CHAPTER 5: ENVIRONMENTAL CONSIDERATIONS

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5.1 AIRPORT AND AIRCRAFT ENVIRONMENTAL CAPABILITY

An integral part of the airport planning process focuses on the manner in which the airport and any planned enhancements to the facility pose environmental impacts. This chapter evaluates the major environmental implications of the planned operation and development of the Minneapolis-St. Paul International Airport.

The larger tables referenced in this chapter are included in Appendix B of this report.

5.2 AIRCRAFT NOISE

5.2.1 QUANTIFYING AIRCRAFT NOISE

Basics of Sound

Sound is a physical disturbance in a medium, a pressure wave moving through air. A sound source vibrates or otherwise disturbs the air immediately surrounding the source, causing variations in pressure above and below the static (at-rest) value of atmospheric pressure. These disturbances force air to compress and expand, setting up a wavelike movement of air particles that move away from the source. Sound waves, or fluctuations in pressure, vibrate the eardrum creating audible sound.

The decibel, or dB, is a measure of sound pressure level that is compressed into a convenient range, that being the span of human sensitivity to pressure. Using a logarithmic relationship and the ratio of sensed pressure compared against a fixed reference pressure value, the dB scale accounts for the range of hearing with values from 0 to around 200. Most human sound experience falls into the 30 dB to 120 dB range.

Decibels are logarithmic and thus cannot be added directly. Two identical noise sources each producing 70 dB do not add to a total of 140 dB, but add to a total of 73 dB. Each time the number of sources is doubled, the sound pressure level is increased 3 dB.

Baseline: 70 dB

2 sources: 70 dB + 70 dB = 73 dB

4 sources: 70 dB + 70 dB + 70 dB + 70 dB = 76 dB

8 sources: 70 dB + 70 dB + 70 dB + 70 dB + 70 dB + 70 dB + 70 dB + 70 dB = 79 dB

The just-noticeable change in loudness for normal hearing adults is about 3 dB. That is, changes in sound level of 3 dB or less are difficult to notice. A doubling of loudness for the average listener of A-weighted sound is about 10 dB.[3] Measured, A-weighted sound levels changing by 10 dBA effect a subjective perception of being “twice as loud”.[4]

[3] A-weighted decibels represent noise levels that are adjusted relative to the frequencies that are most audible to the human ear.

[4] Peppin and Rodman, Community Noise, p. 47-48; additionally, Harris, Handbook, Beranek and Vér, Noise and Vibration Control Engineering, among others.

Day-Night Average Sound Level (DNL)

In 1979 the United States Congress passed the Aviation Safety and Noise Abatement Act. The Act required the Federal Aviation Administration (FAA) to develop a single methodology for measuring and determining airport noise impacts. In January 1985 the FAA formally implemented the Day-Night Average Sound Level (DNL) as the noise metric descriptor of choice for determining long-term community noise exposure in the airport noise compatibility planning provisions of 14 C.F.R. Part 150. Additionally, FAA Order 1050.1, *"Environmental Impacts: Policies and Procedures"* and FAA Order 5050.4, *"National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions,"* outlines DNL as the noise metric for measuring and analyzing aircraft noise impacts.

As detailed above, the FAA requires the DNL noise metric to determine and analyze noise exposure and aid in the determination of aircraft noise and land use compatibility issues around United States airports. Because the DNL metric correlates well with the degree of community annoyance from aircraft noise, the DNL has been formally adopted by most federal agencies dealing with noise exposure. In addition to the FAA, these agencies include the Environmental Protection Agency, Department of Defense, Department of Housing and Urban Development, and the Veterans Administration.

The DNL metric is calculated by cumulatively averaging sound levels over a 24-hour period. This average cumulative sound exposure includes the application of a 10-decibel penalty to sound exposures occurring during the nighttime hours (10:00 PM to 7:00 AM). Since the ambient, or background, noise levels usually decrease at night the night sound exposures are increased by 10 decibels because nighttime noise is more intrusive.

The FAA considers the 65 DNL contour line to be the threshold of significance for noise impact. As such, sensitive land use areas (e.g., residential) around airports that are located in the 65 or greater DNL contours are considered by the FAA as incompatible structures.

Integrated Noise Model (INM)

The FAA-established mechanism for quantifying airport DNL noise impacts is the Integrated Noise Model (INM). The FAA's Office of Environment and Energy (AEE-100) has developed the INM for evaluating aircraft noise impacts in the vicinity of airports. The INM has many analytical uses, such as assessing changes in noise impact resulting from new or extended runways or runway configurations and evaluating other operational procedures. The INM has been the FAA's standard tool since 1978 for determining the predicted noise impact in the vicinity of airports. Statutory requirements for INM use are defined in FAA Order 1050.1, *"Environmental Impacts: Policies and Procedures"* and FAA Order 5050.4, *"National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions,"* and Federal Aviation Regulations (FAR) Part 150, *"Airport Noise Compatibility Planning."*

The model utilizes flight track information, runway use information, operation time of day data, aircraft fleet mix, standard and user-defined aircraft profiles, and terrain as inputs. Quantifying aircraft-specific noise characteristics in the INM is accomplished through the use of a comprehensive noise database that has been developed under the auspices of Federal Aviation Regulations (FAR) Part 36. As part of the airworthiness certification process, aircraft manufacturers are required to subject an aircraft to a battery of noise tests. Through the use of federally adopted and endorsed algorithms, this aircraft-specific noise information is used in the generation of INM DNL contours. Justification for such an approach is rooted in national standardization of noise quantification at airports.

The INM produces DNL noise exposure contours that are used for land use compatibility maps. The INM program includes built-in tools for comparing contours and utilities that facilitate easy export to commercial Geographic Information Systems. The model also calculates predicted noise at specific sites such as hospitals, schools or other sensitive locations. For these grid points, the model reports detailed information for the analyst to determine which events contribute most significantly to the noise at that location. The model supports 16 predefined noise metrics that include cumulative sound exposure, maximum sound level and time-above metrics from both the A-Weighted, C-Weighted and the Effective Perceived Noise Level families.

The INM aircraft profile and noise calculation algorithms are based on several guidance documents published by the Society of Automotive Engineers (SAE). These include the SAE-AIR-1845 report titled *"Procedure for the Calculation of Airplane Noise in the Vicinity of Airports,"* as well as others which address atmospheric absorption and noise attenuation. The INM is an average-value-model and is designed to estimate long-term average effects using average annual input conditions. Because of this, differences between predicted and measured values can occur because certain local acoustical variables are not averaged, or because they may not be explicitly modeled in the INM. Examples of detailed local acoustical variables include temperature profiles, wind gradients, humidity effects, ground absorption, individual aircraft directivity patterns and sound diffraction, terrain, buildings, barriers, etc.

The noise contours for the 2030 Preferred Alternative were calculated using INM version 7.0b, which is the most current version released by the Federal Aviation Administration. The noise contours developed for the 2008 base case, as developed in the Metropolitan Airports Commission's 2009 Annual Noise Contour Report, were calculated using INM version 7.0a. The input data developed in the 2009 Annual Noise Contour Report were re-run in the latest version of the INM and compared. The slight differences in the contours due to changes implemented in the latest version of the model did not justify reproducing the 2008 noise contour analysis contained in the 2009 Annual Noise Contour Report. Moreover, by using the 2008 actual noise contour that was developed in the 2009 Annual Noise Contour Report, the comparative noise assessment between the base case and forecast noise contours are conservative in this document.

The 2030 noise contour, which shows potential impacts, generated considerable discussion with adjacent communities during the Metropolitan Council's LTCP approval process. To address these concerns and to fully understand the noise impacts associated with increased aircraft operations, the MAC should initiate an FAA Part 150 study update, in consultation with the MSP Noise Oversight Committee (NOC), when the forecast level of operations five years into the future exceeds the levels of mitigation in the Consent Decree (582,366 annual operations). The results of this study should be incorporated into the first subsequent LTCP Update.

5.3 MSP BASE CASE 2008 NOISE CONTOURS

5.3.1 2008 BASE CASE AIRCRAFT OPERATIONS AND FLEET MIX

The past seven years have presented many challenges to the aviation industry. From a local perspective, operational levels and the aircraft fleet mix at MSP have been subject to lingering effects from the events of September 11, 2001, high fuel prices, a flurry of bankruptcy filings by several legacy airlines including Northwest Airlines, an economic recession and overall market forces that appear to be favoring consolidation, as indicated by Delta Air Lines' acquisition of

Northwest Airlines in 2008. These developments have had profound effects on airline and airport operations. For example, the actual 2008 operational level at MSP was below the operational level documented at the airport over 13 years ago.

The total MSP operations numbers for this study were derived from Airport Noise and Operations Monitoring System (ANOMS) data. The ANOMS total operations number was 1.2% lower than the Federal Aviation Administration Air Traffic Activity Data System (ATADS) number. The slightly lower ANOMS number can be attributed to normal system data gaps that occur regularly on an annual basis. To rectify the numbers, Metropolitan Airports Commission staff adjusted the ANOMS data upward to equal the total 2008 FAA ATADS number. **Table 5.1** provides the total number of 2008 aircraft operations at MSP by operational category.

TABLE 5.1: 2008 TOTAL OPERATIONS NUMBERS

Operations Category	Number of Operations*
Scheduled Passenger Air Carrier (a)	402,347
Cargo	14,361
Charter	536
GA	29,708
Military	3,020
TOTAL	449,972

Notes:

(a) Includes both air carrier and regional carrier operations.

* Based on actual year-to-date 2008 ANOMS data adjusted to match FAA ATADS data (to account for unavailable ANOMS operations data).

The 2008 total operations number of 449,972 — in the context of historical annual operations at MSP, the 2008 operations level is the lowest annual operations at MSP since 1994.

