ACRP *Guidebook*, WRI and USEPA emission factors and calculation protocols were used to quantify GHG emissions associated with the MAC and MSP Airport. The following section discusses the specific calculation methodology, data sources, and assumptions used to estimate GHG emissions. Based on the types of sources at MSP, emissions from the following sources were quantified as aircraft emissions, stationary source emissions (both direct and indirect from electricity consumption), and non-aircraft mobile source emissions. These emission sources and the approach to developing their emissions are described further.

As described in the ACRP *Guidebook* and Climate Leaders GHG Inventory Protocol, carbon emission factors are based on the carbon content of the fuel, per unit volume or per unit energy, in addition to the percent oxidized and $CO_2$-to-carbon ratio. Similarly, $CH_4$ and $N_2O$ are two other Kyoto Protocol GHGs emitted during combustion. The $CH_4$ and $N_2O$ emission factors provide a mass of constituent per unit volume of fuel consumed. The mass of constituent is then multiplied by its respective global warming potential (GWP) in order to provide an equivalent $CO_2$e basis. $CO_2$e equivalent values are based upon the GWP values of 1 for $CO_2$, 25 for $CH_4$, and 298 for $N_2O$ (based on a 100 year period) as presented in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. Based on these $CO_2$e factors, 1 ton of $CH_4$ is 25 times more "potent" than 1 ton of $CO_2$ and is weighted, as such, in the GHG emissions inventory. For refrigerants, the GWP for HFC-134a of 1,430 was used.

### 4.2.1 Aircraft Emissions

EDMS was used to calculate all aircraft emissions using total fuel dispensed at MSP as the upper bound. The following data were collected and used to perform the aircraft calculations (see **Section 2** for greater details regarding aircraft fleet mix, number of operations, ground travel time, and single engine taxi):

- Aircraft fleet mix and number of operations: The total number of flight operations by aircraft type at MSP was obtained from the SIMMOD analysis. The number of flight operations was divided by two in order to obtain the number of LTO cycles.

- Fuel burn rates: Fuel burn rates for the modes of operation in an LTO cycle were obtained from the EDMS model. The modes of operation reported by EDMS are: 1) approach, 2) taxi-in/taxi-out, 3) takeoff, and 4) climb out. The aircraft emissions for reverse thrust during landing are included in the taxi in. Each of the segments of an LTO cycle has a different fuel burn rate.

- Time-in-mode: The amount of time in taxi in/taxi out was determined based on information within the SIMMOD model. This information was adjusted for single engine taxi operations for Delta where applicable.

- APU: The fuel usage was estimated based on manufacture fuel flow rates for respective APU (typically from 50 to 860 pounds per hour) or other appropriate methods.

- Engine startup: Fuel usage within the aircraft engine startup mode was estimated based on published guidance for the engine startup fuel flow rate.[9] Based on the number of non-piston aircraft operations and this fuel flow rate, the engine startup fuel usage was determined.

Mixing heights (also referred to as mixing depths) are used by meteorologists to quantify the vertical height of pollutant mixing that occurs in the atmosphere. Consistent with the ACRP *Guidebook*, the GHG emissions inventory assessed emissions with a mixing height of 3,000 feet.

The estimated fuel usage for aircraft operations (Jet A and avgas) are provided in **Section 2**. Each carbon emission factor provides a mass of carbon dioxide ($CO_2$) per unit volume of fuel. **Table E.4.1** provides the emission factors for aircraft fuels.

Table E.4.1

**GHG Emission Factors - Aircraft**

| Fuel | $CO_2$ | $N_2O$ | $CH_4$ | Units |
|---|---|---|---|---|
| Jet A | 21.095 | 0.000683 | 0.000595 | lb/gallon |
| Avgas | 18.355 | 0.000242 | 0.0155 | lb/gallon |

### 4.2.2 Ground Support Equipment

Ground support equipment is a term used to describe the equipment that service aircraft after arrival and before departure at an airport. The type of GSE includes aircraft tugs, baggage tugs, belt loaders, fuel or hydrant trucks, water trucks, lavatory trucks, and cargo loaders, among others.

Air emissions resulting from the operation of GSE vary depending on the type of equipment, fuel type (gasoline, diesel, propane, etc.) and the duration of equipment operation (engine run time). The type of GSE used depends on the aircraft type and the designated category of an aircraft operation (i.e., passenger, cargo, etc.). GSE fuel usage was based on MSP records. The estimated fuel usage for GSE is provided in **Section 2** along with details related to the types of equipment used at MSP and their fuel type and operating times. **Table E.4.2** provides the GHG emission factors for GSE.

Table E.4.2

**GHG Emission Factors – Ground Support Equipment**

| Fuel | $CO_2$ | $N_2O$ | $CH_4$ | Units |
|---|---|---|---|---|
| Diesel | 22.384 | 1.84E-04 | 3.06E-03 | lb/gallon |
| Gasoline | 19.564 | 2.00E-04 | 5.50E-04 | lb/gallon |
| Propane | 12.669 | 1.20E-04 | 2.01E-03 | lb/gallon |

### 4.2.3 Stationary Source Emissions

Stationary sources, referred to as Airport Facilities, at MSP include the following:

- Boilers and chillers for facility use
- Snowmelters
- Heaters
- Emergency power generators
- Purchased electricity

Emissions from stationary sources were calculated in accordance with ACRP *Guidebook* which references the United States Environmental Protection Agency's (USEPA) *Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance: Direct Emissions from Stationary Combustion Sources* (May 2008).

$CO_2$ emissions for each stationary source, excluding purchased electricity, were calculated by multiplying total fuel combusted by its associated carbon emission factor as provided in the ACRP *Guidebook* and the Energy Information Administration *Voluntary Reporting of Greenhouse Gases Program.* Total fuel combusted was calculated from fuel purchase and dispenser records. The respective $CH_4$ and $N_2O$ factors were also used to determine emissions of those constituents. GWPs were then used to convert the masses to a $CO_2e$ basis. The estimated fuel usages for stationary sources are provided in **Section 2**. **Table E.4.3** provides the emission factors for stationary sources.

Table E.4.3

**GHG Emission Factors – Stationary Sources**

| Fuel | $CO_2$ | $N_2O$ | $CH_4$ | Units |
|---|---|---|---|---|
| Natural gas | 11.6976 | 2.20E-09 | 1.10E-07 | lb/therm |
| No. 2 Oil | 22.384 | 1.84E-04 | 3.06E-03 | lb/gallon |
| Jet A | 21.095 | 0.000683 | 0.000595 | lb/gallon |
| Propane | 12.669 | 1.20E-04 | 2.01E-03 | lb/gallon |
| Electrical | 1.31717 | 1.41E-05 | 1.39E-05 | lb/kwh |

Emissions from purchased electricity were also calculated in accordance with the ACRP *Guidebook* and USEPA protocol. Total electricity purchased, based on invoices, was multiplied by the emission factors to determine $CO_2e$ emissions. However, the carbon emission factor is based on continuous emissions monitoring system (CEMS) data and is specific to Xcel Energy electricity production in the Midwest. **Table E.4.3** also provides the emission factors for electrical consumption.

Calculations did not include minor sources such as cutting torches, welding operations, or fugitive emissions associated with maintenance activities due to the relative insignificance of those emissions when compared to overall emissions.

GHG emissions from refrigerant usage was based on material balancing of the emissions taking into account the charging, operating, and disposal of refrigerants and were calculated using maintenance records indicating total annual compound recharged. MSP uses 1,1,1,2-Tetrafluoroethane (or HFC-134a), classified as a GHG, within its refrigerant systems.

### 4.2.4 Motor Vehicles

Motor vehicle sources at MSP include the following:

- Fleet Vehicles: Automobiles, trucks, and heavy equipment, owned and controlled by the MAC and/or tenant organizations for use on airport property. These vehicles burn diesel, gasoline and E85 fuels.

- Ground Access Vehicles (GAV): This category of mobile sources includes vehicles driven onto the MSP property from outside the airport. This includes passenger and airport employee vehicles (airlines, tenants, etc.), taxis, shuttles, buses, delivery trucks (FedEx/UPS, other), etc. With the exception of MAC employees, who were accounted for separately, the landside vehicle category characterizes emissions from the general public while driving on MSP property.

Emissions from motor vehicles were calculated in accordance with the ACRP *Guidebook*, which provides recommended instructions to airport operators on how to prepare an airport-specific GHG emissions inventory.

Emission factors and other data used to develop emissions for motor vehicles were obtained from the ACRP *Guidebook,* U.S. Energy Information Administration[10], the American Association of State Highway and Transportation Officials (AASHTO) Standing Committee on the Environment[11], and USEPA's MOBILE6.2.

### 4.2.5 Fleet Vehicles

Emission calculations from on-airport vehicles and equipment (MAC and tenant fleet) were completed using total fuel combusted as provided by dispenser records and fuel purchase receipts to determine total GHG emissions. Emissions for each mobile source were then calculated by multiplying total fuel combusted by its associated emission factors, considering fuel type. MAC records provide fuel usage from fleet vehicles of 169,573 gallons (diesel), 96,315 gallons (gasoline), and 33,412 gallons (E85) during 2010. **Table E.4.4** provides the emission factors for fleet vehicles. Emission factors for $N_2O$ and $CH_4$ for E85 fuel-vehicles are based on emission factors for gasoline and ethanol.

Table E.4.4

**GHG Emission Factors – Fleet Vehicles**

| Fuel | $CO_2$ | $N_2O$ | $CH_4$ | Units |
|---|---|---|---|---|
| Diesel | 22.384 | 1.84E-04 | 3.06E-03 | lb/gallon |
| Gasoline | 19.564 | 2.00E-04 | 5.50E-04 | lb/gallon |
| E85 | 2.95 | 2.54E-03 | 2.14E-03 | lb/gallon |

### 4.2.6 Ground Access Vehicles

Emission calculations from landside vehicles were completed using a bottom-up approach. The bottom-up approach uses distance traveled multiplied by a fuel economy factor to determine total GHG emissions. Fuel economy factors were obtained from USEPA's MOBILE6.2 model. Fuel efficiencies were developed by vehicle type and fuel type. The vehicle class distribution percentage was multiplied by its respective fuel economy factor to get a single fuel economy from the weighted average for diesel and gasoline. Motor vehicle volumes and mileage traveled were based on traffic study data shown in Section 2 and on-airport and off-airport roadway networks.

The calculated fuel economy factors were multiplied by the number of vehicles visiting the airport, respective distribution, and distance traveled within MSP to get a total quantity of fuel combusted for gasoline and diesel. The total volume of each fuel combusted was then multiplied by the respective emission factors within the AASHTO's *Greenhouse Gas Emission Inventory Methodologies for State Transportation Departments*. GHG emissions from ground access vehicles include running and idling activities. **Table E.4.4** provides the emission factors used for ground access vehicles.

## 4.3 Estimating Future Year GHG Emissions

For future years, activity factors were provided by HNTB and project architects to determine total fuel and energy use in each alternative. The following sources were used:

- Aircraft – increase in operations and changes in fleet mix were used to determine total fuel use and emissions in future years for each alternative.

- Vehicles – projections for traffic increases were used to determine total emissions in future years for each alternative. This includes on-airport roadways, parking lots, and off-airport roadways.

- Stationary Sources – increase in energy consumption (natural gas and electricity) as provided by the project architects based on increased area were used to calculate total emissions. This was then split between the MAC-controlled and tenant-controlled categories based on historical split. This split assigned approximately 7.4 percent of electricity and 9.7 percent of natural gas consumption (and emissions) to the MAC. It should be noted that insignificant sources were assumed to stay the same as the baseline scenario.

- GSE – increases were determined based on increase in aircraft activity.

# 5 Detailed Emissions Inventory Results

The following section provides detailed emissions inventory results for the criteria pollutants and GHG. The results provide the emission inventories by source type.

## 5.1 Criteria Pollutant Emissions

The detailed results of the No Action Alternative operational emissions inventory for 2020 and 2025 are presented in **Table E.5.1**.

As shown, airport-related CO and NO$_x$ emissions are estimated to be produced in the greatest quantities, followed by VOC, SO$_x$, and PM$_{10/2.5}$. Aircraft are expected to remain the largest source category of emissions with off-airport motor vehicles, on-airport motor vehicles, and GSE/APUs generating less, by comparison. This outcome is consistent with the 2010 Baseline emissions inventory results. According to these results, there is a forecasted increase in emissions from 2020 to 2025 for all pollutants and from all sources (except GSE), which is attributable to the increase in airport operational levels within this timeframe. The only exception is emissions from GSE, which are anticipated to decrease due to emission reductions associated with advancements in equipment technology on a nation-wide basis[12].

Table E.5.1

**No Action Alternative**
**Operational Emissions Inventory**
(tons per year)

| **Source** | CO | | VOC | | NO$_X$ | | SO$_X$ | | PM$_{10}$ | | PM$_{2.5}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** |
| Aircraft | 1,721 | 1,989 | 281 | 325 | 2,006 | 2,321 | 203 | 232 | 21 | 24 | 21 | 24 |
| GSE | 619 | 551 | 20 | 18 | 54 | 42 | 5.2 | 5.9 | 3.5 | 3.2 | 3.3 | 2.9 |
| APUs | 56 | 55 | 4.5 | 4.4 | 56 | 65 | 7.9 | 8.9 | 7.2 | 7.5 | 7.2 | 7.5 |
| On-airport Roadways | 678 | 777 | 21 | 23 | 28 | 26 | 0.6 | 0.7 | 1.8 | 2.0 | 0.9 | 1.0 |
| Parking lots/ramps | 136 | 151 | 6.8 | 7.3 | 5.4 | 5.0 | 0.1 | 0.1 | 0.2 | 0.3 | 0.1 | 0.1 |
| Stationary Sources | 19 | 19 | 5.0 | 5.0 | 25 | 25 | 0.3 | 0.3 | 2.1 | 2.1 | 2.1 | 2.1 |
| Fuel Storage | - | - | 11 | 13 | - | - | - | - | - | - | - | - |
| **On-airport Total(1)** | **3,229** | **3,543** | **350** | **396** | **2,175** | **2,485** | **217** | **247** | **36** | **39** | **35** | **37** |
| Off-airport Roadways(2) | 1,476 | 1,712 | 37 | 41 | 66 | 61 | 1.0 | 1.2 | 3.3 | 3.8 | 1.7 | 1.8 |
| **Totals(1)** | **4,705** | **5,256** | **387** | **436** | **2,241** | **2,545** | **218** | **249** | **39** | **43** | **36** | **39** |

Note:
(1)Totals may differ from sum due to rounding.
(2)Off-airport roadways include airport-related motor vehicles only.