In addition to the reduction in overall operations at MSP, the aircraft fleet mix at MSP is continuing to change. Considering the multi-faceted nature of the variables that are presently impacting the operational downturn at MSP, it is difficult to forecast long-term operational implications. All signs, however, seem to point to a fundamental change in the nature of airline operations at MSP, especially in the type of aircraft flown by all airlines. Specifically, operations by older aircraft such as the DC9 and B727 that have been “hushkitted” to meet the Stage 3 noise standard are decreasing. Following the events of September 11, 2001, the number of monthly Stage 3 hushkit operations dropped off significantly at MSP and has never returned to pre-9/11 levels. The number of monthly Stage 3 hushkit operations dropped to 9,450 in September 2001 and has continued to drop since. Stage 3 hushkit operations dropped to a low of 2,487 total monthly operations in September 2008. In January 2009 the number of monthly Stage 3 hushkitted operations dropped to an all-time low of 2,150. At the same time that older hushkit aircraft operations are declining, the use of newer and quieter manufactured Stage 3 aircraft is on the rise. The best examples at MSP of the increasing use of newer aircraft are the Airbus A320/319, Airbus 330, Canadair Regional Jets (CRJs), Boeing B757-200/300, and Boeing B737-800. These aircraft are replacing older hushkitted Stage 3 aircraft such as the DC10, DC9, and B727.

When comparing the DC9 hushkitted aircraft to the CRJ-200 regional jet (the CRJ is one of the replacement aircraft for the smaller DC9s at MSP), 43 CRJ operations would be required to generate the same noise impact as one DC9 operation. The CRJ-200 aircraft represents newer technology engine noise emission levels.

Table 5.2 provides a breakdown of the 2008 aircraft fleet mix at MSP.

TABLE 5.2: 2008 AIRCRAFT FLEET MIX AVERAGE DAILY OPERATIONS

Group	Aircraft Type	Day	Night	Total
Manufactured/ Re-engined Stage 3 Jet	A300-622R	2.2	2.0	4.1
	A310-304	0.3	1.0	1.2
	A319-131	118.1	8.9	126.9
	A320-211	138.6	11.2	149.8
	A321-232	0.4	0.3	0.8
	A330	8.8	1.6	10.4
	B717-200	5.4	0.7	6.1
	B737-300	15.4	2.7	18.0
	B737-400	0.5	0.2	0.7
	B737-500	10.5	2.0	12.5
	B737-700	9.5	1.6	11.1
	B737-800	24.2	12.6	36.9
	B747-100	0.0	0.0	0.0
	B747-200	0.5	0.2	0.7
	B747-400	2.3	0.0	2.3
	B757-200	62.0	7.1	69.0
	B757-300	31.9	3.7	35.5
	B767-200	0.3	0.0	0.3
	B767-300	0.2	0.3	0.6
	B777-200	0.0	0.0	0.0
	CARJ/CL601	255.2	19.9	275.1
	CL600	2.3	0.2	2.5
	CNA500	1.4	0.1	1.5
	CNA650	3.1	0.3	3.4
	CNA750	5.1	0.5	5.6
	DC10	3.6	2.4	6.0
	DC820	0.0	0.0	0.0
	DC860	0.0	0.0	0.0
	DC870	0.6	1.0	1.6
	EMB145	31.3	3.3	34.5
	GIV	2.0	0.1	2.1
	GV	66.9	5.9	72.8
	IA1125	0.8	0.1	0.9
	L101	0.1	0.0	0.1
	LEAR35	7.0	2.8	9.8
	MD11GE	0.5	0.6	1.1
	MD81	28.0	4.9	32.9
	MD9025	0.5	0.2	0.7
	MU3001	8.5	0.6	9.1
	Total	847.8	99.0	946.8
Hushkit Stage 3 Jet	727Q	1.7	2.9	4.6
	737Q	0.1	0.0	0.1
	BAC111	0.0	0.0	0.0
	DC9Q	100.2	9.2	109.4
	Total	102.0	12.1	114.1
Stage 2 less than 75,000 lb.	FAL20	1.1	0.1	1.1
	GII	1.9	0.2	2.1
	GIII	0.3	0.0	0.3

MTOW	LEAR25	5.6	0.5	6.1
	Total	8.9	0.8	9.6
Propeller	1900D	4.2	0.7	4.9
	BEC58P	9.9	3.8	13.7
	C130	6.5	0.3	6.8
	CNA172	0.2	0.0	0.2
	CNA206	0.3	0.0	0.3
	CNA441	1.0	0.1	1.1
	DHC6	6.9	2.4	9.2
	DHC8	0.1	0.0	0.1
	GASEPF	1.6	1.7	3.3
	GASEPV	1.1	0.1	1.2
	HS748A	0.2	0.0	0.2
	PA28	0.1	0.0	0.1
	PA31	0.8	0.1	0.9
	SD330	0.1	0.0	0.2
	SF340	108.9	7.4	116.3
	Total	141.7	16.6	158.3
Helicopter	A109	0.0	0.0	0.0
	B206L	0.0	0.0	0.0
	B212	0.0	0.0	0.0
	B222	0.0	0.0	0.0
	S70	0.0	0.0	0.0
	Total	0.1	0.0	0.1
	C17	0.1	0.0	0.1
Military Jet	C9A	0.0	0.0	0.0
	F16GE	0.0	0.0	0.0
	F-18	0.0	0.0	0.0
	KC135	0.0	0.0	0.0
	T1	0.1	0.0	0.1
	T34	0.0	0.0	0.0
	T38	0.1	0.0	0.1
	U21	0.1	0.0	0.1
	Total	0.5	0.0	0.5
Total Ops.		1100.9	128.5	1229.4

5.3.2 2008 BASE CASE RUNWAY USE

The Federal Aviation Administration's control of runway use throughout the year for arrival and departure operations at MSP has a notable effect on the overall noise impact around the airport. The number of people and dwellings impacted by noise is a direct factor of the number of operations on a given runway and the land uses off the end of the runway.

Historically, prior to the opening of Runway 17-35, arrival and departure operations occurred on the parallel runways at MSP (12L-30R and 12R-30L) in a manner that resulted in approximately 50% of the arrival and departure operations occurring to the northwest over South Minneapolis and to the southeast over Mendota Heights and Eagan. As a result of the dense residential land uses to the northwest and the predominantly industrial/commercial land uses to the southeast of MSP, focusing arrival and departure operations to the southeast has long been the preferred configuration from a noise reduction perspective.

Since the introduction of Runway 17-35 at MSP, another opportunity exists to route aircraft over an unpopulated area – the Minnesota River Valley. With use of the Runway 17 Departure Procedure, westbound departure operations off Runway 17 are routed such that they avoid close-in residential areas southwest of the new runway. Thus, use of Runway 17 for departure operations is the second preferred operational configuration (after Runways 12L and 12R) for noise reduction purposes.

Table 5.3 provides the runway use percentages for 2008.

TABLE 5.3: 2008 RUNWAY USE

Op Type	Runway	Day	Night	Total
Arrivals	04	0.0%	0.0%	0.0%
	22	0.1%	0.0%	0.1%
	12L	22.5%	15.0%	21.7%
	30R	22.6%	21.9%	22.5%
	12R	21.1%	24.4%	21.4%
	30L	17.8%	37.2%	19.8%
	17	0.0%	0.0%	0.0%
	35	15.8%	1.5%	14.4%
	Total	100.0%	100.0%	100.0%
Departures	04	0.1%	0.1%	0.1%
	22	0.2%	0.1%	0.2%
	12L	13.2%	19.8%	14.0%
	30R	28.8%	24.9%	28.4%
	12R	6.6%	20.9%	8.2%
	30L	24.3%	20.4%	23.8%
	17	26.7%	13.8%	25.3%
	35	0.0%	0.0%	0.0%
	Total	100.0%	100.0%	100.0%
Overall	04	0.1%	0.1%	0.1%
	22	0.1%	0.0%	0.1%
	12L	17.9%	17.5%	17.9%
	30R	25.7%	23.4%	25.5%
	12R	13.9%	22.6%	14.8%
	30L	21.0%	28.5%	21.8%
	17	13.2%	7.2%	12.6%
	35	8.0%	0.7%	7.2%
	Total	100.0%	100.0%	100.0%

Note: Totals may not add up to 100% due to rounding.

Sources: MAC ANOMS data was used to calculate runway use for 2008.

5.3.3 2008 BASE CASE FLIGHT TRACKS

In large part, the 2008 Integrated Noise Model (INM) flight tracks are consistent with those used previously to develop the 2002 MSP Part 150 Update 2007 forecast mitigated noise contour, with the exception of Runways 17, 35, and 4 departure tracks. The Metropolitan Airports Commission (MAC) updated the INM departure tracks to conform to actual radar flight track data.

Figures 5-1 (a-h) provide the INM departure and arrival flight tracks that were used to develop the 2008 actual noise contour. **Table 5.4,** in Appendix B, provides the 2008 INM flight use percentages.

5.3.4 2008 BASE CASE ATMOSPHERIC CONDITIONS

The MAC gathered atmospheric data for the 2008 base case noise contour from the National Weather Service (NWS) and the Minnesota State Climatologist's Office. The MAC used the NWS's 2008 annual average temperature of 44.7 degrees Fahrenheit and 2008 average annual wind speed of 7.6 Kts. in the INM modeling process. The MAC also used a 2008 average annual pressure of 29.98 inches and a 2008 annual average relative humidity of 74%, as reported by the Minnesota State Climatologist's Office.

5.3.5 2008 MODELED VERSUS MEASURED DNL LEVELS

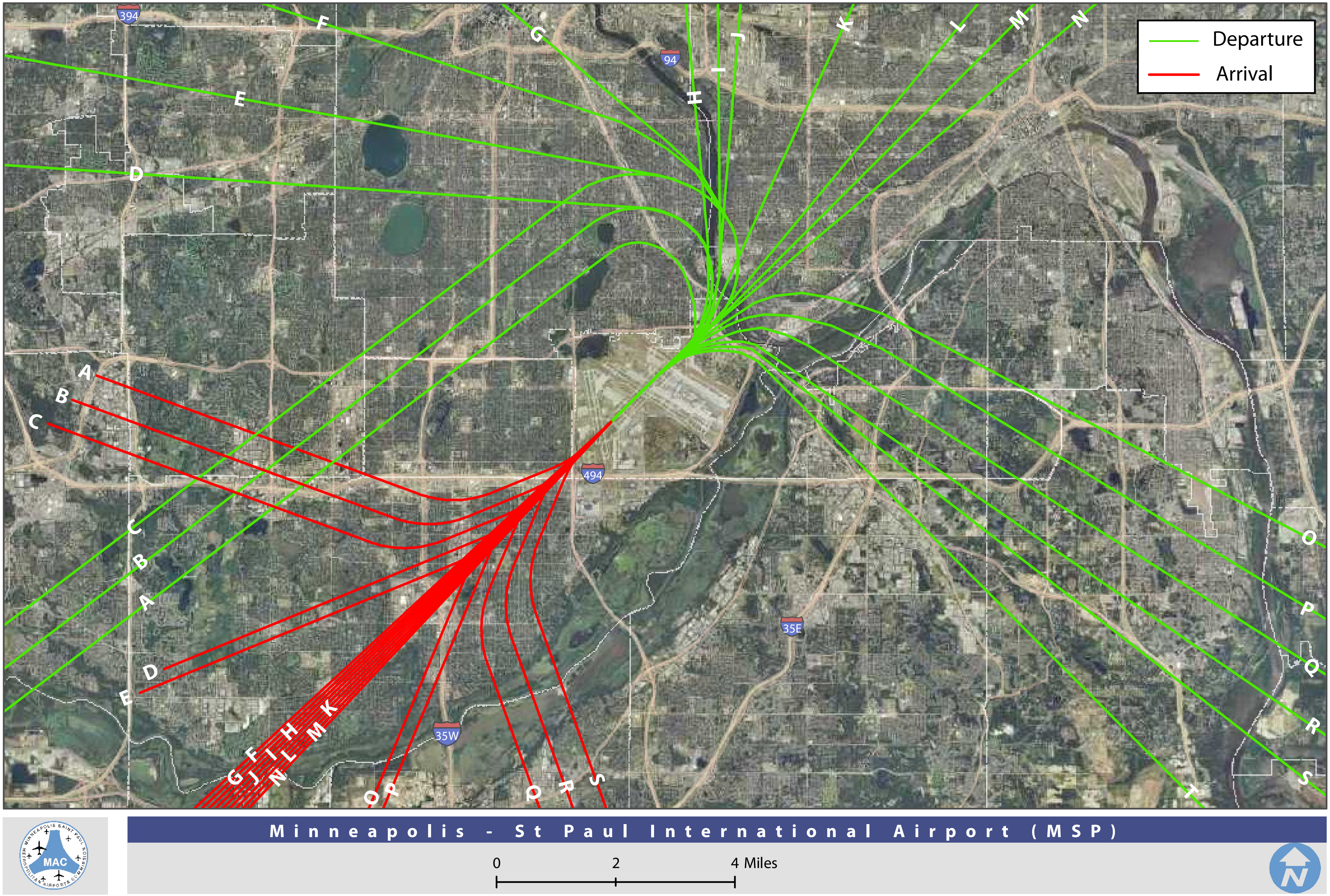
As part of the 2008 base case noise contour development process, a correlation analysis was conducted comparing the INM-developed 2008 base case DNL noise contours to actual measured aircraft noise levels at the 39 Airport Noise and Operations Monitoring System (ANOMS) Remote Noise-Monitoring Towers (RMTs) around MSP in 2008. An INM grid point analysis was conducted to determine the model's predicted 2008 DNL noise levels at each of the RMT locations (determined in INM by the latitude and longitude coordinates of each RMT).

Table 5.5 provides a comparison of the INM grid point analysis at each RMT site, based on the 2008 base case noise contour as produced with INM, and the actual ANOMS monitored aircraft DNLs at those locations in 2008.

The average absolute difference between the modeled and measured DNLs was 1.9 dB. The median difference was 1.1 dB. The ANOMS RMTs, on average, reported higher DNL levels than the INM model generated. The MAC believes that this is due in part to the inclusive approach MAC staff has taken in tuning the ANOMS noise-to-track matching parameters. This conservative approach, along with the increasing number of quieter jets operating at the airport, results in increased instances of community-driven noise events being attributed to quieter aircraft operating at further distances from the monitoring location.

INM Flight Tracks
Runway 04

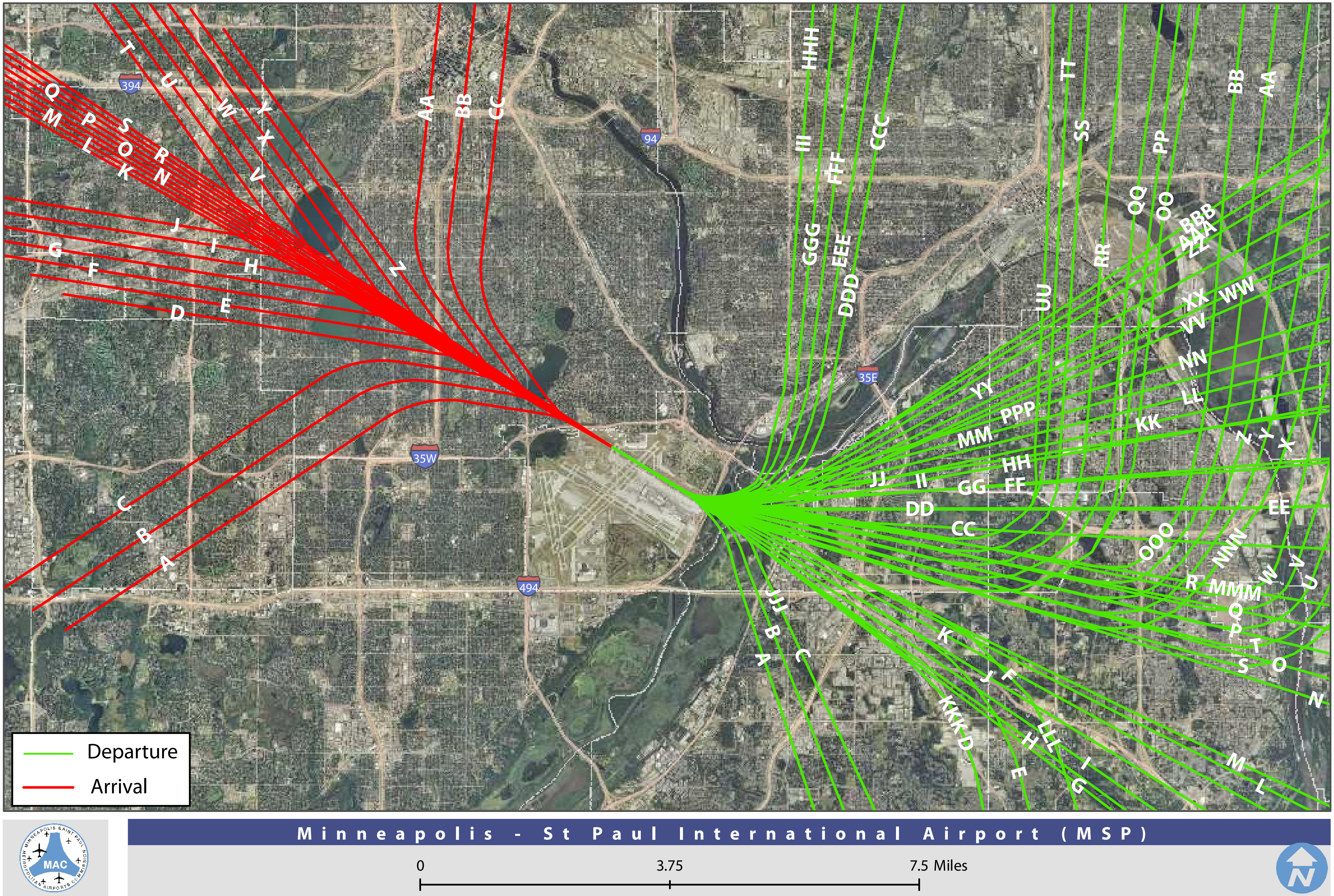
Figure 5-1a



Minneapolis - St Paul International Airport (MSP)