Source: Wenck Associates, Inc, KB Environmental Sciences, Inc, and David Braslau Associates, Inc., 2011.

The detailed results of the Airlines Remain Alternative operational emissions inventory for 2020 and 2025 are presented in **Table E.5.2.**

As shown, CO and NO$_X$ emissions are expected to be emitted in the greatest quantities, followed by VOC, SO$_X$, and PM$_{10/2.5}$. This is consistent with the No Action Alternative. Aircraft emissions are expected to remain the dominant source of these pollutants followed by motor vehicles and GSE/APUs.

Between 2020 and 2025, there is a predicted increase in emissions for all pollutants and for all sources (except GSE) attributable to the forecasted increase in airport operational levels within this timeframe. The exception is emissions from GSE which are shown to decrease due to the advancements in equipment technology.

Table E.5.2

**Alternative 1 – Airlines Remain**
**Operational Emissions Inventory**
(tons per year)

| Source | CO | | VOC | | $NO_X$ | | $SO_X$ | | $PM_{10}$ | | $PM_{2.5}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** |
| Aircraft | 1,723 | 1,920 | 282 | 318 | 2,006 | 2,306 | 203 | 227 | 21 | 24 | 21 | 24 |
| GSE | 620 | 545 | 20 | 17 | 54 | 42 | 5.2 | 5.8 | 3.5 | 3.1 | 3.3 | 2.9 |
| APUs | 56 | 55 | 4.5 | 4.4 | 56 | 65 | 7.9 | 8.8 | 7.2 | 7.4 | 7.2 | 7.4 |
| On-airport Roadways | 684 | 777 | 22 | 23 | 28 | 26 | 0.6 | 0.6 | 1.8 | 2.0 | 0.9 | 1.0 |
| Parking lots/ramps | 122 | 137 | 6.2 | 6.8 | 4.8 | 4.5 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 |
| Stationary Sources | 21 | 21 | 5.0 | 5.0 | 26 | 26 | 0.3 | 0.3 | 2.2 | 2.2 | 2.2 | 2.2 |
| Fuel Storage | - | - | 11 | 13 | - | - | - | - | - | - | - | - |
| **On-airport Total**(1) | **3,225** | **3,455** | **350** | **388** | **2,175** | **2,470** | **217** | **243** | **36** | **38** | **35** | **37** |
| Off-airport Roadways(2) | 1,481 | 1,719 | 37 | 41 | 66 | 61 | 1.1 | 1.2 | 3.3 | 3.8 | 1.7 | 1.8 |
| **Total**(1) | **4,707** | **5,174** | **387** | **429** | **2,241** | **2,531** | **218** | **244** | **39** | **42** | **36** | **39** |

Note:
(1) Totals may differ from sum due to rounding.
(2) Off-airport roadways include airport-related motor vehicles only.

Source: Wenck Associates, Inc, KB Environmental Sciences, Inc, and David Braslau Associates, Inc., 2011.

The results of the Airlines Relocate Alternative emissions inventory for 2020 and 2025 are presented in **Table E.5.3.**

As shown, CO and $NO_X$ emissions under Airlines Relocate Alternative are expected to be emitted in the greatest quantities, followed by VOC, $SO_X$, and $PM_{10/2.5}$. This is consistent with the results for the No Action Alternative. Aircraft emissions are expected to remain the dominant source of these pollutants followed by motor vehicles and GSE/APUs.

Between 2020 and 2025, there is a predicted increase in emissions for all emissions and for all sources (except GSE) attributable to the forecasted increase in airport operational levels within this timeframe. The exception is emissions from GSE which are shown to decrease due to the advancements in equipment technology.

Table E.5.3

**Alternative 2 – Airlines Relocate**
**Operational Emissions Inventory**
(tons per year)

| Source | CO | | VOC | | $NO_X$ | | $SO_X$ | | $PM_{10}$ | | $PM_{2.5}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** |
| Aircraft | 1,663 | 1,979 | 273 | 326 | 1,994 | 2,320 | 199 | 231 | 21 | 24 | 21 | 24 |
| GSE | 619 | 542 | 20 | 17 | 54 | 42 | 5.2 | 5.8 | 3.5 | 3.1 | 3.3 | 2.9 |
| APUs | 54 | 53 | 4.2 | 4.2 | 54 | 62 | 7.5 | 8.5 | 6.9 | 7.2 | 6.9 | 7.2 |
| On-airport Roadways | 810 | 901 | 26 | 27 | 33 | 31 | 0.7 | 0.8 | 2.1 | 2.3 | 1.0 | 1.1 |
| Parking lots/ramps | 124 | 139 | 6.3 | 6.8 | 4.8 | 4.6 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 |
| Stationary Sources | 21 | 21 | 5.1 | 5.1 | 27 | 27 | 0.4 | 0.4 | 2.2 | 2.2 | 2.2 | 2.2 |
| Fuel Storage | - | - | 11 | 13 | - | - | - | - | - | - | - | - |
| **On-airport Total**(1) | **3,290** | **3,636** | **346** | **399** | **2,167** | **2,486** | **213** | **247** | **36** | **39** | **34** | **37** |
| Off-airport Roadways(2) | 1,416 | 1,650 | 35 | 39 | 63 | 58 | 1.0 | 1.2 | 3.2 | 3.7 | 1.6 | 1.8 |
| **Total**(1) | **4,706** | **5,285** | **381** | **438** | **2,230** | **2,545** | **214** | **248** | **39** | **43** | **36** | **39** |

Notes:
(1) Totals may differ from sum due to rounding.
(2) Off-airport roadways include airport-related motor vehicles only.

Source: Wenck Associates, Inc, KB Environmental Sciences, Inc, and David Braslau Associates, Inc., 2011.

## 5.2 GHG Emissions

For this analysis, the total GHG emissions are represented by $CO_2$ equivalents ($CO_2$e), which accounts for the Global Warming Potentials (GWP) based on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, which range from 1 for $CO_2$ to 25 for $CH_4$ to 298 for $N_2O$. For refrigerants, the GWP for HFC-134a of 1,430 was used. Based on these $CO_{2e}$ factors, 1 ton of $CH_4$ is 25 times more potent than 1 ton of $CO_2$ and is weighted, as such, in the GHG emissions inventory.

The ACRP *Guidebook on Preparing Airport Greenhouse Gas Emission Inventories (ACRP Report 11)*[13], which provides recommended instructions to airport operators on how to prepare an airport-specific GHG emissions inventory, was used to complete this analysis. Consistent with ACRP *Guidebook*, the GHG emissions estimates include aircraft within the landing take-off (LTO) cycle, GSE, APU, motor vehicles, stationary sources, and electricity usage at MSP. Aircraft cruise emissions above the 3,000-foot level were also included.

GHG emissions from refrigerant usage were based on material balancing of the emissions taking into account the charging and operational use of refrigerants. MSP uses 1,1,1,2-Tetrafluoroethane (or HFC-134a), classified as a GHG, within its refrigerant systems.

GHG emissions were further categorized by ownership and control in the following manner: (1) emissions related to MAC activities were assigned to the Airport category; (2) emissions related to airport tenants were assigned to the tenant category; and (3) emissions related to the public, such as private automobiles, were assigned to the public category.

The differences in GHG emission totals between 2020 and 2025 are attributable to the forecasted increases in airport operations over this time period.

**Table E.5.4** summarizes the GHG emissions for the No Action Alternative.

Table E.5.4

**No Action Alternative**
**GHG Emissions Inventory**
(metric tons per year of $CO_2e$)

| ***Source*** | **Scope** | **2020** | **2025** |
|---|---|---|---|
| *Airport Owned/Controlled* | | | |
| Stationary Sources - Combustion | 1 | 3,435 | 3,435 |
| Stationary Sources - Refrigerants | 1 | 675 | 675 |
| MAC Fleet Vehicles | 1 | 3,572 | 4,191 |
| Electrical Consumption | 2 | 7,281 | 7,281 |
| On-airport Roadways | 3 | 27,385 | 32,134 |
| Parking Ramps/Lots | 3 | 3,708 | 4,184 |
| **Total – Airport Owned/Controlled**(1) | | **46,054** | **51,899** |
| *Tenant Owned/Controlled* | | | |
| Aircraft (Ground-based) | 3 | 204,053 | 243,432 |
| Aircraft (Ground to 3,000 feet) | 3 | 252,473 | 276,820 |
| Aircraft (cruise mode) | 3 | 3,178,015 | 3,484,481 |
| Aircraft - Engine Startup | 3 | 3,187 | 3,461 |
| Auxiliary Power Units | 3 | 22,417 | 25,180 |
| **Subtotal – Aircraft**(1) | | **3,660,145** | **4,033,373** |
| Ground Support Equipment | 3 | 33,482 | 37,912 |
| Stationary Sources - Combustion | 3 | 22,037 | 22,037 |
| Electrical Consumption | 3 | 91,446 | 91,446 |
| **Total – Tenant Owned/Controlled**(1) | | **3,807,110** | **4,184,768** |
| *Passenger Owned/Controlled* | | | |
| Off-airport Roadways (Airport-related only) | 3 | 57,769 | 68,497 |
| **Total – Passenger Owned/Controlled**(1) | | **57,769** | **68,497** |
| **Grand Total**(1) | | **3,910,933** | **4,305,163** |

Note:
(1) Totals may differ from sum due to rounding.

Source: Wenck Associates, Inc, KB Environmental Sciences, Inc, and David Braslau Associates, Inc., 2011.

**Table E.5.5** summarizes the estimated GHG emissions inventory for MSP under Airlines Remain Alternative in 2020 and 2025. As shown, the total GHG emissions are represented by $CO_2e$ and the same methodology was used for the No Action Alternative.

Table E.5.5

### Alternative 1 – Airline Remain
### GHG Emissions Inventory

(metric tons per year of $CO_2e$)

| Source | Scope | 2020 | 2025 |
|---|---|---|---|
| *Airport Owned/Controlled* | | | |
| Stationary Sources - Combustion | 1 | 3,578 | 3,578 |
| Stationary Sources - Refrigerants | 1 | 675 | 675 |
| MAC Fleet Vehicles | 1 | 3,607 | 4,195 |
| Electrical Consumption | 2 | 8,474 | 8,474 |
| On-airport Roadways | 3 | 27,660 | 32,167 |
| Parking Ramps/Lots | 3 | 3,172 | 3,644 |
| **Total – Airport Owned/Controlled**(1) | | **47,165** | **52,733** |
| *Tenant Owned/Controlled* | | | |
| Aircraft (Ground-based) | 3 | 204,207 | 233,728 |
| Aircraft (Ground to 3,000 feet) | 3 | 252,473 | 276,820 |
| Aircraft (cruise mode) | 3 | 3,178,015 | 3,484,481 |
| Aircraft - Engine Startup | 3 | 3,187 | 3,461 |
| Auxiliary Power Units | 3 | 22,305 | 24,874 |
| **Subtotal – Aircraft**(1) | | **3,660,187** | **4,023,363** |
| Ground Support Equipment | 3 | 33,236 | 37,723 |
| Stationary Sources - Combustion | 3 | 23,325 | 23,325 |
| Electrical Consumption | 3 | 106,437 | 106,437 |
| **Total – Tenant Owned/Controlled**(1) | | **3,823,186** | **4,190,849** |
| *Passenger Owned/Controlled* | | | |
| Off-airport Roadways (Airport-related only) | 3 | 57,970 | 68,679 |
| **Total – Passenger Owned/Controlled**(1) | | **57,970** | **68,679** |
| **Grand Total**(1) | | **3,928,321** | **4,312,261** |

Notes:

(1) Totals may differ from sum due to rounding.

Source: Wenck Associates, Inc, KB Environmental Sciences, Inc, and David Braslau Associates, Inc., 2011.

**Table E.5.6** summarizes the GHG emissions for Airlines Relocate Alternative. The total GHG emissions are represented by $CO_2e$ (or $CO_2$ equivalent) and the same methodology used for the No Action Alternative.

Table E.5.6

**Alternative 2 – Airlines Relocate GHG Emissions Inventory**

(metric tons per year of $CO_2e$)

| Source | Scope | 2020 | 2025 |
|---|---|---|---|
| *Airport Owned/Controlled* | | | |
| Stationary Sources - Combustion | 1 | 3,626 | 3,626 |
| Stationary Sources - Refrigerants | 1 | 675 | 675 |
| MAC Fleet Vehicles | 1 | 4,255 | 4,845 |
| Electrical Consumption | 2 | 8,976 | 8,976 |
| On-airport Roadways | 3 | 32,630 | 37,148 |
| Parking Ramps/Lots | 3 | 3,251 | 3,700 |
| **Total – Airport Owned/Controlled**(1) | | **53,413** | **58,970** |
| *Tenant Owned/Controlled* | | | |
| Aircraft (Ground-based) | 3 | 196,237 | 242,053 |
| Aircraft (Ground to 3,000 feet) | 3 | 252,473 | 276,820 |
| Aircraft (cruise mode) | 3 | 3,178,015 | 3,484,481 |
| Aircraft - Engine Startup | 3 | 3,187 | 3,461 |
| Auxiliary Power Units | 3 | 21,340 | 24,083 |
| **Subtotal – Aircraft**(1) | | **3,651,252** | **4,030,898** |
| Ground Support Equipment | 3 | 33,236 | 37,558 |
| Stationary Sources - Combustion | 3 | 23,624 | 23,624 |
| Electrical Consumption | 3 | 112,747 | 112,747 |
| **Total – Tenant Owned/Controlled**(1) | | **3,820,860** | **4,204,827** |
| *Passenger Owned/Controlled* | | | |
| Off-airport Roadways (Airport-related only) | 3 | 55,376 | 65,990 |
| **Total – Passenger Owned/Controlled**(1) | | **55,376** | **65,990** |
| **Grand Total**(1) | | **3,929,648** | **4,329,787** |

Note:
(1) Totals may differ from sum due to rounding.