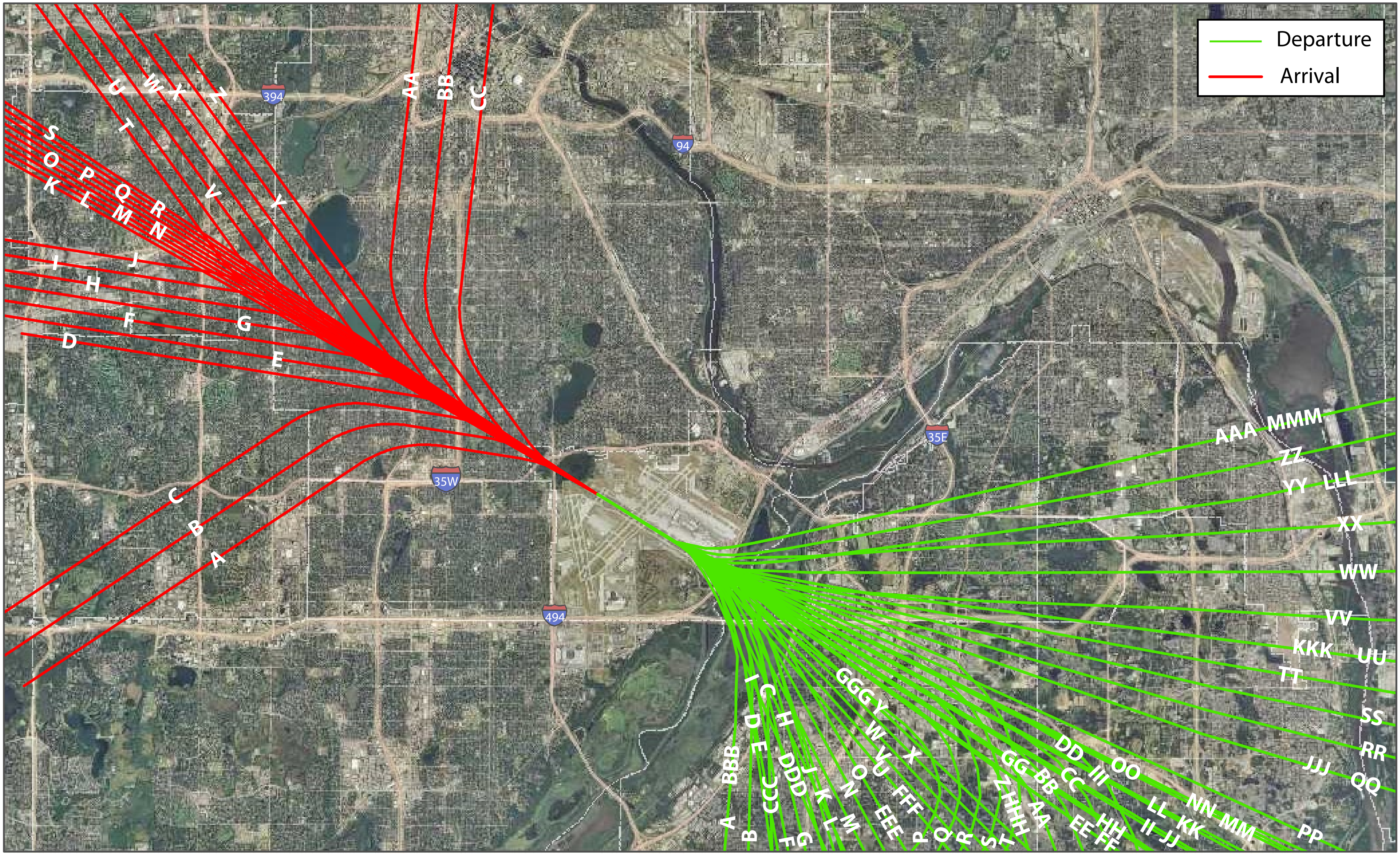
INM Flight Tracks Runway 12L

Figure 5-1b



INM Flight Tracks
Runway 12R

Figure 5-1c

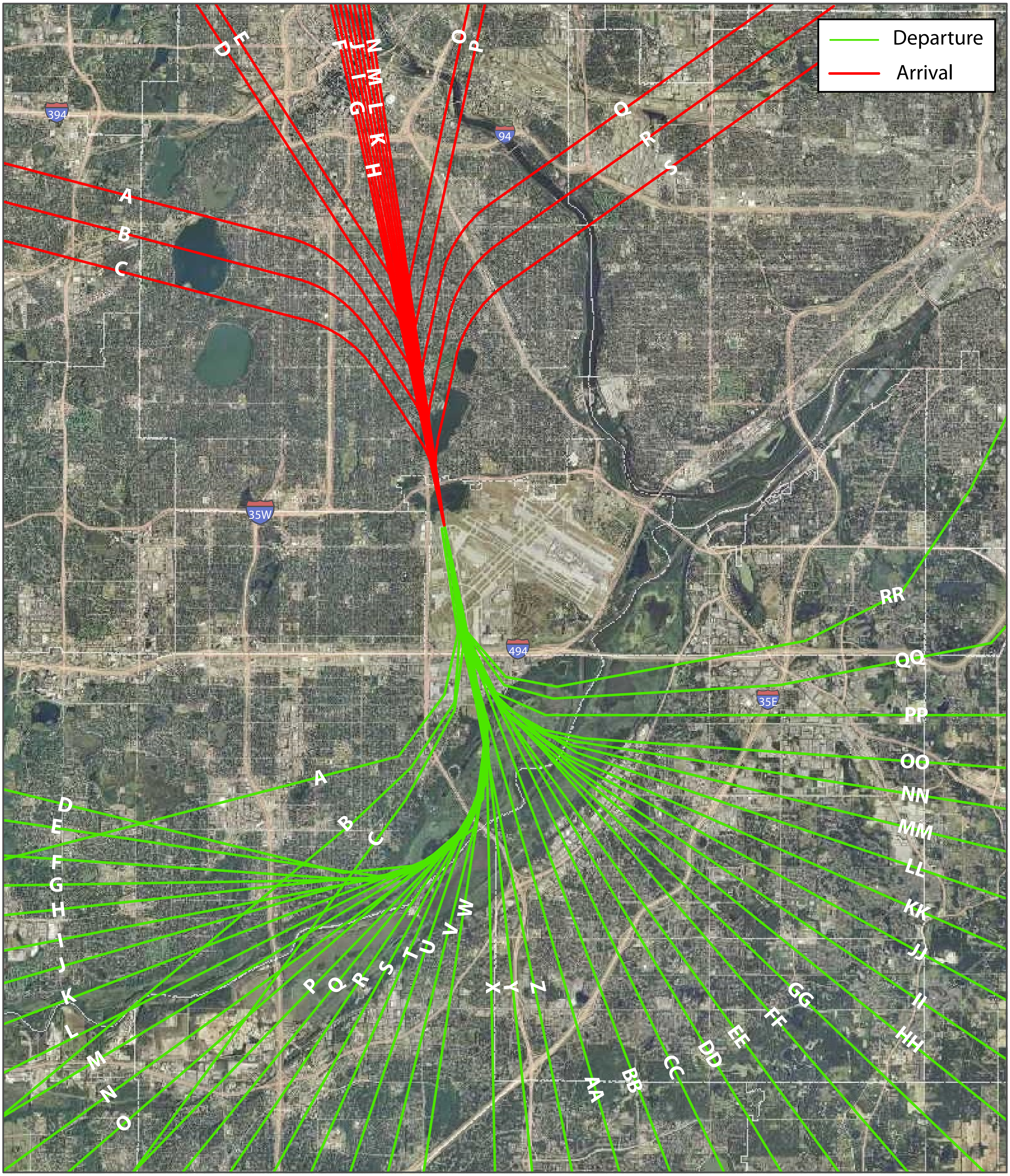


Minneapolis - St Paul International Airport (MSP)