Source: Wenck Associates, Inc, KB Environmental Sciences, Inc, and David Braslau Associates, Inc., 2011.

# 6 HAPS Emissions Inventory

## 6.1 Introduction

In recent years, public and agency interest has increased regarding airport contributions to levels of hazardous air pollutants (HAPs).[14] HAPs comprise gaseous organic and inorganic chemicals and particulate matter with known or suspected potential to cause cancer (carcinogenic) or other serious health effects (non-carcinogenic). They are commonly emitted by a wide range of airport and non-airport sources, including aircraft, ground support equipment, motor vehicles, home furnaces, evaporating fuel and paints, wood burning, carpets, dry-cleaning of clothing, and industrial facilities. The term HAPs refers to pollutants that do not have established Ambient Air Quality Standards (AAQS) but present potential adverse human health risks from short-term or long-term exposures. Although there are no Federal or state reporting requirements applicable to airports for these pollutants, the HAP analysis performed in this Appendix was consistent with agency guidelines for quantifying emissions of HAPs.

HAPs emissions inventories were prepared for all analysis years and alternatives.

Speciation factors were applied to quantify individual HAP compounds. These factors estimate the quantity of an individual HAP based on total emissions of VOC. This methodology was employed partly because limited testing has been performed nationwide to identify and quantify HAP emissions levels associated with airport sources, including aircraft engines.

Annual emissions of specific air toxic compounds in tons per year were estimated from all activities at the Airport and from motor vehicles on the major roadways in the vicinity of the airport. The source categories identified for air toxic emissions inventory included aircraft sources; GSE; motor vehicles on airport roadways, parking facilities, and at terminal curbsides; fuel storage and handling; on-site stationary fuel combustion sources including, generators, and snowmelters. Motor vehicles on access and egress roads in the vicinity of the airport were also accounted.

## 6.2 Approach

Emissions inventories are quantities of air pollutants emitted over a given time period, and provide information about pollutant contributions from various sources. Emissions are estimated by multiplying emission factors by source activity levels. Emission factors are the emissions from a single source for a unit of time or distance (e.g., a single motor vehicle traveling one mile). The source activity for such a factor would be the number of vehicle miles traveled in a given time period, such as one day. Emission inventories specifically for air toxic substances are typically developed using both emission factors and published speciation profile data. Speciation profiles list the weight fractions or weight percentages of the "air toxic" emissions, by compound, which are included in the VOC emissions for each source category. Depending on the nature of the source activity data, both emission factors and speciation profiles were used in this air toxic emissions inventory study. For each of the Alternatives, annual emission inventories of identifiable Airport-related HAPs that are a subset of VOC emissions were developed based on FAA guidance.

The USEPA MOBILE6.2 computer program was used to develop individual HAP speciation data for use in calculating on-road motor vehicle HAP emissions from the projected on- and off-Airport vehicle fleet mixes and associated activity data. In this regard, MOBILE6.2 was first used to develop individual HAP emission factors for the on-road motor vehicles. Speciation data were then developed for each HAP based on the ratio of individual HAP emission factors and corresponding VOC emission factors, as appropriate.

In September of 2009, FAA released its new guidance for quantifying airport-related HAP emissions from airport sources[15]. The guidance provides detailed recommendations on the preparation of the analysis and references HAPs speciation profiles for airport emission sources.[16]

## 6.3 Detailed Results

A summary of the HAPs emissions inventory is presented in **Table E.6.1**. Formaldehyde is expected to occur in the greatest amounts followed by acetaldehyde, benzene, acrolein, 1,3-butadiene, and methyl alcohol. Aircraft is the largest contributor of formaldehyde, acetaldehyde, acrolein, 1,3-butadiene, and methyl alcohol, while motor vehicles are expected to be the largest contributor of benzene.

Generally, the HAP emissions for Alterative 1 and 2 are less than the No Action due to lower aircraft taxi times and other airfield improvements. The differences in emission totals between 2020 and 2025 are attributable to the forecasted increases in airport operations, changes in ground-based aircraft taxi times, and changes in on- and off-site surface traffic volumes over this time period. However, some of these increases are offset by the reductions in HAPs emissions factors from improvements with GSE and motor vehicle engine exhaust that are regulated to continue in the future. **Tables E.6.2** through **E.6.8** present the detailed HAP emissions inventory for the 2010 Baseline Condition, future-year No Action and Action Alternatives.

Table E.6.1

**Summary of HAPs Emissions Inventory (tons)**

| | **No Action** | | **Alternative 1** | | **Alternative 2** | |
|---|---|---|---|---|---|---|
| **Pollutant** | **2020** | **2025** | **2020** | **2025** | **2020** | **2025** |
| 1,3-butadiene | 3.92 | 4.58 | 3.93 | 4.45 | 3.80 | 4.58 |
| 2,2,4-trimethylpentane | 0.28 | 0.23 | 0.28 | 0.23 | 0.28 | 0.23 |
| 2-methylnaphthalene | 0.43 | 0.51 | 0.44 | 0.50 | 0.42 | 0.51 |
| Acetaldehyde | 9.92 | 11.6 | 9.95 | 11.3 | 9.61 | 11.6 |
| Acetone | 0.88 | 1.02 | 0.88 | 0.99 | 0.85 | 1.02 |
| Acrolein | 5.27 | 6.18 | 5.29 | 6.01 | 5.08 | 6.18 |
| Benzaldehyde | 1.03 | 1.20 | 1.03 | 1.17 | 0.99 | 1.20 |
| Benzene | 7.23 | 8.14 | 7.24 | 8.00 | 7.21 | 8.22 |
| Chlorobenzene | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Cyclohexane | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 |
| Ethylbenzene | 0.85 | 0.94 | 0.85 | 0.92 | 0.83 | 0.93 |
| Formaldehyde | 27.7 | 32.4 | 27.8 | 31.5 | 26.8 | 32.4 |
| Isopropylbenzene (cumene) | 0.03 | 0.04 | 0.03 | 0.04 | 0.03 | 0.04 |
| M & P-xylene | 1.92 | 2.19 | 1.92 | 2.17 | 1.90 | 2.19 |
| Methyl alcohol | 3.80 | 4.47 | 3.81 | 4.34 | 3.66 | 4.47 |
| M-xylene | 0.34 | 0.29 | 0.34 | 0.29 | 0.34 | 0.30 |
| Naphthalene | 1.23 | 1.44 | 1.23 | 1.40 | 1.18 | 1.44 |
| N-heptane | 0.49 | 0.52 | 0.50 | 0.52 | 0.49 | 0.52 |
| N-hexane | 0.77 | 0.78 | 0.77 | 0.78 | 0.77 | 0.78 |
| O-xylene | 1.08 | 1.18 | 1.08 | 1.17 | 1.06 | 1.18 |
| Phenol (carbolic acid) | 1.54 | 1.81 | 1.54 | 1.75 | 1.48 | 1.80 |
| Propionaldehyde | 1.62 | 1.90 | 1.63 | 1.84 | 1.57 | 1.89 |
| Styrene | 0.68 | 0.79 | 0.68 | 0.77 | 0.65 | 0.79 |
| Toluene | 3.32 | 3.64 | 3.33 | 3.60 | 3.28 | 3.64 |

Source: Wenck Associates, Inc, KB Environmental Sciences, Inc, and David Braslau Associates, Inc., 2011.

Table E.6.2

**2010 Baseline Condition Hazardous Air Pollutants Emissions Inventory (tons)**

| | Source | | | | |
|---|---|---|---|---|---|
| Pollutant | Aircraft | APU/GSE | Motor Vehicles | Stationary Sources | Total |
| 1,3-butadiene | 2.83 | 0.07 | 0.41 | 0.01 | 3.32 |
| 2,2,4-trimethylpentane | NA | 1.02 | NA | NA | 1.02 |
| 2-methylnaphthalene | 0.34 | 0.01 | NA | NA | 0.35 |
| Acetaldehyde | 7.17 | 0.35 | 0.89 | NA | 8.41 |
| Acetone | 0.70 | 0.02 | NA | NA | 0.72 |
| Acrolein | 4.10 | 0.10 | 0.06 | NA | 4.26 |
| Benzaldehyde | 0.79 | 0.05 | NA | NA | 0.84 |
| Benzene | 2.83 | 1.26 | 3.72 | 0.40 | 8.20 |
| Chlorobenzene | NA | NA | NA | <0.01 | <0.01 |
| Cyclohexane | NA | NA | NA | 0.02 | 0.02 |
| Ethylbenzene | 0.29 | 0.46 | NA | 0.28 | 1.03 |
| Formaldehyde | 20.7 | 1.01 | 1.12 | 0.19 | 23.0 |
| Isopropylbenzene | 0.01 | NA | NA | 0.02 | 0.03 |
| M & P-xylene | 0.47 | 0.01 | NA | 1.05 | 1.54 |
| Methyl alcohol | 2.97 | 0.07 | NA | NA | 3.05 |
| M-xylene | NA | 1.26 | NA | NA | 1.26 |
| Naphthalene | 0.91 | 0.02 | NA | 0.06 | 0.98 |
| N-heptane | 0.11 | 0.50 | NA | 0.18 | 0.79 |
| N-hexane | NA | 1.04 | NA | 0.40 | 1.44 |
| O-xylene | 0.28 | 0.63 | NA | 0.44 | 1.35 |
| Phenol | 1.20 | 0.03 | NA | NA | 1.23 |
| Propionaldehyde | 1.23 | 0.14 | NA | NA | 1.36 |
| Styrene | 0.52 | 0.01 | NA | 0.01 | 0.55 |
| Toluene | 1.07 | 2.05 | NA | 1.14 | 4.26 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## Table E.6.3
## 2020 No Action Hazardous Air Pollutants Emissions Inventory (tons)

| | Source | | | | |
|---|---|---|---|---|---|
| Pollutant | Aircraft | APU/GSE | Motor Vehicles | Stationary Sources | Total |
| 1,3-butadiene | 3.53 | 0.08 | 0.30 | 0.01 | 3.92 |
| 2,2,4-trimethylpentane | NA | 0.28 | NA | NA | 0.28 |
| 2-methylnaphthalene | 0.42 | 0.01 | NA | NA | 0.43 |
| Acetaldehyde | 8.95 | 0.29 | 0.67 | NA | 9.92 |
| Acetone | 0.86 | 0.02 | NA | NA | 0.88 |
| Acrolein | 5.12 | 0.11 | 0.04 | NA | 5.27 |
| Benzaldehyde | 0.99 | 0.04 | NA | NA | 1.03 |
| Benzene | 3.52 | 0.40 | 2.84 | 0.46 | 7.23 |
| Chlorobenzene | NA | NA | NA | <0.01 | <0.01 |
| Cyclohexane | NA | NA | NA | 0.02 | 0.02 |
| Ethylbenzene | 0.36 | 0.13 | NA | 0.35 | 0.85 |
| Formaldehyde | 25.8 | 0.86 | 0.85 | 0.19 | 27.7 |
| Isopropylbenzene | 0.01 | NA | NA | 0.03 | 0.03 |
| M & P-xylene | 0.59 | 0.01 | NA | 1.32 | 1.92 |
| Methyl alcohol | 3.72 | 0.08 | NA | NA | 3.80 |
| M-xylene | NA | 0.34 | NA | NA | 0.34 |
| Naphthalene | 1.13 | 0.02 | NA | 0.07 | 1.23 |
| N-heptane | 0.13 | 0.14 | NA | 0.22 | 0.49 |
| N-hexane | NA | 0.28 | NA | 0.49 | 0.77 |
| O-xylene | 0.35 | 0.18 | NA | 0.55 | 1.08 |
| Phenol | 1.50 | 0.03 | NA | NA | 1.54 |
| Propionaldehyde | 1.53 | 0.10 | NA | NA | 1.62 |
| Styrene | 0.65 | 0.01 | NA | 0.02 | 0.68 |
| Toluene | 1.34 | 0.58 | NA | 1.41 | 3.32 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.6.4

### 2020 Alternative 1 - Airlines Remain Alternative Hazardous Air Pollutants Emissions Inventory (tons)

| | Source | | | | |
|---|---|---|---|---|---|
| Pollutant | Aircraft | APU/GSE | Motor Vehicles | Stationary Sources | Total |
| 1,3-butadiene | 3.54 | 0.08 | 0.30 | 0.01 | 3.93 |
| 2,2,4-trimethylpentane | NA | 0.28 | NA | NA | 0.28 |
| 2-methylnaphthalene | 0.43 | 0.01 | NA | NA | 0.44 |
| Acetaldehyde | 8.98 | 0.29 | 0.67 | NA | 9.95 |
| Acetone | 0.86 | 0.02 | NA | NA | 0.88 |
| Acrolein | 5.14 | 0.11 | 0.04 | NA | 5.29 |
| Benzaldehyde | 0.99 | 0.04 | NA | NA | 1.03 |
| Benzene | 3.54 | 0.40 | 2.83 | 0.47 | 7.24 |
| Chlorobenzene | NA | NA | NA | <0.01 | <0.01 |
| Cyclohexane | NA | NA | NA | 0.03 | 0.03 |
| Ethylbenzene | 0.37 | 0.13 | NA | 0.35 | 0.85 |
| Formaldehyde | 25.9 | 0.85 | 0.84 | 0.20 | 27.8 |
| Isopropylbenzene | 0.01 | NA | NA | 0.03 | 0.03 |
| M & P-xylene | 0.59 | 0.01 | NA | 1.32 | 1.92 |
| Methyl alcohol | 3.7 | 0.08 | NA | NA | 3.81 |
| M-xylene | NA | 0.34 | NA | NA | 0.34 |
| Naphthalene | 1.14 | 0.02 | NA | 0.07 | 1.23 |
| N-heptane | 0.13 | 0.14 | NA | 0.22 | 0.50 |
| N-hexane | NA | 0.28 | NA | 0.49 | 0.77 |
| O-xylene | 0.35 | 0.18 | NA | 0.55 | 1.08 |
| Phenol | 1.51 | 0.03 | NA | NA | 1.54 |
| Propionaldehyde | 1.53 | 0.09 | NA | NA | 1.63 |
| Styrene | 0.65 | 0.01 | NA | 0.02 | 0.68 |
| Toluene | 1.35 | 0.58 | NA | 1.41 | 3.33 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.6.5

## 2020 Alternative 2 - Airlines Relocate Alternative Hazardous Air Pollutants Emissions Inventory (tons)

| Pollutant | Source | | | | Total |
|---|---|---|---|---|---|
| | Aircraft | APU/GSE | Motor Vehicles | Stationary Sources | |
| 1,3-butadiene | 3.41 | 0.07 | 0.31 | 0.01 | 3.80 |
| 2,2,4-trimethylpentane | NA | 0.28 | NA | NA | 0.28 |
| 2-methylnaphthalene | 0.41 | 0.01 | NA | NA | 0.42 |
| Acetaldehyde | 8.63 | 0.28 | 0.70 | NA | 9.61 |
| Acetone | 0.83 | 0.02 | NA | NA | 0.85 |
| Acrolein | 4.94 | 0.10 | 0.05 | NA | 5.08 |
| Benzaldehyde | 0.95 | 0.04 | NA | NA | 0.99 |
| Benzene | 3.40 | 0.40 | 2.93 | 0.48 | 7.21 |
| Chlorobenzene | NA | NA | NA | <0.01 | <0.01 |
| Cyclohexane | NA | NA | NA | 0.03 | 0.03 |
| Ethylbenzene | 0.35 | 0.13 | NA | 0.35 | 0.83 |
| Formaldehyde | 24.9 | 0.82 | 0.88 | 0.21 | 26.8 |
| Isopropylbenzene | 0.01 | NA | NA | 0.03 | 0.03 |
| M & P-xylene | 0.57 | 0.01 | NA | 1.32 | 1.90 |
| Methyl alcohol | 3.59 | 0.08 | NA | NA | 3.66 |
| M-xylene | NA | 0.34 | NA | NA | 0.34 |
| Naphthalene | 1.09 | 0.02 | NA | 0.07 | 1.18 |
| N-heptane | 0.13 | 0.14 | NA | 0.22 | 0.49 |
| N-hexane | NA | 0.28 | NA | 0.49 | 0.77 |
| O-xylene | 0.34 | 0.18 | NA | 0.55 | 1.06 |
| Phenol | 1.45 | 0.03 | NA | NA | 1.48 |
| Propionaldehyde | 1.48 | 0.09 | NA | NA | 1.57 |
| Styrene | 0.63 | 0.01 | NA | 0.02 | 0.65 |
| Toluene | 1.29 | 0.58 | NA | 1.41 | 3.28 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## Table E.6.6
## 2025 No Action Hazardous Air Pollutants Emissions Inventory (tons)

| | Source | | | | |
|---|---|---|---|---|---|
| Pollutant | Aircraft | APU/GSE | Motor Vehicles | Stationary Sources | Total |
| 1,3-butadiene | 4.16 | 0.08 | 0.33 | 0.01 | 4.58 |
| 2,2,4-trimethylpentane | NA | 0.23 | NA | NA | 0.23 |
| 2-methylnaphthalene | 0.50 | 0.01 | NA | NA | 0.51 |
| Acetaldehyde | 10.54 | 0.30 | 0.75 | NA | 11.6 |
| Acetone | 1.00 | 0.02 | NA | NA | 1.02 |
| Acrolein | 6.03 | 0.11 | 0.05 | NA | 6.18 |
| Benzaldehyde | 1.16 | 0.04 | NA | NA | 1.20 |
| Benzene | 4.15 | 0.35 | 3.13 | 0.51 | 8.14 |
| Chlorobenzene | NA | NA | NA | <0.01 | <0.01 |
| Cyclohexane | NA | NA | NA | 0.02 | 0.02 |
| Ethylbenzene | 0.43 | 0.11 | NA | 0.40 | 0.94 |
| Formaldehyde | 30.4 | 0.86 | 0.93 | 0.19 | 32.4 |
| Isopropylbenzene | 0.01 | NA | NA | 0.03 | 0.04 |
| M & P-xylene | 0.70 | 0.01 | NA | 1.48 | 2.19 |
| Methyl alcohol | 4.39 | 0.08 | NA | NA | 4.47 |
| M-xylene | NA | 0.29 | NA | NA | 0.29 |
| Naphthalene | 1.33 | 0.02 | NA | 0.08 | 1.44 |
| N-heptane | 0.16 | 0.12 | NA | 0.25 | 0.52 |
| N-hexane | NA | 0.24 | NA | 0.54 | 0.78 |
| O-xylene | 0.41 | 0.15 | NA | 0.62 | 1.18 |
| Phenol | 1.77 | 0.03 | NA | NA | 1.81 |
| Propionaldehyde | 1.80 | 0.10 | NA | NA | 1.90 |
| Styrene | 0.76 | 0.01 | NA | 0.02 | 0.79 |
| Toluene | 1.58 | 0.49 | NA | 1.57 | 3.64 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

Table E.6.7

### 2025 Alternative 1 - Airlines Remain Alternative Hazardous Air Pollutants Emissions Inventory (tons)

| | Source | | | | |
|---|---|---|---|---|---|
| Pollutant | Aircraft | APU/GSE | Motor Vehicles | Stationary Sources | Total |
| 1,3-butadiene | 4.04 | 0.07 | 0.33 | 0.01 | 4.45 |
| 2,2,4-trimethylpentane | NA | 0.23 | NA | NA | 0.23 |
| 2-methylnaphthalene | 0.49 | 0.01 | NA | NA | 0.50 |
| Acetaldehyde | 10.23 | 0.29 | 0.74 | NA | 11.3 |
| Acetone | 0.97 | 0.02 | NA | NA | 0.99 |
| Acrolein | 5.85 | 0.11 | 0.05 | NA | 6.01 |
| Benzaldehyde | 1.13 | 0.04 | NA | NA | 1.17 |
| Benzene | 4.03 | 0.34 | 3.11 | 0.51 | 8.00 |
| Chlorobenzene | NA | NA | NA | <0.01 | <0.01 |
| Cyclohexane | NA | NA | NA | 0.03 | 0.03 |
| Ethylbenzene | 0.42 | 0.11 | NA | 0.40 | 0.92 |
| Formaldehyde | 29.6 | 0.85 | 0.93 | 0.20 | 31.5 |
| Isopropylbenzene | 0.01 | NA | NA | 0.03 | 0.04 |
| M & P-xylene | 0.68 | 0.01 | NA | 1.48 | 2.17 |
| Methyl alcohol | 4.3 | 0.08 | NA | NA | 4.34 |
| M-xylene | NA | 0.29 | NA | NA | 0.29 |
| Naphthalene | 1.30 | 0.02 | NA | 0.08 | 1.40 |
| N-heptane | 0.15 | 0.12 | NA | 0.25 | 0.52 |
| N-hexane | NA | 0.24 | NA | 0.54 | 0.78 |
| O-xylene | 0.40 | 0.15 | NA | 0.62 | 1.17 |
| Phenol | 1.72 | 0.03 | NA | NA | 1.75 |
| Propionaldehyde | 1.75 | 0.10 | NA | NA | 1.84 |
| Styrene | 0.74 | 0.01 | NA | 0.02 | 0.77 |
| Toluene | 1.53 | 0.49 | NA | 1.58 | 3.60 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## Table E.6.8
## 2025 Alternative 2 - Airlines Relocate Alternative Hazardous Air Pollutants Emissions Inventory (tons)

| Pollutant | Source | | | | Total |
|---|---|---|---|---|---|
| | Aircraft | APU/GSE | Motor Vehicles | Stationary Sources | |
| 1,3-butadiene | 4.16 | 0.07 | 0.34 | 0.01 | 4.58 |
| 2,2,4-trimethylpentane | NA | 0.23 | NA | NA | 0.23 |
| 2-methylnaphthalene | 0.50 | 0.01 | NA | NA | 0.51 |
| Acetaldehyde | 10.5 | 0.28 | 0.77 | NA | 11.6 |
| Acetone | 1.00 | 0.02 | NA | NA | 1.02 |
| Acrolein | 6.03 | 0.10 | 0.05 | NA | 6.18 |
| Benzaldehyde | 1.16 | 0.04 | NA | NA | 1.20 |
| Benzene | 4.15 | 0.34 | 3.21 | 0.52 | 8.22 |
| Chlorobenzene | NA | NA | NA | <0.01 | <0.01 |
| Cyclohexane | NA | NA | NA | 0.03 | 0.03 |
| Ethylbenzene | 0.43 | 0.11 | NA | 0.40 | 0.93 |
| Formaldehyde | 30.4 | 0.83 | 0.96 | 0.21 | 32.4 |
| Isopropylbenzene | 0.01 | NA | NA | 0.03 | 0.04 |
| M & P-xylene | 0.70 | 0.01 | NA | 1.48 | 2.19 |
| Methyl alcohol | 4.39 | 0.08 | NA | NA | 4.47 |
| M-xylene | NA | 0.29 | NA | NA | 0.3 |
| Naphthalene | 1.33 | 0.02 | NA | 0.08 | 1.44 |
| N-heptane | 0.16 | 0.12 | NA | 0.25 | 0.52 |
| N-hexane | NA | 0.24 | NA | 0.54 | 0.78 |
| O-xylene | 0.41 | 0.15 | NA | 0.62 | 1.18 |
| Phenol | 1.77 | 0.03 | NA | NA | 1.80 |
| Propionaldehyde | 1.80 | 0.09 | NA | NA | 1.89 |
| Styrene | 0.76 | 0.01 | NA | 0.02 | 0.79 |
| Toluene | 1.58 | 0.48 | NA | 1.58 | 3.64 |

Source: Wenck Associates, Inc., KB Environmental Sciences, Inc., and David Braslau Associates, Inc., 2011.

## ENDNOTES

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[1] *Documentation for Aircraft Component of the National Emissions Inventory Methodology.* Environmental Protection Agency, April, 2010. Prepared by Eastern Research Group, ERG No. 0245.02.302.001, Contract No. EP-D-07-097.

[2] *A Survey of Airline Pilots Regarding Fuel Conservation Procedures for Taxi Operations*, Massachusetts Institute of Technology.

[3] *Opportunities for Reducing Surface Emissions through Airport Surface Movement Optimization,* Massachusetts Institute of Technology, 2008.

[4] Analysis of Emissions Inventory for Single Engine Taxi-out Operations, Center for Air Transportation Systems Research.

[5] National Oceanic & Atmospheric Administration, Climatography of the United States, http://cdo.ncdc.noaa.gov/climatenormals/clim20/mn/215435.pdf

[6] Transportation Research Board, Airport Cooperative Research Panel, ACRP Report 11, Project 02-06, *Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories*. http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_011.pdf

[7] MPCA, Discussing Greenhouse Gases in Environmental Review, December 2011 http://www.pca.state.mn.us/index.php/view-document.html?gid=12570

[8] *FAA, 2012, Considering Greenhouse Gases and Climate Under the National Environmental Policy Act: Interim Guidance, January 12, 2012.*

[9] ICAO/CAEP Working Group 3, Engine Starting Emissions, May 5, 2006.

[10] Energy Information Administration, www.eia.doe.gov/oiaf/1605/coefficients.html.

[11] ICF International, *Greenhouse Gas Emission Inventory Methodologies for State Transportation Departments*, July 2011.

[12] Clean Air Nonroad Diesel Rule, USEPA, 420-F-04-032, May 2004 http://www.epa.gov/nonroaddiesel/2004fr/420f04032.htm

[13] Transportation Research Board, Airport Cooperative Research Panel, ACRP Report 11, Project 02-06, *Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories*. http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_011.pdf.

[14] HAPs are also referred to as toxic air contaminants and, more generally, as air toxics.

[15] FAA, Guidance for Quantifying Speciated Organic Gas Emissions from Airport Sources, September 2, 2009.

[16] A speciation profile is the amount of an individual HAP per the amount of VOC or PM emitted by that emission source.

# Attachment 1:

## Air Quality Assessment Protocol

# *Air Quality Assessment Protocol*

Minneapolis-St. Paul International Airport (MSP)
2020 Improvements
FINAL DRAFT Environmental Assessment/Environmental Assessment Worksheet (EA/EAW)

Prepared for the:

Federal Aviation Administration (FAA)

and

Metropolitan Airports Commission (MAC)

Prepared by the:

MSP Air Quality Team

Wenck Associates, Inc.

KB Environmental Sciences Inc.

David Braslau Associates, Inc.