0 3.75 7.5 Miles

INM Flight Tracks
Runway 17

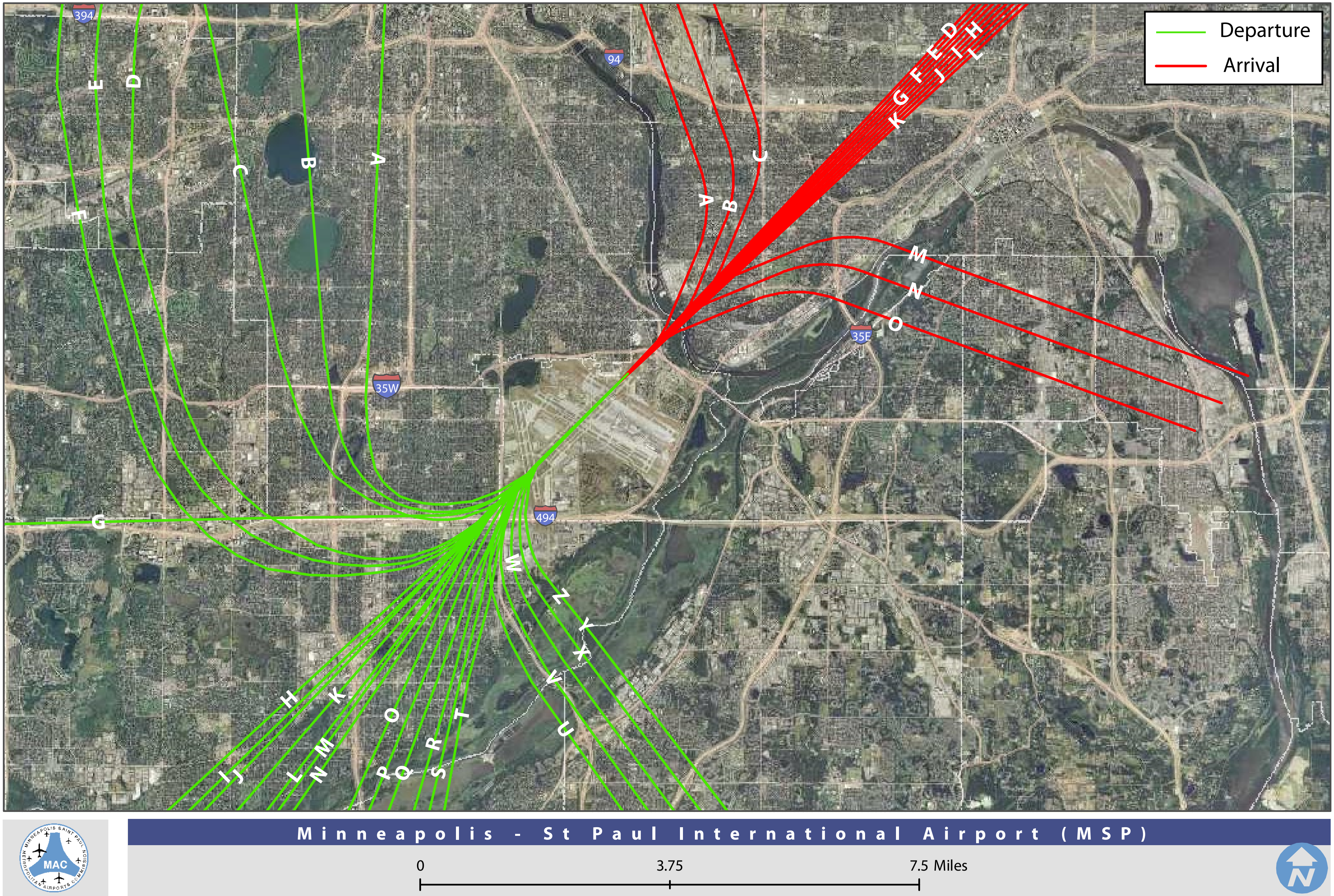
Figure 5-1d



0 2.5 5 Miles

INM Flight Tracks
Runway 22

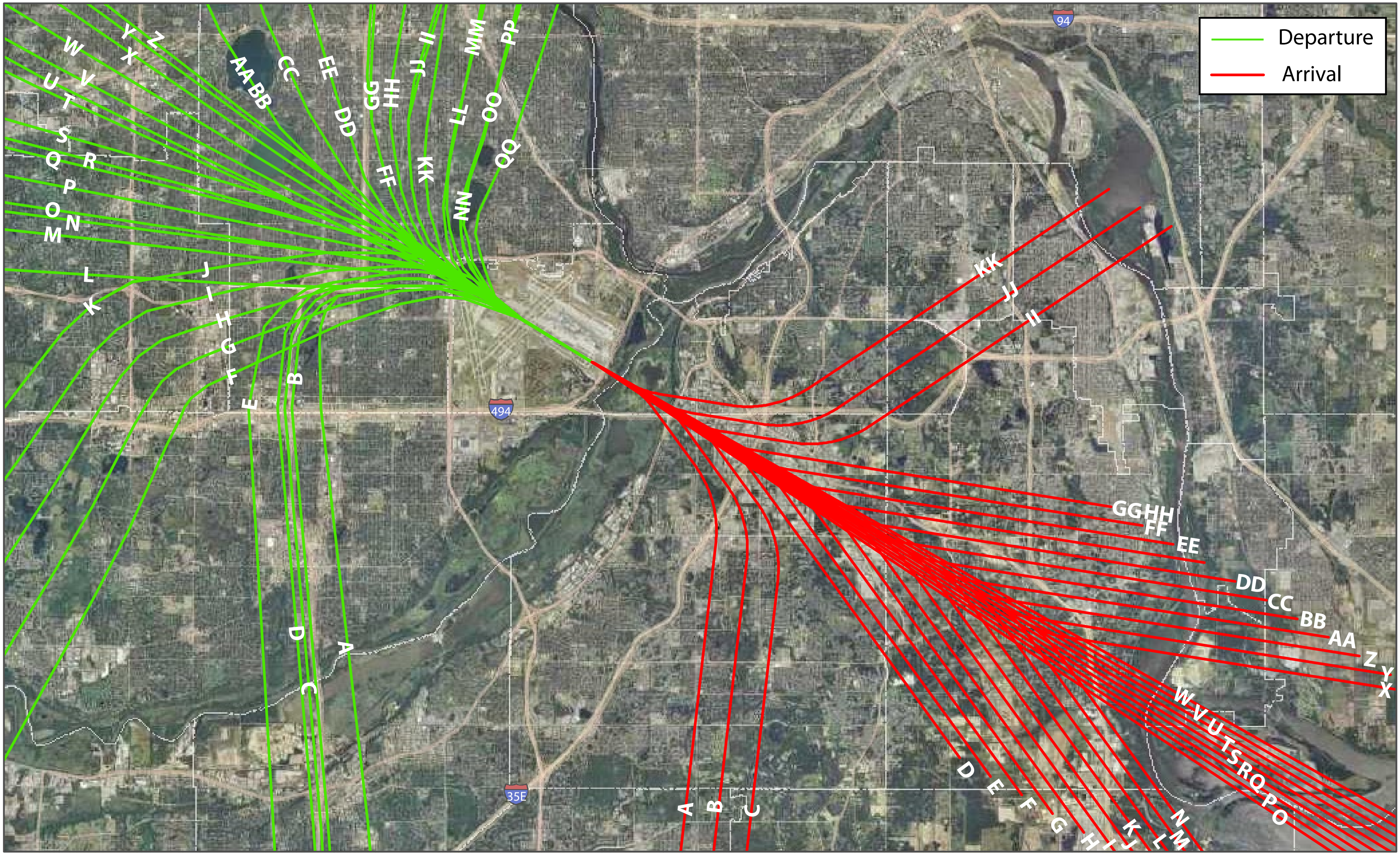
Figure 5-1e



Minneapolis - St Paul International Airport (MSP)

INM Flight Tracks
Runway 30L

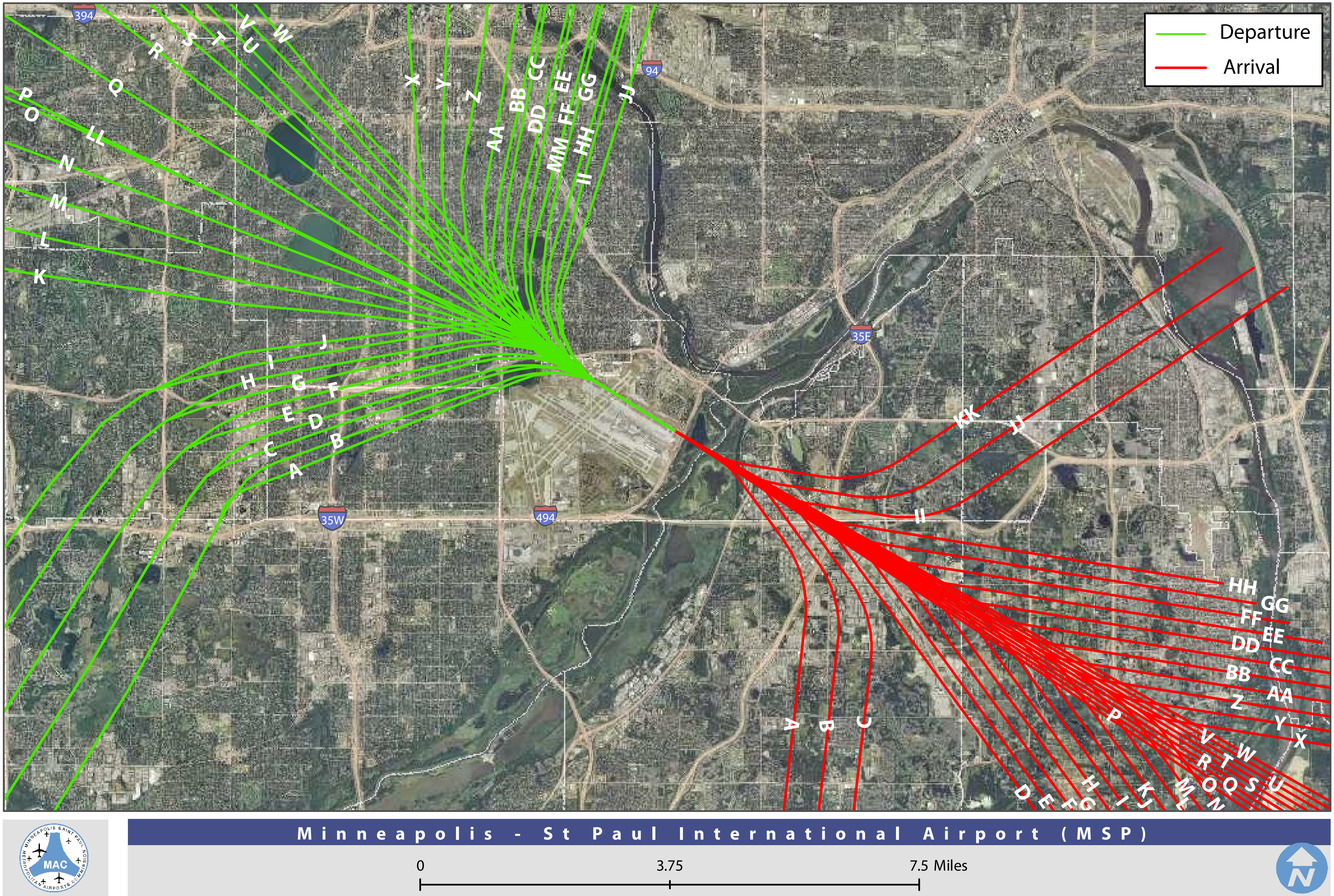
Figure 5-1f



Minneapolis - St Paul International Airport (MSP)

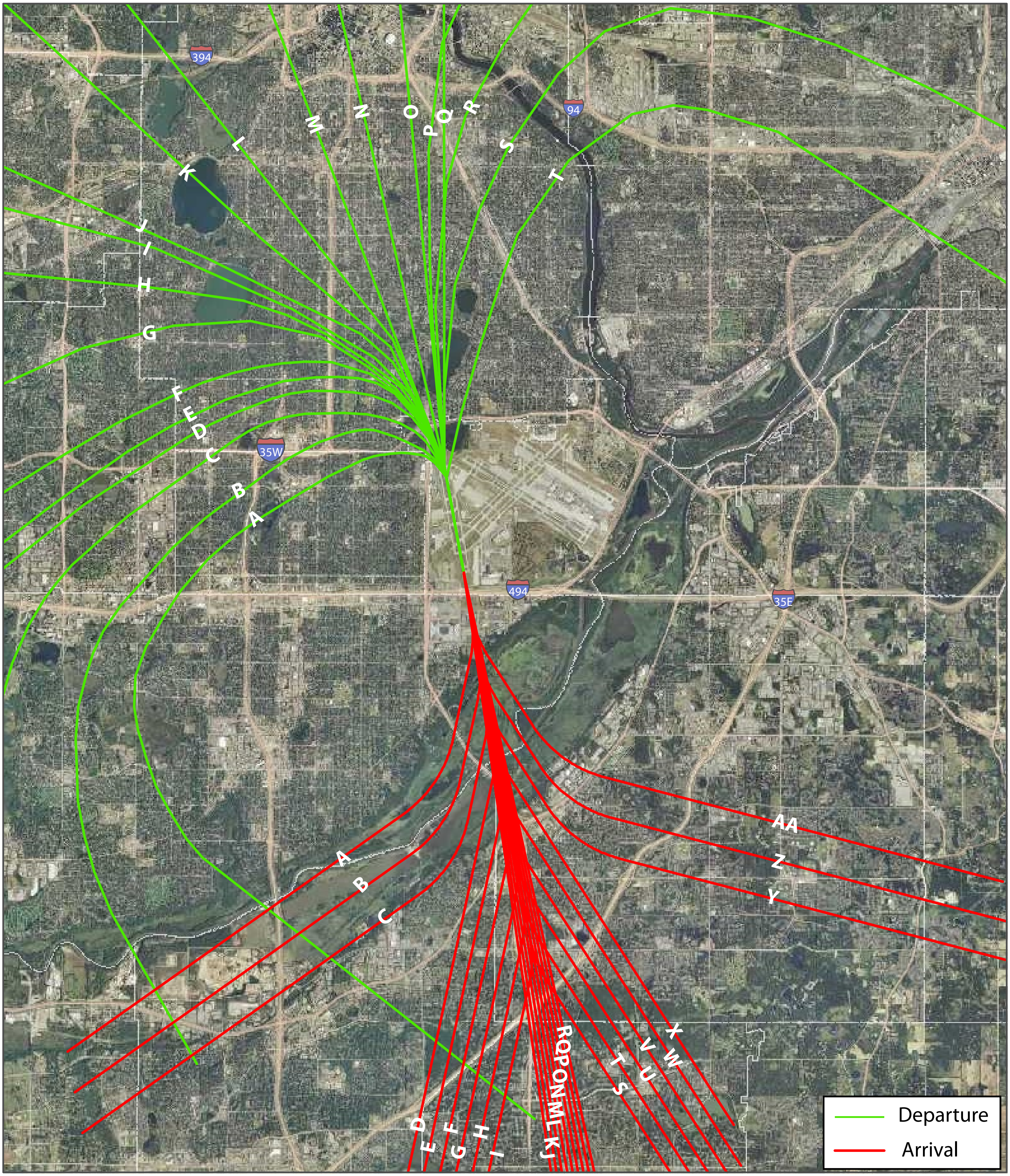
INM Flight Tracks Runway 30R

Figure 5-1g



INM Flight Tracks
Runway 35

Figure 5-1h



Minneapolis - St Paul International Airport (MSP)

0 2.5 5 Miles

The use of **Figure 5-1a** absolute values provides a perspective of total difference between the INM-modeled values and the measured DNL values provided by the ANOMS in 2008. The median is considered the most reliable indicator of correlation when considering the data variability across modeled and monitored data.