June 2011

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# EXECUTIVE SUMMARY

The Metropolitan Airports Commission (MAC) has prepared a Long Term Comprehensive Plan (LTCP) Update for the Minneapolis-St. Paul International Airport (MSP). In the LTCP Update, the MAC identified specific physical improvements at MSP to allow the Airport to effectively continue providing the Twin Cities commercial air transport needs as forecast through 2030. MAC is preparing an *Environmental Assessment* (EA) and *Environmental Assessment Worksheet* (EAW) for the improvements proposed through 2020 (i.e., the proposed alternatives) at MSP. Prepared in accordance with the National Environmental Policy Act (NEPA) and the Minnesota Environmental Policy Act (MEPA), the *EA/EAW* will address the potential impacts to a wide assortment of environmental factors associated with the Proposed Alternatives, including the impacts to air quality.

The purpose of this document, referred to as the *Air Quality Assessment Protocol*, is described below:

**Purpose of the *Air Quality Assessment Protocol***

The purpose of this document is to describe the overall technical approach for conducting the air quality analysis prepared in support of the EA/EAW for the improvements needed through 2020 as proposed in the Long-Term Comprehensive Plan (LTCP) Update at MSP. As with any planning process as project components change and evolve this protocol could change as well.

The air quality assessment will be conducted following Federal Aviation Administration (FAA) guidelines including Order 1050.1E Chg 1, *Environmental Impacts: Policies and Procedures* (Appendix A, Section 2, *Air Quality*); Order 5050.4B, *National Environmental Policy Act (NEPA) Implementing Instructions for Airport Projects*; *Environmental Desk Reference for Airport Actions*; and the A*ir Quality Procedures for Civilian Airports and Air Force Bases.* The majority of the technical analysis will also be accomplished using the latest version of the FAA *Emissions and Dispersion Modeling System* (EDMS) and other U.S. Environmental Protection Agency (U.S. EPA) approved models.

The focus of the air quality assessment will be on the U.S. EPA "criteria-based" air pollutants, which are carbon monoxide (CO), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), particulate matter ($PM_{10}$/$PM_{2.5}$), and lead (Pb). Ozone-forming ($O_3$) emissions will also be addressed through the analysis of the precursors of volatile organic compounds (VOCs) and nitrogen oxides ($NO_x$). Hazardous (or "toxic") air pollutants (HAPs) and Mobile Source Air Toxics (MSATs) will similarly be evaluated. For HAPs the assessments will take the form of an emissions inventory – both with and without the planned improvements to MSP. For MSATs a qualitative assessment will be made as required under the Federal Highway Administration (FHWA) Interim Guidance on MSATs.

To the extent necessary, dispersion modeling of select criteria air pollutants within the vicinity of the alternatives will be conducted. Greenhouse gases (GHG) attributable to the planned improvements to the airport will also be addressed.

The results of the criteria air pollutant assessment will be compared to appropriate regulatory criteria including the federal Clean Air Act (CAA) General Conformity Rule applicability thresholds and the National and Minnesota Ambient Air Quality Standards (AAQS). The overall goal is to help ensure that the alternatives would be constructed and operated in compliance with NEPA, MEPA, the State Implementation Plan (SIP) and other applicable federal, state and local air quality regulations.

The information provided in this document should be treated as a synopsis of the technical approach of the air quality assessment, which will be expanded upon in the *EA/EAW*. Review comments or questions on this Protocol should be provided to the following MAC contact person:

**Submit review comments to:**

Mr. Roy Fuhrmann
Director of Environment
Metropolitan Airports Commission
6040 28th Avenue South
Minneapolis, MN 55450

(612) 726-8134
Roy.Fuhrmann@mspmac.org

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# 1. INTRODUCTION

This section provides introductory and background information on the purpose of this *Air Quality Assessment Protocol*.

## 1.1 Background Information and Project Description

Minneapolis-St. Paul International Airport (MSP) is the primary air transportation hub of Minnesota. The airport is located within Hennepin County, approximately seven miles south of downtown Minneapolis and is operated by the Metropolitan Airports Commission (MAC).

In accordance with the National Environmental Policy Act (NEPA) and the Minnesota Environmental Policy Act (MEPA), the MAC is preparing an *Environmental Assessment* (EA) and *Environmental Assessment Worksheet* (EAW) analyzing the improvements through 2020 identified in the MSP Long-Term Comprehensive Plan (LTCP) Update (i.e., the Proposed Action). The EA/EAW will address the impacts of the LTCP alternatives on a wide assortment of environmental factors, including the potential impacts to both local and regional air quality.

For the purposes of the EA/EAW, three alternatives will be analyzed for their environmental impacts:

- No Action Alternative – The No Action Alternative includes Airport limited incremental improvements that will be implemented prior to 2020. These improvements are independent of the Proposed Action and will or have already received environmental approval or are categorically excluded from formal environmental assessment by the Federal Aviation Administration (FAA) and the Minnesota Environmental Quality Board (EQB).
- Alternative 1 - Airlines Remain Alternative – This Alternative includes the terminal and landside improvements needed by the year 2020. With this Alternative the terminal and landside facilities improvements consist of those necessary to accommodate the forecasted airline's growth within their current terminal. The specific improvements required, such as the number of gates at each terminal, will be determined as part of the EA/EAW process.
- Alternative 2 - Airlines Relocate Alternative - This Alternative includes terminal and landside improvements needed by the year 2020. The improvements are based on relocating all non-Sky Team airlines (all airlines except Delta Air Lines and its alliance partners) to Terminal 2-Humphrey**.**

**Figure 1** illustrates the Area of Potential Effect.

## 1.2 Purpose of the Protocol

This document, referred to as the *Air Quality Assessment Protocol*, outlines and describes the overall technical approach and methodology for conducting the air quality analysis contained in the EA/EAW. The primary objective for producing this document is to advise the EA/EAW Team, MAC, FAA and other regulatory agencies of the scope of the analysis. This will help ensure that work is completed in an acceptable manner and that the construction and operation of the selected Alternative will comply with applicable federal, state and local air quality regulations.

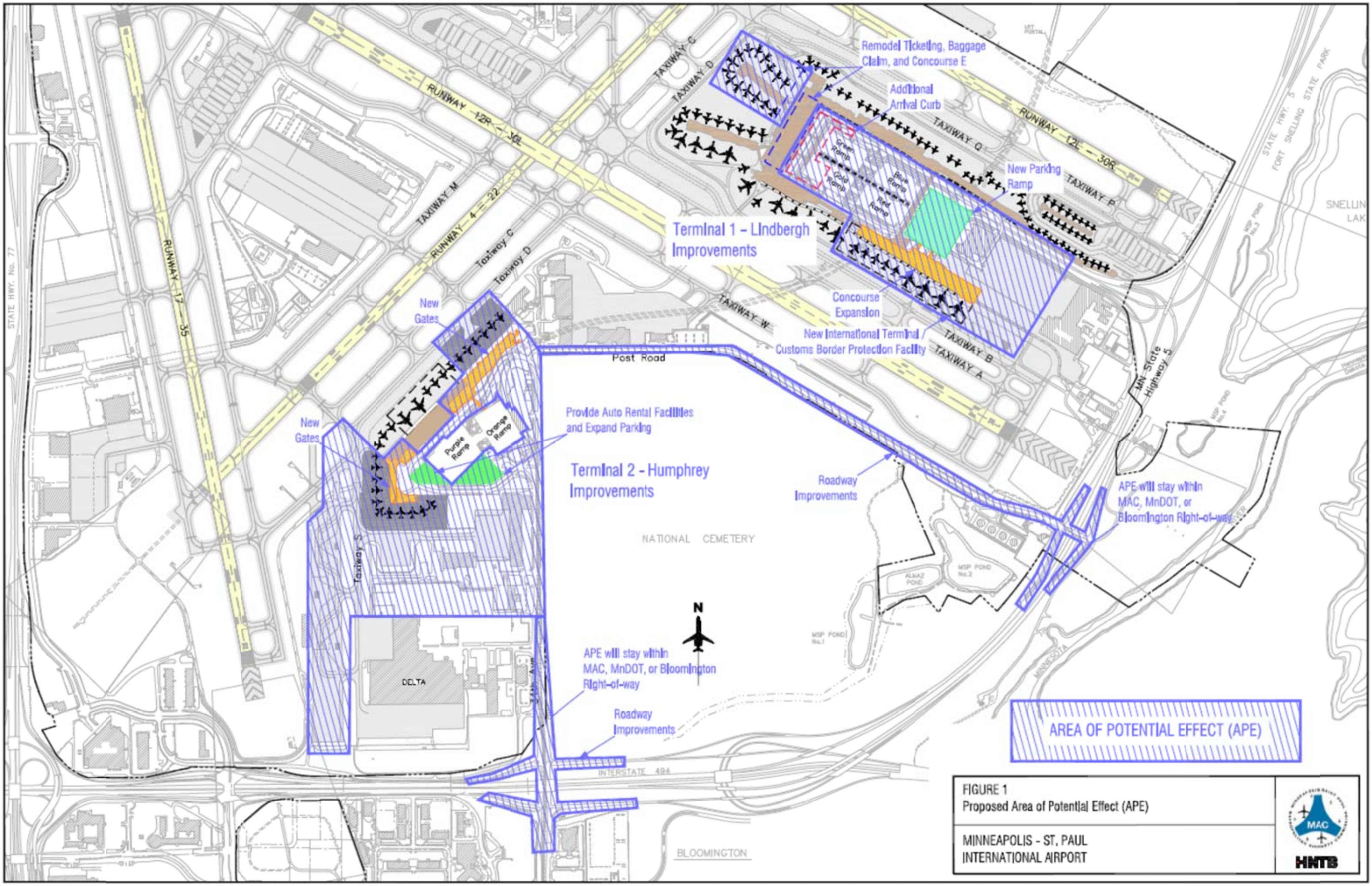


FIGURE 1
Proposed Area of Potential Effect (APE)

MINNEAPOLIS - ST. PAUL
INTERNATIONAL AIRPORT

## 2. Regulatory Background

This section provides information pertaining to air quality conditions in the Minneapolis/St. Paul metropolitan area and identifies the applicable regulatory criteria that will be applied to the results of the air quality assessment.

### 2.1 Regulatory Agencies

The Minnesota Pollution Control Agency (MPCA) is primarily responsible for the regulation of air quality state-wide, including the Minneapolis/St. Paul metropolitan area. The MPCA is also involved in the preparation of the State Implementation Plan (SIP). The Metropolitan Council is responsible for preparing a Transportation Improvement Plan (TIP) and Clean Air Act conformity documentation for the Twin Cities Metropolitan Area

On the federal level, the U.S. Environmental Protection Agency (U.S. EPA) establishes air quality goals and sets standards under the federal Clean Air Act (CAA). For airport projects, the FAA is involved in the assessment of air quality impacts under NEPA as well as compliance with the General Conformity Rule of the CAA.

**Table 1** provides a summary listing of the roles and responsibilities of each of these agencies.

### 2.2 Attainment / Nonattainment Designations

Hennepin County, along with portions of surrounding counties, is currently designated by the U.S. EPA to be in "attainment" of all the National Ambient Air Quality Standards (NAAQS), with the exception of carbon monoxide (CO), for which Hennepin County is designated as an "attainment/maintenance" area.

Importantly, by mid-2011, the U.S. EPA will announce whether it will retain or revise the 2008 ozone ($O_3$) NAAQS. Although Hennepin County is not currently identified as an area with historical monitored levels of $O_3$ that would violate the proposed standard (as shown in **Figure 2**), Hennepin County (red dot) is surrounded on three sides (orange dots) by counties with $O_3$ levels that violate the proposed standard. Therefore, there is the potential for Hennepin County to be included in an ozone non-attainment area in the near future.

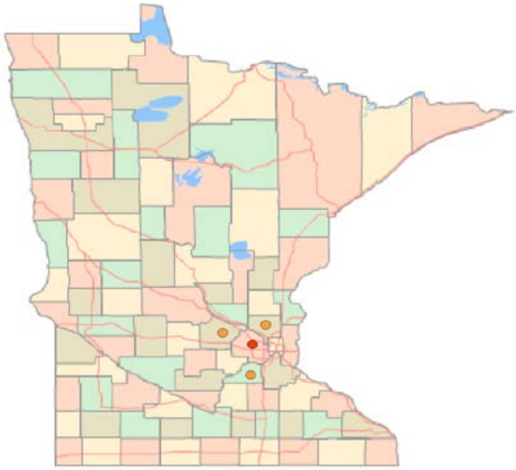


**Figure 2: Potential Non-Attainment Areas for Ozone**

The current attainment/non-attainment designations for the Minneapolis/St. Paul area are listed in **Table 2**. As shown, the area (including MSP) is in "attainment" for lead (Pb), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), particulate matter less than 10 microns in size ($PM_{10}$), particulate matter less than 2.5 microns in size ($PM_{2.5}$), and the current eight-hour standard for $O_3$. The "attainment" designations mean that pollutant levels are either below or meet the NAAQS for these criteria pollutants.

However, as discussed above, the area is designated as "attainment/maintenance" with respect to the NAAQS for CO. This maintenance designation signifies that violations of the NAAQS for CO have occurred in the past, that the area is currently in attainment, and that the area is required to perform certain air quality conformance activities with respect to CO such as the CO Maintenance Plan discussed in Section 2.3 below.

**Table 1: Agencies Involved in Air Quality Issues Associated with the Alternatives**

| Agency | Roles and Responsibilities |
|---|---|
| U.S. Environmental Protection Agency (EPA) | *Federal agency* - Sets national clean air policies under the federal Clean Air Act (CAA); promulgates the National Ambient Air Quality Standards (NAAQS); reviews and approves State Implementation Plans (SIPs). Also regulates motor vehicle, off-road equipment and aircraft engine emissions nation-wide. |
| Federal Aviation Administration (FAA) | *Federal agency* – In cooperation with the Minneapolis St. Paul Metropolitan Airports Commission, responsible for preparing the EA under NEPA and ensuring compliance with the General Conformity Rule of the CAA. |
| Minnesota Pollution Control Agency (MPCA) | *State agency* - Involved in the preparation of the Minnesota SIP and primarily responsible for the management of air quality within Minnesota |
| Metropolitan Council (MC) | *Regional Agency* - Responsible for preparing the Transportation Improvement Plan (TIP) and Conformity Documentation for the Twin Cities Metropolitan Area. |

Source: KB Environmental Sciences, 2011.

**Table 2: Attainment/Non-attainment Designations**

| Pollutant | Status[1] |
|---|---|
| Carbon monoxide (CO) | Attainment/Maintenance |
| Lead (Pb) | Attainment |
| Nitrogen dioxide ($NO_2$) | Attainment |
| Ozone ($O_3$), 8-Hour | Attainment |
| Particulate matter ($PM_{10}$) | Attainment |
| Particulate matter ($PM_{2.5}$) | Attainment |
| Sulfur dioxide ($SO_2$) | Attainment |

Source: U.S. EPA, 2011.

[1] Maintenance areas are areas that are in transition from non-attainment to attainment. Attainment areas meet the NAAQS.

## 2.3 Air Quality Management Plans

A CO Maintenance Plan has been developed and is periodically updated, as part of the State Implementation Plan (SIP) for the Minneapolis/St. Paul area, to help maintain compliance with the NAAQS. Prepared principally by the MPCA with assistance from the Metropolitan

Council (MC) and approved by the U.S. EPA, this Maintenance Plan establishes area-wide emission budgets, control strategies, and timeframes for achieving the attainment status. **Table 3** provides a summary of the applicable SIP.

**Table 3: State Implementation Plan (SIP) Summary**

| Pollutant | Document Title | Comments |
|---|---|---|
| Carbon monoxide (CO) | *Revision of the Minneapolis-St. Paul Carbon Monoxide Maintenance Plan (August 2004)* | Provides CO emission estimates for 2009, 2019, 2025, and 2030. |

Source: KB Environmental Sciences, 2011.

## 2.4 Regulatory Standards and Criteria for Air Quality

There are an assortment of regulatory standards and criteria pertaining to air quality in the Minneapolis/St. Paul area. The most relevant of these to the MSP air quality assessment are briefly discussed.

### Federal and State Standards

Under the federal CAA, the U.S. EPA has promulgated NAAQS for several "criteria" air pollutants to protect public health, welfare and the environment. The MPCA has adopted these standards and they are shown in **Table 4**.

### Table 4: National and Minnesota Ambient Air Quality Standards

| Pollutant | Averaging Time | Standards | |
|---|---|---|---|
| | | National | State[1] |
| Carbon monoxide (CO) | 1-hour | 35 ppm<br>(40 mg/m$^3$) | 30 ppm<br>(35 mg/m$^3$) |
| | 8-hour | 9 ppm<br>(10 mg/m$^3$) | Same |
| Ozone ($O_3$) | 8-hour | 0.075 ppm<br>(147 µg/m$^3$) | Same |
| Nitrogen dioxide ($NO_2$) | 1-hour | 0.10 ppm<br>(188 µg/m$^3$) | n/a |
| | Annual | 0.053 ppm<br>(100 µg/m$^3$) | Same |
| Sulfur dioxide ($SO_2$) | 1-hour | 0.075 ppm<br>(196 µg/m$^3$) | 0.5 ppm<br>(1300 µg/m$^3$) |
| | 3-hour | 0.5 ppm<br>(1300 µg/m$^3$) | Same |
| | 24-hour | 0.14 ppm<br>(365 µg/m$^3$) | Same |
| | Annual | 0.03 ppm<br>(80 µg/m$^3$) | 0.02 ppm<br>(60 µg/m$^3$) |
| Particulate matter ($PM_{10}$)[2] | 24-hour | 150 µg/m$^3$ | Same |
| | Annual | n/a | 50 µg/m$^3$ |
| Particulate matter ($PM_{2.5}$) | 24-hour | 35 µg/m$^3$ | n/a |
| | Annual | 15 µg/m$^3$ | n/a |
| Lead (Pb) | 3-month rolling average | 0.15 µg/m$^3$ | n/a |
| | Quarterly | 1.5 µg/m$^3$ | Same |

Source: US Environmental Protection Agency, 2010 and Minnesota Pollution Control Agency (MPCA) 2010.

[1] For this project, any ambient impact analysis will be evaluated based on the federal standards while the state standards are provided for disclosure purposes.

[2] U.S. EPA revoked the annual $PM_{10}$ standard in 2006.

n/a = not applicable, ppm = parts per million, µg/m$^3$ = micrograms/cubic meter,
mg/m$^3$ = milligrams/cubic meter

### General Conformity Requirements

The General Conformity Rule of the federal CAA prohibits federal agencies (including the FAA) from permitting or funding projects or actions that do not conform to an applicable SIP. Following a two-step process, the "Applicability Analysis" first determines whether or not a project's emissions are subject to the Conformity Rule. Secondly, if the emissions are subject to the Rule, a formal "Conformity Determination" is conducted. While the General Conformity requirements are separate from NEPA, the two analyses are often performed concurrently.

The applicable General Conformity "de-minimis" levels for the Minneapolis/St. Paul area are shown in **Table 5**.

**Table 5: General Conformity Rule**

**Applicability Analysis De-minimis Levels**

| Pollutant | De-minimis Levels (tons/year) |
|---|---|
| Carbon monoxide (CO) | 100 |

Source: General Conformity Rule (40 CFR Part 93, Subpart B).

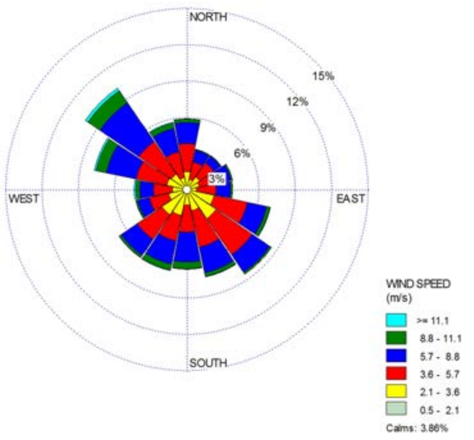
## 3. EXISTING CONDITIONS

This section briefly describes existing meteorological and air quality conditions in the MSP area.

### 3.1 Meteorological Conditions

A wind rose for data collected at MSP is provided as **Figure 3**. As shown, the average wind speed at the airport is 10.4 miles per hour and the wind direction varies but is predominately from the northwest and southeast.

**Figure 3: MSP Wind Rose**



### 3.2 Air Quality Monitoring Data

MPCA operates several ambient ("outdoor") air quality monitoring stations in the Minneapolis/St. Paul area as part of its permanent, state-wide air monitoring program. These stations sample and record levels of the U.S. EPA criteria air pollutants and an assortment of hazardous air pollutants (HAPs).

**Table 6** provides the most recent data (2007 through 2009) from these nearest air monitoring stations including the pollutants measured and the highest recorded levels. Information also is provided indicating whether or not the highest recorded levels recorded at these sites represent violations of the NAAQS. The closest of these air monitoring stations to MSP is located at Richfield Intermediate School.

**Table 6: Air Monitoring Data in the MSP Area (2007 – 2009)**

| Site Name (Dist. & Dir. from MSP) | Pollutant | Averaging Period | NAAQS | Year | | | Exceeds NAAQS |
|---|---|---|---|---|---|---|---|
| | | | | 2007 | 2008 | 2009 | |
| Richfield Intermediate School | $PM_{2.5}$ | Annual | 15.0 µg/m$^3$ | 9.2 | 8.89 | 10.0 | No |
| | | 24-hour (98th percentile) | 35 µg/m$^3$ | 23 | 22 | 33 | No |
| Vandalia Street | $PM_{10}$ | 24-hour | 150 µg/m$^3$ | 63 | 61 | 49 | No |
| | Pb | Rolling 3-mo. Avg. | 0.15 µg/m$^3$ | <0.1 | <0.1 | <0.1 | No |
| Lexington Avenue | CO | 8-hour | 9 ppm | 2.2 | 2.4 | 2.1 | No |
| | | 1-hour | 35 ppm | 3 | 3.2 | 2.6 | No |
| 528 Hennepin Avenue Minneapolis Arts Center | $SO_2$ | Annual | 0.03 ppm | 0.001 | 0.002 | 0.002 | No |
| | | 24-hour | 0.14 ppm | 0.011 | 0.015 | 0.029 | No |
| | | 3-hour | 0.5 ppm | 0.032 | 0.04 | 0.045 | No |
| | | 1-hour | 0.075 ppm | 0.042 | 0.043 | 0.05 | No |
| 2142 120th Street Inver Grove Heights | $NO_2$ | Annual | 0.053 ppm | 0.009 | 0.005 | 0.005 | No |
| | | 1-hour (98th percentile) | 0.100 ppm | 0.032 | 0.032 | 0.029 | No |
| 917 Dakota Street Shakopee | $O_3$ | 8-hour | 0.075 ppm | 0.075 | 0.067 | 0.063 | No |

Source: U.S. EPA AIRData – Monitor Data Queries 2010; and U.S. EPA Air Quality System – Detailed AQS Data, 2011.
Indicates highest reading recorded for the year —unless indicated otherwise.
n/a = not applicable, ppm = parts per million, µg/m$^3$ = micrograms/cubic meter,
mg/m$^3$ = milligrams/cubic meter

# 4. AIR QUALITY ASSESSMENT

The following section describes the approach, methodologies, models, data sources, and other supporting information that will be used in conducting the air quality assessment.

## 4.1 Overall Approach and Methodologies

The overall approach to conducting the air quality assessment follows FAA Orders for preparing NEPA documents. Principal among these are the following publications:

- FAA Order 1050.1E, Change 1 (effective March 20, 2006), *Policies & Procedures for Considering Environmental Impacts* - This document provides general guidelines for the *air quality assessment of all airport-related projects* or actions evaluated under NEPA [FAA, 2006a].
- FAA Order 5050.4B, *National Environmental Policy Act (NEPA) Implementing Instructions for Airport Projects* - Developed specifically for projects or actions under the jurisdiction of the Airports Division of the FAA, this document provides general guidelines for the assessment of NEPA-related air quality impacts [FAA, 2006b].
- FAA, *An Environmental Desk Reference for Airport Actions* – This document summarizes applicable special purpose laws. Its function is to help FAA integrate the compliance of NEPA and applicable special purpose laws (including those pertaining to air quality) [FAA, 2007].
- FAA *Air Quality Procedures for Civilian Airports and Air Force Bases* and *Addendum* - Referred to as the *Air Quality Handbook*, the document provides detailed guidelines for preparing airport-related air quality assessments for FAA-sponsored projects or actions involving emissions inventory, dispersion modeling, CO hotspot intersection analysis, and General Conformity [FAA, 2004].

Following these guidelines, the air quality assessment will include emission inventories of the EPA "criteria" pollutants (or their precursors) and HAPs. For ease of reference, **Table 7** provides a listing of each analysis, the intended purpose, and the basis for inclusion in the air quality assessment.

## 4.2 Models

The majority of the technical analysis will be accomplished using the latest version of the Emissions and Dispersion Modeling System (EDMS 5.1.3). EDMS is the FAA-required model for assessing airport-related air quality impacts. Other models that will be used include the MOBILE 6.2 motor vehicle emissions model, the CAL3QHC roadway dispersion model for hot-spot CO concentrations, and the NONROAD2008 emissions model for construction-related emissions. For ease of reference, **Table 8** provides a listing of each model, the intended application, and other relevant information.

**Table 7 Summary Matrix of Air Quality Impact Analyses**

| Analysis | Purpose | Applicable Regulations or Guidelines |
|---|---|---|
| Emissions Inventory | To identify the sources and types, and quantify the amounts of air emissions associated with the operation/construction of the alternatives. The results will also be used to compare future-year conditions for the alternatives, used in support of the General Conformity Rule Applicability Analysis. | FAA Order 1050.1E, Change 1, *Environmental Impacts: Policies & Procedures*<br>FAA Order 5050.4B *National Environmental Policy Act (NEPA) Implementing Instructions for Airport Projects*<br>FAA *Air Quality Procedures for Civilian Airports & Air Force Bases* including the *Addendum* |
| Atmospheric Dispersion Analysis | To predict existing and future-year ambient (i.e., outdoor) levels of CO both on and off the airport site and ensure that the project-related emissions do not cause or contribute to violations of the NAAQS. | FAA *Air Quality Procedures for Civilian Airports & Air Force Bases* & *Addendum* |
| CO "Hot-Spot" Intersection Analysis | To predict existing and future-year ambient levels of CO in the vicinities of roadway intersections both on and off the airport, and to ensure that the project-related traffic emissions do not cause or contribute to violations of the NAAQS. | EPA, *Guideline for Modeling Carbon Monoxide from Roadway Intersection* |
| HAPs Emissions Inventory | To identify, quantify and disclose the sources, types and amounts of HAPs associated with operation/construction of the alternatives. | FAA *Guidance for Quantifying Speciated Organic Gas Emissions from Airport Sources*. |
| General Conformity Rule Applicability Analysis | To determine if project-related emissions exceed the CAA General Conformity Rule *de- minimis* levels and if a formal determination is needed to demonstrate the alternatives will conform to the applicable SIP. | FAA Order 1050.1E, Change 1, *Environmental Impacts: Policies & Procedures*, Section 2. *Air Quality*<br>40 CFR Part 93, Subpart B, *Determining Conformity of General Federal Actions to State or Federal Implementation Plans*<br>FAA, EPA *General Conformity Guidance for Airports - Questions & Answers* |
| Greenhouse Gas (GHG) Emissions Inventory | To disclose the amounts of GHGs associated with the alternatives. | MPCA General Guidance Sept. 2009 *Carbon Footprint Development in Environmental Review*<br>Airport Cooperative Research Program (ACRP) *Guidebook on Preparing Airport GHG Emissions Inventories* Transportation Research Board. Report 11 |

Source: KB Environmental Sciences, Inc., 2011

**Table 8: Air Quality Assessment Models**

| Model | Application | Comments |
|---|---|---|
| EDMS | Emissions model used to compute aircraft main engine and APU, GSE and fueling emissions of CO, $NO_x$, $SO_x$, $PM_{10/2.5}$ and VOC. | EDMS is the FAA-required model for assessing airport-related air emissions. The most recent version available (ver. 5.1.3) will be used. |
| NONROAD | Source of construction vehicle/ equipment emission factors. | NONROAD is the U.S. EPA database of emission factors for vehicles and equipment that are not road-registered or otherwise not contained in MOBILE6.2. For this analysis, the most recent version (NONROAD2008) will be used. |
| MOBILE6.2 | Source of federal emission factors for motor vehicle and road-registered GSE engines. | MOBILE6.2 is the U.S. EPA database of on-road emission factors and is the most recent version of this model. Source of on-road construction vehicle emissions factors. |
| CAL3QHC | Roadway dispersion model for hot-spot CO concentrations, | CAL3QHC is the U.S. EPA model for assessing air emissions near roadways. |

Source: KB Environnemental Sciences, Inc., 2011.