Overall, the small variation between the actual ANOMS monitored aircraft noise levels and the INM-modeled noise levels provides additional external system verification that the INM is providing an accurate assessment of the aircraft noise impacts around MSP.

TABLE 5.5: 2008 MEASURED VERSUS INM DNL VALUES AT ANOMS RMT LOCATIONS

RMT Site	2008 Annual Measured DNL (a)	2008 Modeled DNL	Difference (Modeled minus Measured)	
			Sign	Absolute
1	57.0	55.9	-1.1	1.1
2	58.9	57.1	-1.8	1.8
3	62.9	62.6	-0.3	0.3
4	61.5	61.2	-0.3	0.3
5	69.4	69.1	-0.3	0.3
6	71.3	68.9	-2.4	2.4
7	60.6	60.5	-0.1	0.1
8	59.0	58.7	-0.3	0.3
9	43.6	42.9	-0.7	0.7
10	48.6	49.5	0.9	0.9
11	44.3	45.6	1.3	1.3
12	39.3	48.1	8.8	8.8
13	54.1	55.8	1.7	1.7
14	62.0	61.4	-0.6	0.6
15	57.5	56.8	-0.7	0.7
16	65.4	63.9	-1.5	1.5
17	49.5	48.2	-1.3	1.3
18	57.9	58.8	0.9	0.9
19	53.7	54	0.3	0.3
20	48.3	50.2	1.9	1.9
21	51.1	52.1	1.0	1.0
22	56.0	56.9	0.9	0.9
23	62.9	61.6	-1.3	1.3
24	60.1	59.9	-0.2	0.2
25	51.5	56.3	4.8	4.8
26	54.8	52.6	-2.2	2.2
27	55.3	56.3	1.0	1.0
28	59.5	61.3	1.8	1.8
29	54.7	54.4	-0.3	0.3
30	62.6	61.2	-1.4	1.4
31	47.9	49.9	2.0	2.0
32	44.9	47.3	2.4	2.4
33	47.7	50.8	3.1	3.1
34	44.8	49.2	4.4	4.4
35	54.2	54.2	0.0	0.0
36	53.5	52.4	-1.1	1.1
37	47.9	49.5	1.6	1.6
38	50.4	51.5	1.1	1.1
39	51.7	53.2	1.5	1.5
Logarithmic Difference			**Average**	**1.9**
			Median	**1.1**

Notes:
All units in dB DNL
(a) computed from daily DNLs

Source: MAC RMT data

5.3.6 2008 BASE CASE NOISE CONTOUR IMPACTS

Based on the 449,972 total operations in 2008, approximately 5,716.5 acres are in the 65 DNL noise contour and approximately 12,975.5 acres are in the 60 DNL noise contour. **Table 5.6** contains the count of single-family (one unit per structure) and multi-family (greater than one unit per structure) dwelling units in the 2008 actual noise contours. The MAC based the counts on the parcel intersect methodology where all parcels that are within or touched by the noise contour are counted.

The 2008 count of residential units within the actual 60 DNL noise contour that have not received noise mitigation around MSP is 4,865. There are no unmitigated homes in the 2008 actual 65 DNL noise contour around MSP.

A depiction of the 2008 actual noise contour is provided in **Figure 5.2**.

TABLE 5.6: SUMMARY OF 2008 ACTUAL DNL NOISE CONTOUR SINGLE-FAMILY AND MULTI-FAMILY UNIT COUNTS

City	Count	Single-Family					Multi-Family				
		60-64	65-69	70-74	75+	Total	60-64	65-69	70-74	75+	Total
Bloomington	Completed	57				57	129	620			749
	Additional										
	Total	57				57	129	620			749
Eagan	Completed	269	1			270					
	Additional										
	Total	269	1			270					
Mendota Heights	Completed	45	1			46	7				7
	Additional										
	Total	45	1			46	7				7
Minneapolis	Completed	6207	2241	116		8564	1905	746	6		2657
	Additional	105				105	4				4
	Total	6312	2241	116		8669	1909	746	6		2661
Richfield	Completed	916	205			1121	284				284
	Additional										
	Total	916	205			1121	284				284
All Cities	Completed	7494	2448	116		10058	2325	1366	6		3697
	Additional	105				105	4				4
	Total	7599	2448	116		10163	2329	1366	6		3701

Note: Parcel intersect method, completed includes all parcels mitigated or eligible for mitigation.

2008 Base Case Contours

Figure 5-2

Minneapolis - St Paul International Airport (MSP)

5.4 2030 PREFERRED ALTERNATIVE FORECAST NOISE CONTOURS

As is detailed in Chapter 4 there are a number of development elements included in the preferred 2030 alternative. Although these developments include additional gates and terminal amenities, because no additional runway capacity is being developed there are no substantive impacts on the forecast noise contours resulting from the proposed developments.

5.4.1 2030 AIRCRAFT OPERATIONS AND FLEET MIX

The forecast information provided in Chapter 2 was the principal source of operations information used in the preparation of the 2030 day/night fleet mix projections. **Table 5.7** provides the total operations summary for 2030.

TABLE 5.7: 2030 TOTAL OPERATIONS NUMBERS

Operations Category	Number of Operations
Scheduled Passenger Air Carrier (a)	576,682
Cargo	18,834
Charter	218
GA (b)	32,988
Military	2,115
Total	**630,837**

Notes:

(a) Includes both air carrier and regional carrier operations

(b) Includes True Air Taxi

This analysis also included the development of detailed fleet mix and stage length information for most of the aircraft operations projected for 2030. Additional analysis utilizing ANOMS and other data sources was required to generate the day/night splits and refine the fleet mix estimates for the general aviation and military operations. **Table 5.8** provides a detailed breakdown of the forecasted 2030 fleet mix at MSP.

TABLE 5.8: 2030 AIRCRAFT FLEET MIX AVERAGE DAILY OPERATIONS

Group	Aircraft Type	Day	Night	Total
Manufactured/Re-engined Stage 3 Jet	737300	0.0	0.0	0.0
	737400	1.8	5.2	7.0
	737700	0.6	0.1	0.7
	737800	227.3	33.3	260.6
	747400	2.1	0.1	2.2
	757300	0.0	0.0	0.0
	757RR	4.4	5.6	10.1
	767300	13.3	3.2	16.5
	767CF6	13.4	1.5	14.9
	777200	8.3	0.5	8.9
	777300	6.4	0.1	6.5
	A300-622R	3.1	2.7	5.9
	A310-304	0.1	0.4	0.5
	A319-131	82.5	9.6	92.1
	A320-211	134.0	15.2	149.3
	A320-232	51.7	5.7	57.4
	A321-232	40.6	5.0	45.6
	A330-301	7.1	0.6	7.7
	A330-343	9.7	0.1	9.8
	CIT3	7.9	0.8	8.7
	CL600	4.2	0.4	4.6
	CL601	251.6	19.5	271.1
	CNA500	2.7	0.2	3.0
	CNA55B	1.1	0.1	1.2
	CNA750	6.1	0.6	6.7
	DC1010	0.4	0.3	0.7
	DHC6	3.6	0.8	4.4
	DHC8	0.1	0.7	0.8
	DHC830	139.0	9.0	147.9
	DO328	0.1	0.0	0.1
	ECLIPSE500	0.5	0.0	0.5
	EMB145	29.9	3.5	33.3
	F10062	0.9	0.1	1.0
	GIV	7.8	0.8	8.5
	GV	271.5	23.4	294.8
	HS748A	0.2	0.0	0.2
	IA1125	0.9	0.1	1.0
	LEAR35	8.6	1.5	10.1
	MD11GE	0.5	0.6	1.1
	MD81	0.1	0.0	0.1
	MD9025	28.7	2.3	31.0
	MU3001	7.0	0.7	7.7
	Total	**1380.0**	**154.2**	**1534.1**

Stage 2 less than 75,000 lbs	FAL20	2.2	0.2	2.4
	GII	1.0	0.1	1.1
	GIIB	0.1	0.0	0.2
	LEAR25	6.5	0.6	7.2
	Total	**9.9**	**1.0**	**10.9**
Propeller	1900D	4.9	0.9	5.8
	BEC58P	14.7	4.5	19.3
	C130	0.1	0.0	0.1
	C-130E	5.0	0.2	5.2
	CNA172	0.1	0.0	0.1
	CNA208	0.8	1.6	2.5
	CNA441	0.8	0.1	0.9
	PA31	0.3	0.1	0.4
	GASEPF	2.1	0.1	2.3
	GASEPV	0.6	0.0	0.6
	Total	**29.5**	**7.7**	**37.1**
Hushkit Stage 3 Jet	737QN	132.0	13.5	145.4
	Total	**132.0**	**13.5**	**145.4**
Helicopter	A109	0.0	0.0	0.1
	B206L	0.1	0.0	0.1
	H500D	0.0	0.0	0.0
	S70	0.0	0.0	0.0
	Total	**0.1**	**0.0**	**0.1**
Military Jet	C17	0.1	0.0	0.1
	C5A	0.0	0.0	0.0
	F16GE	0.0	0.0	0.0
	F-18	0.0	0.0	0.0
	KC-135	0.0	0.0	0.0
	T1	0.1	0.0	0.1
	T34	0.0	0.0	0.0
	T-38A	0.1	0.0	0.1
	U21	0.0	0.0	0.0
	Total	**0.4**	**0.0**	**0.4**
Total Operations		**1551.8**	**176.3**	**1728.1**

Source: ops_calc.dbf from INM Version 7.0b
Notes: Differences may exisit due to rounding
This is the modeled INM fleet mix and due to aircraft substitutions,
it will not exactly match the fleet mix in the LTCP

In summary, a total of 630,837 annual operations, which equates to approximately 1,728 daily operations, are forecasted for 2030.