## 4.3 Emissions Inventory

In general terms an emissions inventory is a quantification of the amount, or weight, of pollutants emitted from a source (or combination of sources) over a period of time. The outcome is a product of source activity levels (i.e., aircraft operations) combined with appropriate emission factors (i.e., grams of pollutant/operation). The results are segregated by pollutant type (i.e., CO, $NO_x$, VOC, etc.), emission source (i.e., aircraft, ground support equipment, etc.) and project milestone year. The data are commonly reported in units of tons/year (tpy).

Under NEPA, the results of the emissions inventory are used to compare the build alternatives to the future no-action alternative and to compare the proposed action-related emissions to appropriate regulatory criteria or thresholds. In this case, these criteria are the CAA General Conformity Rule “de-minimis” levels.

For this assessment, the U.S. EPA “criteria-based” pollutants to be included in the emissions inventory are CO, $NO_x$, $PM_{10/2.5}$, and sulfur oxides ($SO_x$). Because emissions of $O_3$ cannot be calculated directly, VOC and $NO_x$ (the primary precursors to $O_3$ formation) will be used as surrogates for this pollutant. Lead (Pb) will not be included in the criteria pollutant emissions inventory because commercial airports are not considered as potentially significant sources of this pollutant.[1]

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[1] The U.S. EPA, the FAA and others are undertaking research on atmospheric lead and lead-containing avgas in the vicinity of general aviation (GA) airports. However, because MSP is primarily a commercial service airport, GA emissions are not considered to be significant.

## 4.4 Data Sources and Other Supporting Information

The sources of emissions that will be analyzed include aircraft (both main engines and auxiliary power units [APUs]); ground support equipment (GSE); motor vehicles traveling to, from and moving about the airport site; stationary sources and fuel facilities; and construction equipment/vehicles. The sources of operational data to be used for this air quality assessment are listed in **Table 9** and briefly described below.

**Table 9: Air Quality Assessment Data and Information Summary**

| Emission Source | Parameter - Source of Data and Information |
|---|---|
| Aircraft | • Total operations, fleet mix, and runway utilization – MSP operational data and forecasts. Source: SIMMOD.<br>• Times-in-mode - EDMS default data and FAA Operations and Performance Database for MSP. |
| GSE/APU | • GSE fleet mix and operating times – MSP-specific data from in-the-field surveys combined with EDMS default data.<br>• APU types and operating times - MSP-specific data from the airlines combined with the EDMS default data and FAA guidance. |
| Motor vehicles | • Traffic volumes and fleet mix – 2010 traffic and classifications counts, traffic forecasts and analysis. Kimley-Horn traffic data.<br>• Parking ramp activity - existing and forecast parking requirements with detailed operational data from the MSP LTCP 2015 Environmental Assessment.<br>• Roadway and intersection level of service (LOS) and operating speeds. Source: Kimley-Horn traffic data.<br>• Regional network related traffic – existing and forecasts volumes and speeds. Source: MC.<br>• Vehicle registration files for MOBILE 6.2. Source: MPCA. |
| Stationary sources and fuel facilities | • Source and fuel types – Information and data for MSP obtained from the MAC.<br>• Fuel throughput volumes – Same as above. |
| Construction equipment and activities | • Project construction schedules and equipment requirements - Construction schedules and equipment needs estimates for the Proposed Alternatives. Source: TKDA data. |
| Other supporting information and materials | • Temporal profiles - MSP monthly, daily, and hourly operations of aircraft obtained from FAA Operations and Performance Database for MSP by aircraft category (air carrier, cargo, general aviation, etc.).<br>• Meteorological data – National Climatic Data Center data collected at MSP. |

Source: KB Environmental Sciences, Inc., 2011.

### Aircraft

#### *Emissions Factors*

Aircraft emissions of CO, $NO_x$, $SO_x$ VOCs, and $PM_{10/2.5}$ will be calculated using EDMS. EDMS contains up-to-date emissions factors for the vast majority of U.S. aircraft, by engine type and operational modes (e.g., take-off, climbout, approach, single engine taxi, and taxi/idle). If EDMS does not contain emissions data for a specific aircraft or aircraft/engine combination currently in operation or forecasted to be in use, supplemental information will be used. These data will come from the EDMS database if an aircraft can be found to have the same engine type, number of engines and aircraft category or be based on manufacturer data.

#### *Operational Data*

Aircraft movements that taken together make up the typical landing-and-takeoff cycle (LTO) are divided into four modes: (1) approach, (2) taxi/idle (including delay, taxi-in, and taxi-out), (3) takeoff and (4) climbout. EDMS automatically calculates the times-in-mode (TIM) for approach, takeoff, and climbout for each aircraft based on its category (e.g., commercial, heavy, passenger jet, etc.). These EDMS TIM data, which are based on FAA guidance, will be used in this analysis, unless airport-specific data is available. Taxi times for the existing condition will be determined based on the FAA Operations and Performance Database for MSP. Future year taxi times will be based on these same "existing" conditions data and adjusted (if necessary) to reflect any changes in aircraft taxi-paths or distances caused by the alternatives. MSP operational data, fleet mix, and runway utilization for existing and future conditions will be obtained from SIMMOD files.

### Ground Support Equipment (GSE)/Auxiliary Power Units (APUs)

#### *Emission Factors*

Ground support equipment (GSE) represents an array of specially designed vehicles and equipment that support and service aircraft in the gate and terminal areas. The GSE fleet typically includes baggage tugs, belt loaders, fuel trucks and aircraft tugs but also include airfield maintenance vehicles (i.e., snowplows, tractors, etc.). . Auxiliary power units (APUs) also are used to provide power to an aircraft while its engines are shut down and gate-power/pre-conditioned air (PCA) are not used. For this analysis, emissions of CO, $NO_x$, VOC, $SO_x$ and PM from GSE, including any applicable APUs, will be calculated using EDMS.

#### *Operational Data*

GSE fleet data from an in-the-field survey combined with default EDMS GSE/APU fleet data, fuel type, and operating times will be used to define the type of GSE used at MSP. However, additional site-specific data and information will be used to supplement the GSE/APU fleet mix, fuel type, and operating times, as appropriate.

### Motor Vehicles

#### *Emissions Factors*

On-airport and off-site motor vehicles include privately owned vehicles (cars, vans, trucks, cabs, rental cars, etc.), mass transit vehicles (buses and vans), government vehicles and cargo-related vehicles (trucks). For this assessment, the latest version of MOBILE (MOBILE6.2) will be used as the source of emission factors.

Input data for the MOBILE 6.2 model specific to the Twin Cities Metropolitan Area, such as the fleet mix and parameters affecting emissions, will be obtained from the MPCA. Motor vehicle emission factors for pollutants other than CO will be derived from the updated EDMS MOBILE 6.2 files adjusted for local conditions.

#### *Operational Data*

Specific data for motor vehicles operating on the airport access/egress drives and on the nearby roadway network will include existing and forecasted traffic volumes, travel speeds, delay periods and other operating characteristics. These data will be obtained from existing and forecasted conditions and/or developed in support of the EA/EAW for the alternatives.

Airport-related traffic volumes and average speeds on the regional network will be obtained from the MC and used to estimate changes in regional CO emissions associated with the planned airport improvements. This traffic is usually accounted for in the region-wide Transportation Improvement Plan (TIP). However, while not included in the project-related emissions inventory used to determine General Conformity; these will be reported separately as a regional effect associated with the airport improvements for disclosure purposes only.

### Stationary Sources

#### *Emissions Factors*

Stationary sources may include steam boilers, back-up generators, engine testing and fuel storage facilities. These sources are subject to individual operating permits and typically make up only a small portion of overall airport emissions. Other stationary sources at the airport such as the storage and use of deicing chemicals, industrial solvents, paints and other coatings that contain VOCs, also constitute a minor portion of the emissions.

EDMS includes emission factors for most airport-related stationary sources based on the amount of fuel or material consumed. Depending on the type of source, emissions will be calculated for some or all of the following pollutants: CO, VOC, $NO_x$, $SO_x$ and PM. For any stationary emissions for which emissions are not revealed in the operating permits or for those that EDMS does not contain emissions factors, other appropriate U.S. EPA-accepted data, such as AP-42 (*Compilation of Air Pollutant Emission Factors*), will be used.

The sources of VOC emissions from the storage and handling of fuel include breathing and working losses from storage tanks, and losses from the filling of tanker trucks. VOC emissions from fuel storage and handling will be calculated using the EDMS model and methodologies.

#### *Operational Data*

The operational characteristics (including type of fuel used) and emission rates of the individual stationary sources at MSP will be used to estimate emissions. Site-specific data and information will be used to estimate stationary source emissions. This information will be based on site surveys, air quality permits, equipment logs, and (if necessary) analysis of airports of a similar size and function as MSP.

## 5. Hazardous Air Pollutants

Hazardous air pollutants (HAPs) are pollutants that do not have established NAAQS but present potential human health risks from short (acute) or long-term (chronic) exposures.[2] Given the inherent uncertainties and state of the science, the FAA's current policy is to compute emissions inventories of HAPs for NEPA disclosure purposes only [FAA, 2009]. Toxicity ranking, dispersion analysis, or risk assessments are too speculative to be appropriate for incorporating into an EA/EAW. Therefore, the emissions-inventory approach described herein is only designed to disclose the types and amounts of HAPs associated with the alternatives that the EA/EAW will consider.

Mobile source air toxics (MSATs) are compounds emitted from vehicles and other nonroad equipment. For MSATs a qualitative assessment will be made as required under the Federal Highway Administration (FHWA) Interim Guidance on MSATs.

### 5.1 Sources of HAPs

For the HAPs emissions inventory, the same operational sources (i.e., aircraft, GSE, etc.) that will be evaluated for U.S. EPA "criteria pollutants" will be included. For consistency, the same operational data (i.e., LTOs, TIM, etc.) and information used to conduct the criteria air pollutant emissions inventory also will be used.

### 5.2 Potential HAPs to be Evaluated

Based on FAA's guidance for quantifying airport-related HAPs, only those compounds identified in the EDMS as being a HAP or included in the U.S. EPA's Integrated Risk Information System (IRIS) database should be reported in NEPA documentation. The current version of EDMS provides estimates of 45 organic gas species that meet these criteria.[3] The number of these organic gases (OGs) reported in the EA/EAW will depend on the type of airport sources that are evaluated and, in some case, the type of fuel that powers the source. All of the HAP/IRIS-identified compounds for which EDMS provides estimates are listed in **Table 10**, although not all of the listed HAPs may be emitted by the alternatives.

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[2] For the purposes of this discussion, the terms hazardous air pollutants, HAPs, toxic air pollutants and air toxics are considered to be synonymous.

[3] The number of HAPs reported in the EA will depend on the type of airport-sources evaluated and, in some cases, the type of fuel that powers the sources.

**Table 10: Potential HAPs to be Included in the Emissions Inventory**

1,1,1-trichloroethane
1,3-butadiene
2,2,4 trimethylpentane
2-ethoxyethanol
2-methylnaphthalene
acetaldehyde
acetone
acrolein (2-propenal)
benzaldehyde
benzene
butyl cellosolve
chlorobenzene
cyclohexane
dichloromethane
thyl acetate
ethyl chloride
ethyl ether
ethylbenzene
ethylene bromide
ethylene glycol
formaldehyde
isomers of xylene
Isopropylbenzene
m & p-xylene
methyl alcohol
methyl chloride
methyl ethyl ketone
methyl isobutyl ketone
methyl tert butyl ether
m-xylene
naphthalene
n-butyl alcohol
n-heptane
n-hexane
o-xylene
perchloroethylene
phenol (carbolic acid)
phthalic anhydride
propionaldehyde
p-xylene
styrene
toluene
trichloroethylene
trichlorotrifluoroethan
vinyl acetate

Source: KB Environmental Sciences, Inc., 2011.

Notably, an inventory of HAP emissions that would result from project-related construction activities will not be prepared. FAA guidance indicates that "although it is recognized that construction activities emit organic gases, it is not currently possible to accurately speciate the emissions for construction equipment due to the lack of data."

Importantly, airports do not meet the U.S. EPA definition of major or area sources of HAPs. Therefore, the inventory results will not be compared to the 10 to 25 ton/year thresholds regulated under Section 112 of the CAA. Rather, the results will be used to compare the alternatives to the No Action Alternative.

## 6. Dispersion Modeling Analysis for On-Airport Sources

Atmospheric dispersion modeling for CO will be conducted to predict the effects of the alternatives on local air quality conditions.

### 6.1 Approach

Consistent with FAA guidance for conducting dispersion modeling for airports, the EDMS will be used and has the capability to assess CO. The most current version of EDMS (version 5.1.3) contains AERMOD, the new and most advanced dispersion model developed by the EPA.