5.4.2 2030 RUNWAY USE

Table 5.9 shows the 2030 modeled runway use.

TABLE 5.9: 2030 RUNWAY USE

Op Type	Runway	Day	Night	Total
Arrivals	04	0.0%	0.0%	0.0%
	22	0.3%	0.3%	0.3%
	12L	18.6%	17.6%	18.5%
	30R	20.7%	13.2%	19.9%
	12R	22.6%	24.8%	22.8%
	30L	10.4%	10.6%	10.4%
	17	0.0%	0.0%	0.0%
	35	27.5%	33.6%	28.1%
	Total	**100.0%**	**100.0%**	**100.0%**
Departures	04	0.2%	0.0%	0.2%
	22	0.1%	0.1%	0.1%
	12L	15.4%	16.5%	15.5%
	30R	20.9%	20.0%	20.8%
	12R	8.1%	10.9%	8.4%
	30L	24.6%	26.9%	24.8%
	17	30.8%	25.6%	30.3%
	35	0.0%	0.0%	0.0%
	Total	**100.0%**	**100.0%**	**100.0%**
Overall	04	0.1%	0.0%	0.1%
	22	0.2%	0.2%	0.2%
	12L	17.0%	17.0%	17.0%
	30R	20.8%	16.7%	20.4%
	12R	15.3%	17.6%	15.6%
	30L	17.4%	19.0%	17.6%
	17	15.4%	13.2%	15.1%
	35	13.8%	16.2%	14.1%
	Total	**100.0%**	**100.0%**	**100.0%**

The runway use modeled for the scheduled and un-scheduled aircraft operations in the development of the forecasted 2030 noise contour is the same as the runway use included in the July 2005 MSP 2015 Terminal Expansion Environmental Assessment. This was determined based on discussions with the MAC and the Federal Aviation Administration related to how the proposed alternatives at MSP would impact the use of the airfield in 2030. The data used were extracted from Table B.2.2 – 2015 Estimated Average Annual Runway Use for the 2015 Proposed Project located in Appendix B, Page B.2.5 of the July 2005 MSP 2015 Terminal Expansion EA.

The runway use modeled for the military operations forecasted in 2030 is based on the runway use modeled in the 2008 base case noise analysis.

The use of the helicopter pads was limited to the six pads modeled in the 2008 base case noise analysis. The operations were distributed evenly across the six pads.

For the purposes of this analysis the runway use for the scheduled and un-scheduled operations was applied to the fleet mix based on aircraft operational categories. This is consistent with the methodology used in the analysis included in the July 2005 MSP 2015 Terminal Expansion EA.

5.4.3 2030 FLIGHT TRACKS

The flight track layout and associated use for all the modeled operations were derived from the 2008 base case noise contour analysis. The Integrated Noise Model (INM) flight tracks used for the 2030 noise contour are the same as those used for the 2008 base case noise contour as provided in **Figures 5.1 (a-h).** The 2030 INM track usage percentages are provided in **Table 5.10** in Appendix B. As with the runway use, the flight track use for scheduled and un-scheduled operations was also applied to the fleet mix by a secondary aircraft operational category. To this end, the fleet mix modeled was categorized by Heavy (H), Passenger (P), Regional (R) and Propeller (P). The 2030 fleet mix was then assigned the corresponding operational categories, so as to assign the aircraft to the appropriate track, to and from the runway, being used for each operation.

The military operations were assigned to the appropriate tracks in the same manner as was done in the 2008 base case noise contour analysis. The helicopter operations were distributed evenly across the tracks associated with the six pads modeled in the 2008 base case noise contour analysis.

5.4.4 2030 ATMOSPHERIC CONDITIONS

The weather data that were used in the 2030 noise contour modeling were derived from the July 2005 MSP 2015 Terminal Expansion EA. This assumes an annual average temperature of 47.7 degrees Fahrenheit, an average annual pressure of 29.9 inches, an average annual humidity of 64% and a 5.3 knot operational headwind.

5.4.5 2030 NOISE CONTOUR IMPACTS

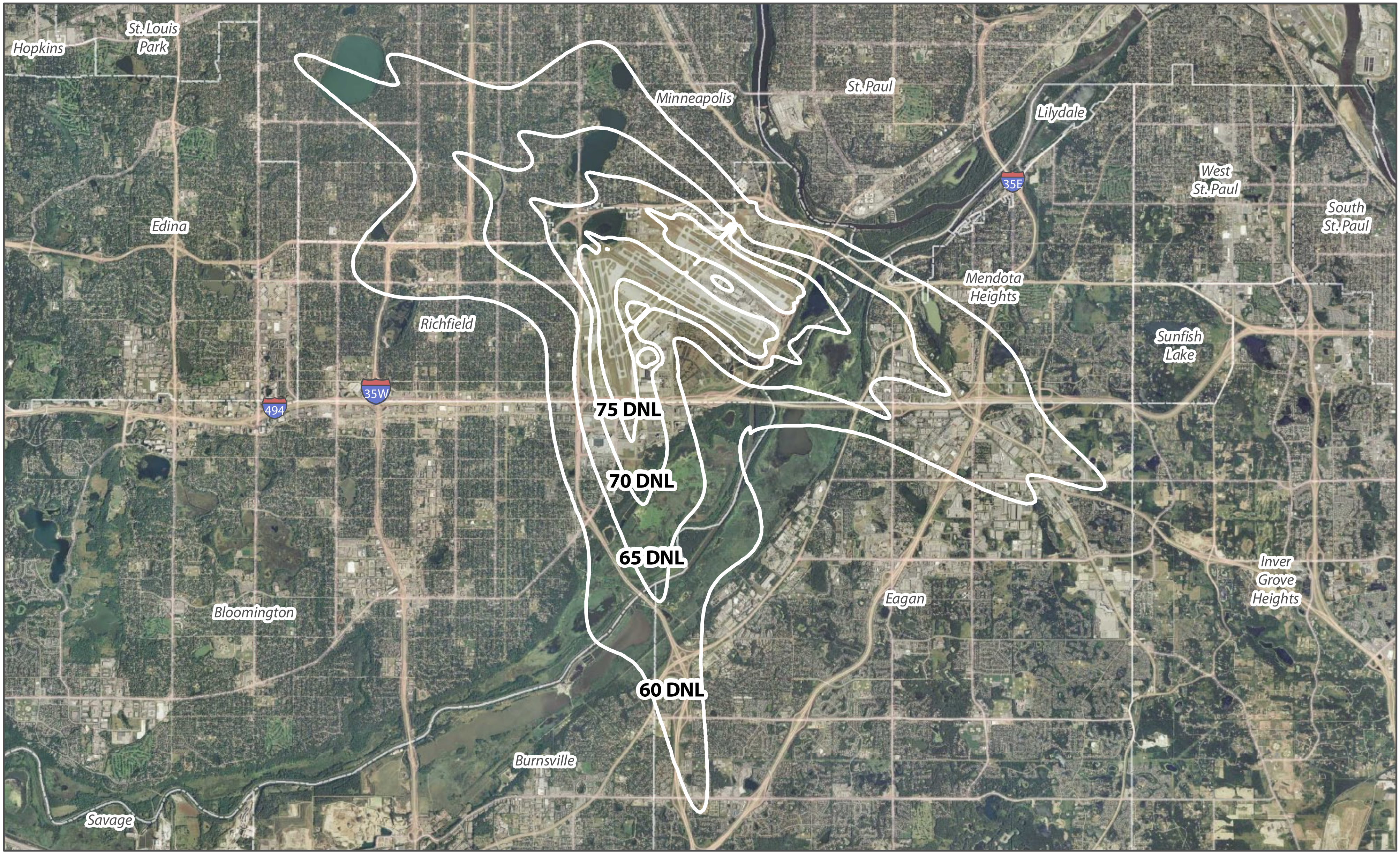
Based on the 630,837 total operations forecasted in 2030, approximately 8,540 acres are in the 65 DNL noise contour (an increase of 2,823.5 acres from the 2008 base case noise contour) and approximately 21,185.1 acres are in the 60 DNL noise contour (an increase of 7,209.7 acres from the 2008 base case noise contour).

Table 5.11 contains the counts of single-family (one unit per structure) and multi-family (greater than one unit per structure) dwelling units in the forecast 2030 noise contour. The counts are based on the parcel intersect methodology where all parcels that are within or touched by the noise contour are counted.

A depiction of the 2030 actual noise contour is provided in **Figure 5-3.**

2030 Preferred Alternative Contours

Figure 5-3



Minneapolis - St Paul International Airport (MSP)

0
3
6 Miles

The forecast 2030 and 2008 base case noise contours are provided in **Figure 5-4**. The 2030 65 DNL noise contour is 49.4% larger than the 2008 base case 65 DNL noise contour, and the 2030 base case 60 DNL noise contour is 55.6% larger than the 2008 base case 60 DNL noise contour.