All standard methods will be used except where project-specific conditions and inputs will be more appropriate and allowable under FAA and EPA modeling conventions. Any non-standard approaches will be coordinated with FAA's Office of Environment and Energy and accounted for when developing task schedules. The results will be expressed as parts per million (ppm) for ease in comparison to the NAAQS.

### 6.2 Background Concentrations

Because the dispersion modeling will address emissions from airport-related sources and the surrounding roadway networks only, background concentrations will be added to the results to account for air pollutants generated by other sources or originating from outside the Study Area. These background concentrations will be derived from existing air monitoring data collected by MPCA.

### 6.3 Meteorological and Physical Conditions

Meteorological data will be obtained from the National Climatic Data Center (NCDC). Data for the most recent five-year period available (2006 through 2010) will be used in a screening process to determine what year, of the five years, would result in the predicted highest ambient concentrations of pollutants.

Based on EPA guidance contained in Appendix W of 40 CFR Part 51 (Guideline on Air Quality Models), most municipal airports are classified as rural, however given the density surrounding MSP the site will likely be classified as urban.

### 6.4 Receptors

For CO pollutant concentrations will be predicted at a sufficient number of receptor locations to identify the maximum concentrations. The term *receptor* generically describes outdoor land uses or activities where the public can reasonably be expected to occupy for a period ranging from one hour to one year. Because EDMS is designed to handle only a moderate number of receptors, a strategy will be developed to help limit the run time of the model while optimizing the results. This involves the identification of sensitive receptors and the use of grid receptors. Overall, the dispersion analysis is expected to use no more than 50 receptors at each alternative site evaluated, selected as follows:

- **Boundary receptors —** Boundary receptors will be located in areas along the airport boundary at a spacing of approximately 10 degrees.
- **Sensitive receptors —** Sensitive receptors will include schools, parks, residential areas and health-/day-care centers located in the vicinity of MSP based on current and future land use plans.
- **Worst-case receptors —** Worst-case receptors will be selected in close proximity to air emissions sources such as near runway ends, terminal area access/egress roads, and off-site intersections. These receptors represent sites where the pollutant concentrations are expected to be the highest and the public has access.

The overall number and locations of the receptors will be justified as part of the Air Quality Assessment Results. This will comprise both quantitative and illustrative demonstrations verifying that the selected receptors represent the highest project-related air quality impacts and that potential receptors located elsewhere (or further away) have lower impacts, by comparison.

## 7. CO 'Hot-Spot" Dispersion Analysis

Where applicable, the effects of motor vehicle CO emissions at intersections will be modeled using the EPA's recommended CAL3QHC model.[4] Emissions factors for motor vehicles will be obtained from EPA's MOBILE6.2 based upon Minnesota-specific input parameters such as vehicle speed, fleet mix, and ambient temperatures.

A worst-case wind speed of 1.0 meter per second will be used along with an atmospheric stability class of E (moderately stable) through D (neutral). A default atmospheric mixing height of 1,000 meters (approximately 3,280 feet) above ground level and a surface roughness length of 100 centimeters will be used.

Receptors (at a height of 1.8 meters) will be located within each intersection, at a location 3 meters from the roadway and along the roadway at a distance of 25, 50, and 100 meters from the intersection in each direction.

The determination of which (if any) intersections for which a CO "hot-spot" analysis will be conducted will be based on the traffic volumes and level of service (LOS) of select intersections located in the Study Area. Intersections that would deteriorate from a LOS of A through C to a LOS of D, E, or F will be judged as candidates for a CO hotspot intersection analysis.

A preliminary assessment has identified the new 34th Street Interchange as the most critical roadway improvement requiring a CO Hot Spot analysis. If any other improvements or intersections are predicted to experience a significant increase in traffic volume with a corresponding decrease in level of service, additional CO Hot Spot analyses may be performed.

## 8. Presentation of Results

As discussed, the results of the emissions inventory will be expressed in units of tons per year for each year of interest, pollutant, and emission source. **Table 11** provides a sample format that could be used to present the emission inventory results.

For ease in reviewing the dispersion modeling results and comparison to the NAAQS, CO will be reported as ppm. The highest predicted concentrations (with background included) will be reported. A sample tabular form for the dispersion modeling results is provided in **Table 12**.

The HAPs emission inventory results (expressed in units of tons per year) will be summarized by individual HAP (i.e., formaldehyde, benzene, etc.) and source (aircraft, GSE, etc.) as shown in **Table 13**.

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[4] U.S. EPA, *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections*, September 1995.

**Table 11 Air Emissions Inventory Results (tons per year) [Sample Format]**

| | Pollutant | | | | | |
|---|---|---|---|---|---|---|
| **Source** | **CO** | **VOC** | **NOx** | **SOx** | **$PM_{10}$** | **$PM_{2.5}$** |
| Aircraft | - | - | - | - | - | - |
| Ground Support Equipment (GSE)/Auxiliary Power Units (APU) | - | - | - | - | - | - |
| On-site Motor Vehicles | - | - | - | - | - | - |
| Fuel Storage Facilities | | | | | | |
| Stationary Sources | - | - | - | - | - | - |
| Construction Activities | - | - | - | - | - | - |
| Totals | - | - | - | - | - | - |

Source: KB Environmental Sciences, Inc., 2011.

**Table 12 Dispersion Modeling Results [Sample Format]**

| **Pollutant** | **Averaging Time** | **Maximum Modeled Concentration** | **NAAQS** | **Comments** |
|---|---|---|---|---|
| Carbon monoxide | 1-hour | x ppm | 35 ppm | Below NAAQS |
| | 8-hour | x ppm | 9 ppm | Below NAAQS |

Source: KB Environnemental Sciences, Inc., 2011.

**Table 13 HAPs Emissions Inventory Results (tons per year) [Sample Format]**

| | Sources | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Aircraft** | **GSE** | **Motor Vehicles** | **Other** | **Totals** |
| Formaldehyde | — | — | — | — | — |
| Acetaldehyde | — | — | — | — | — |
| Benzene | — | — | — | — | — |
| Toluene | — | — | — | — | — |

Source: KB Environmental Sciences, Inc., 2011.
Table to be expanded, as necessary.

## 9. Greenhouse Gases

The MPCA requests proposers of projects to prepare a carbon footprint if the proposed project must obtain both an air emissions permit and also complete environmental review under MEPA. The MPCA published its “General Guidance for Carbon Footprint Development in Environmental Review” in September 2009. The document provides basic guidance for how to prepare a carbon footprint that responds to Question 23 of the EAW form, which requests a description of stationary source emissions including “any greenhouse gases (such as carbon dioxide, methane, nitrous oxide).” The MPCA guidance requests that the carbon footprint include the six primary greenhouse gases (GHGs):

- Carbon Dioxide ($CO_2$)
- Methane ($CH_4$)
- Nitrous Oxide ($N_2O$)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride ($SF_6$)

In the guidance document, the MPCA refers to the Climate Registry General Reporting Protocol (GRP) for how to report a project carbon footprint in MEPA environmental review. The GRP follows international (World Resources Institute) guidance for setting boundaries (that is, the guidance defines scopes or what sources are counted and how ownership is assigned), performing calculations, and documenting information sources. The MPCA guidance document requests a full carbon footprint, including (1) direct facility emissions of the six primary GHGs (consistent with the Scope 1 GRP category) and (2) indirect emissions of the six primary GHGs from the consumption of purchased electricity (consistent with the Scope 2 GRP category). The MPCA guidance also states that the footprint may, at the project proposer’s option, include in the carbon footprint the direct emissions of other GHGs (that is, other than the six primary GHGs).

Although the GRP follows international guidance, it does not address all scenarios. Considering that the MPCA continues to refine and update its approach for handling proposed project assessments, the guidance document states that the “MPCA will be flexible and adaptive with project proposers.” As such, the guidance provides for project proposers to use other protocols in situations that do not have proper quantification protocols under the GRP.

Airports pose a unique challenge for quantifying and attributing emissions based on the multiple stakeholders and global reach. Based on the unique challenges, the Transportation Research Board’s Airport Cooperative Research Program (ACRP) developed a Guidebook on Preparing Airport GHG Emissions Inventories. The ACRP guidance also follows international guidance on boundaries. However, the ACRP guidance provides different recommendations than the MPCA guidance and includes more detailed calculation methodologies for airport-specific quantification. For example, the ACRP recommendations include direction to use calculation tools discussed elsewhere in this air quality assessment protocol (e.g. EDMS, MOBILE6.2, and NONROAD). Use of these calculation tools varies slightly from the methodology in the MPCA carbon footprint guidance but will offer more relevant information in analyzing GHG emissions from the alternatives that will be discussed in the EA/EAW.

The MAC prepares a GHG Emissions Inventory for MSP on a biannual basis (i.e., 2005, 2007, 2009) as a means of quantifying the airport's "carbon footprint" and tracking short- and long-term trends. The following scope is proposed for addressing GHG emissions from each alternative discussed in the EA/EAW.

- Coordinate with MPCA staff to set specific methodologies for quantifying and reporting GHGs under the alternatives.
- Obtain appropriate monitoring and recordkeeping data for GHG emissions from sources at the MSP.
- Calculate GHG emissions from the listed sources during calendar year 2010, and the alternatives in accordance with calculation methodologies consistent with the ACRP guidance. Calculation tools to be used:
    - EDMS
    - MOBILE6.2
    - NONROAD
- Prepare and submit a carbon footprint report for the EA/EAW that details the 2010 baseline condition and effects of the alternatives.

## 10. Construction Activities

The construction requirements for the proposed action will involve a variety of air emissions sources including on- and off-road construction vehicles, machinery and equipment. These emission sources are associated with the following activities:

- Site preparation and earth-moving;
- Material transport;
- Leveling and grading of project footprint;
- Construction operations; and
- Storage and movement of raw and construction materials.

This section outlines the procedures, data sources, and other analytical parameters to be used in developing the air emissions estimates for constructing the alternatives.

### Construction Equipment Types

For the purposes of this analysis, the construction equipment types will be subdivided into two categories: off-road equipment and on-road vehicles. Off-road equipment is used to move and grade fill materials, install utilities, pave runway/taxiway/apron surfaces, construct buildings and install other miscellaneous airfield support features. These include a wide array of scrapers, loaders, dozers, cranes and off-road haul trucks. On-road vehicles include transport trucks for the delivery of raw materials, supplies and equipment, as well as the personal vehicles used by the construction workers. Typical on-road vehicles include automobiles, vans and trucks of various sizes and functions.

### Activity Levels and Load Factors

Activity levels are defined as the hours of operation for a piece of equipment over a given time, and load factors are the engine performance demands, as a percent of maximum power. Equipment type and duration of each project component will be developed with assistance from construction engineers. Activity level will be determined by the estimated construction time in months relative to average 12-month activity for each type of equipment. Average load factors obtained from the US EPA nonroad section will be used to determine emission levels for each type of equipment. The emission factors will be based on the age distribution in the NONROAD2008 model for the 2008 calendar year.

### Equipment & Vehicle Emissions Factors

The construction-related emission inventories will be calculated using emission factors obtained from the U.S. EPA's NONROAD2008 model and MOBILE6.2 emissions model.

## 11. General Conformity

As discussed previously in Section 2.4, the General Conformity Rule of the federal CAA prohibits federal agencies (including FAA) from permitting or funding projects or actions that do not conform to an applicable SIP. The principal aim of this requirement is to help ensure that the project/action does not:

- Cause or contribute to a new violation of a NAAQS;
- Increase the severity of an existing violation of an NAAQS; or
- Delay the timely attainment of an NAAQS.

As MSP is located in a CO attainment/maintenance area subject to a SIP, the project will be evaluated with respect to its conformity.

Following EPA and FAA guidance, the applicability of the General Conformity Rule will first be determined based upon the comparison of project-related emissions to the proper "de-minimis" thresholds. Both "direct" and "indirect" sources of emissions will be evaluated.

Should the net change in emissions be less than the de-minimis levels, the alternatives will be shown to conform and no further analysis will be necessary. If the outcome reveals a net increase(s) in emissions above the applicability thresholds, a formal General Conformity Determination will be conducted.

## 12 Transportation Conformity

Off-site roadway projects associated with the alternatives will also be evaluated under the Transportation Conformity Rule of the federal CAA. In addition to the FAA and MAC, this process may involve the Federal Highway Administration (FHWA), the Minnesota Department of Transportation (MnDOT) and the MC.

In summary, the Transportation Conformity Rule requires that off-site roadway projects that are deemed "regionally significant" (i.e., arterials, freeways, etc.) be included in a conforming Transportation Improvement Plan (TIP).[5] In other words, the entire TIP (including the project-related roadway projects) must conform to the SIP (i.e., the individual roadway projects are not shown to conform to the SIP). Transportation Conformity also applies to transit-related projects, in which case the Federal Transit Administration is involved.

Only funded and approved projects are included in the TIP and evaluated for Transportation Conformity. Although the FAA and MAC are not directly responsible for Transportation Conformity determinations, any required transportation conformity analyses and

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[5] Off-site roadway projects include any project whose limits extend (entirely or partially) beyond airport layout boundary.

determinations in the future will be coordinated with the appropriate federal, state, and local agencies and any available outcomes would be fully disclosed in the EA/EAW. At this time none of the adjacent roadway projects, including the 34th Street Interchange, are currently listed in the MC 2009 – 2012 Transportation Improvement Program for the Twin Cities Metropolitan Area. Any roadway improvements associated with the LTCP will be considered in future Transportation Conformity analysis where appropriate.

# References

40 CFR Part 93, Subpart A, *Determining Conformity to State or Federal Implementation Plans of Transportation Plans, Programs and Projects Developed, Funded or Approved Under Title 23 U.S.C or the Federal Transit Laws* (1998).

40 CFR Part 93, Subpart B, *Determining Conformity of General Federal Actions to State or Federal Implementation Plans* (1993).

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U.S. EPA, 40 CFR, Chapter 1, Part 51, Appendix W (*Guideline of Air Quality Models*)

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