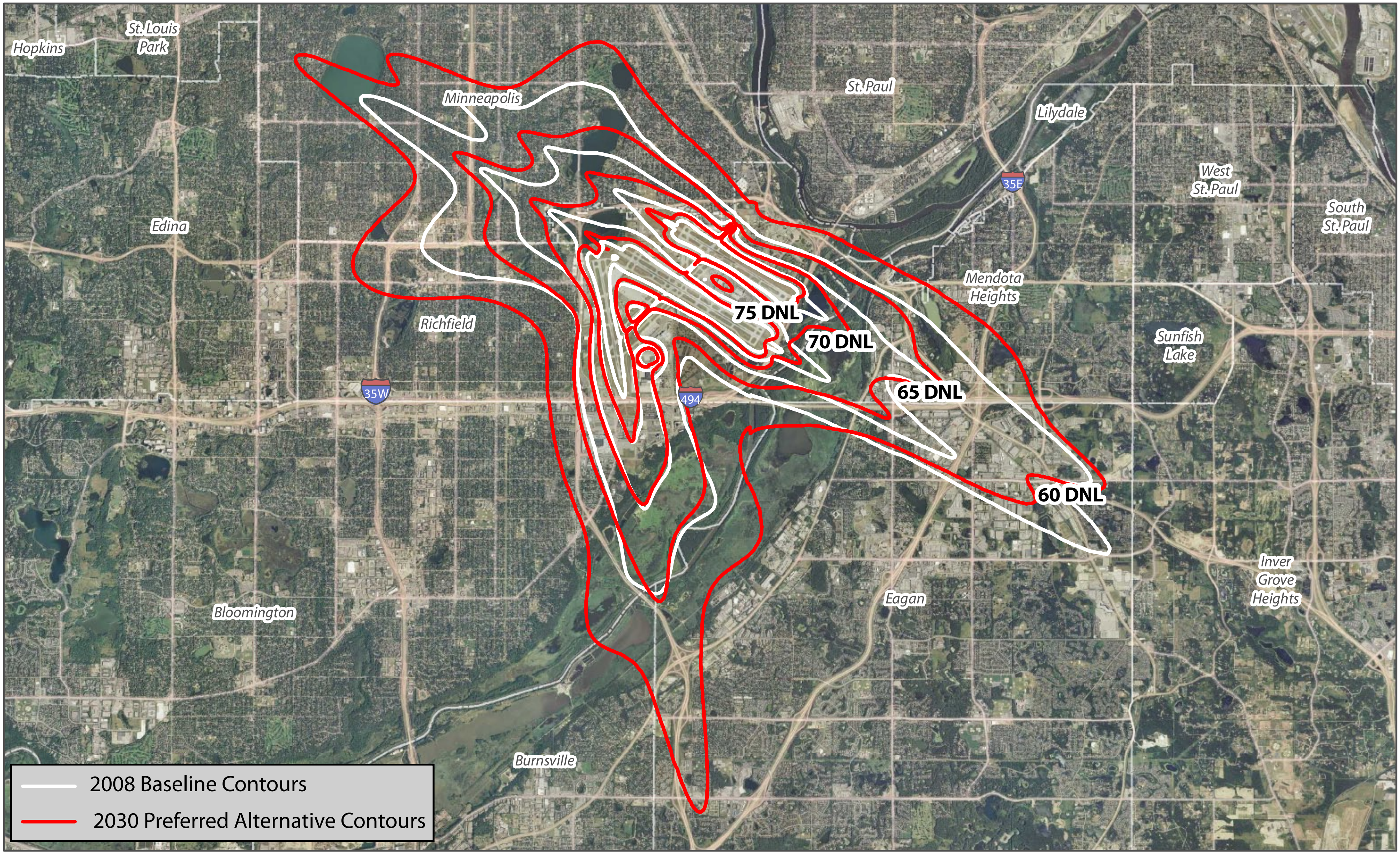
TABLE 5.11: SUMMARY OF 2030 FORECAST DNL NOISE CONTOUR SINGLE-FAMILY AND MULTI-FAMILY UNIT COUNTS

City	Count	Dwelling Units Within DNL (dB) Interval									
		Single-Family					Multi-Family				
		60-64	65-69	70-74	75+	Total	60-64	65-69	70-74	75+	Total
Bloomington	Completed	306	98	0	0	404	666	447	620	0	1733
	Additional	45	0	0	0	45	24	50	0	0	74
	Total	351	98	0	0	449	690	497	620	0	1807
Burnsville	Completed	0	0	0	0	0	0	0	0	0	0
	Additional	29	0	0	0	29	0	0	0	0	0
	Total	29	0	0	0	29	0	0	0	0	0
Eagan	Completed	194	0	0	0	194	0	0	0	0	
	Additional	342	0	0	0	342	104	0	0	0	104
	Total	536	0	0	0	536	104	0	0	0	104
Mendota	Completed	0	0	0	0	0	0	0	0	0	0
	Additional	13	0	0	0	13	0	0	0	0	0
	Total	13	0	0	0	13	0	0	0	0	0
Mendota Heights	Completed	66	4	0	0	70	49	0	0	0	49
	Additional	13	0	0	0	13	226	0	0	0	226
	Total	79	4	0	0	83	275	0	0	0	275
Minneapolis	Completed	6548	3966	784	0	11298	2513	606	525	0	3644
	Additional	3600	2	0	0	3602	1556	0	0	0	1556
	Total	10148	3968	784	0	14900	4069	606	525	0	5200
Richfield	Completed	1172	545	69	0	1786	1407	218	0	0	1625
	Additional	1578	0	0	0	1578	1252	4	0	0	1256
	Total	2750	545	69	0	3364	2659	222	0	0	2881
All Cities	Completed	8286	4613	853	0	13752	4635	1271	1145	0	7051
	Additional	5620	2	0	0	5622	3162	54	0	0	3216
	Total	13906	4615	853	0	19374	7797	1325	1145	0	10267

Note: Parcel intersect method, completed includes all parcels mitigated or eligible for mitigation.

2008 Base Case Contours and 2030 Preferred Alternative Contours

Figure 5-4



Minneapolis - St Paul International Airport (MSP)

0 3 6 Miles

5.5 AIR QUALITY

5.5.1 AIRCRAFT EMMISSIONS

This analysis details the data inputs used to develop the emissions inventory for use in the Long Term Comprehensive Plan Update (LTCP) at Minneapolis St. Paul International Airport (MSP) and the results of the analysis. The purpose of this analysis is to determine the aircraft-related emissions for National Ambient Air Quality Standard (NAAQS) criteria pollutants at MSP for the years 2008 and 2030.

Pollutants Considered

Air pollutants associated with emissions include major criteria pollutants. The US Environmental Protection Agency has established National Ambient Air Quality Standards (NAAQS) and identified six “criteria pollutants” that cause or contribute to air pollution and could endanger the public’s health and welfare. The NAAQS criteria pollutants and/or their precursors included in this study are: Carbon Monoxide (CO), Particulate Matter (PM-10, PM-2.5), Sulfur Dioxide (SO_X), Nitrogen Dioxide (NO_X), Volatile Organic Compounds (VOCs) and lead.

Operational Pollutant Sources

Aircraft operations that potentially contribute to pollutant concentrations on the ground include departure taxiing, queuing, takeoff, climb-out, approach, landing and arrival taxiing. Other aircraft-related emissions included in this emission inventory are aircraft ground support equipment (GSE) and Auxiliary Power Units (APUs) that provide power and air-conditioning to aircraft when the engines are not running.

Aircraft Operations

Annual landing and takeoff aircraft operational levels were determined from the 2008 Integrated Noise Model (INM) operations database file generated and provided by the MAC and the operations database file for the 2030 noise contours. **Tables 5.12** and **5.13** provide the INM and Emissions and Dispersion Modeling System (EDMS) fleet mix modeled and annual landing takeoff operations (LTOs) for 2008 and 2030, respectively. It should be noted that EDMS total operations vary slightly from INM total operations due to rounding functions within the EDMS model.

TABLE 5.12: FLEET MIX AND LTO ANNUAL OPERATIONS – 2008

INM Type	EDMS Type	LTO Annual
F16GE	Lockheed Martin F-16 Fighting Falcon	7.6
GASEPF	Cessna 172 Skyhawk	607.4
GASEPV	Cessna 182	215.3
A109	Agusta A-109	3.5
A300-622R	Airbus A300B4-600 series	755.3
A310-304	Airbus A310-300 series	228.0
A319-131	Airbus A319-100 series	23,163.9
A320-211	Airbus A320-200 series	27,343.8
A321-232	Airbus A321-200 series	137.5
A330-301	Airbus A330-300 series	1,890.8
IA1125	Israel IAI-1125 Astra	168.3
B206L	Bell 206 JetRanger	6.1
B212	Bell UH-1 Iroquois	0.5
B222	Agusta A109	1.0
737N17	Boeing 737-200 series	10.1
737N9	Boeing 737-200 series	7.6
BAC111	BAC 1-11 300/400	2.0
BEC58P	Raytheon Beech Baron 58	2,493.1
1900D	Raytheon Beech 1900-D	885.6
717200	Boeing 717-200 series	1,106.6
737300	Boeing 737-300 series	3,290.5
737400	Boeing 737-400 series	123.9
737500	Boeing 737-500 series	2,282.1
737700	Boeing 737-700 series	2,023.7
737800	Boeing 737-800 with winglets	6,730.0
747100	Boeing 747-100 series	2.0
747200	Boeing 747-200 series	126.4
747400	Boeing 747-400 series	417.6
757PW	Boeing 757-200 series	12,597.1
757300	Boeing 757-300 series	6,486.6
767CF6	Boeing 767-200 series	51.1
767300	Boeing 767-300 series	101.6
777200	Boeing 777-200-ER	5.1
C-130E	Lockheed C-139 Hercules	1,246.3
C17	Boeing C-17A	20.2
C9A	Boeing DC-9-10 series	1.0
CNA172	Cessna 172 Skyhawk	31.8
CNA206	Cessna 206	56.6
CNA500	Cessna 501 Citation I SP	274.5
CIT3	Cessna 500 Citation 1	618.3

INM Type	EDMS Type	LTO Annual
CNA750	Cessna 750 Citation X	1,013.1
CL600	Bombardier Challenger 600	668.8
CL601	Bombardier Challenger 601	50,210.2
CNA441	Cessna 441 Conquest II	222.4
DHC6	DeHavilland DHC-6-300 Twin Otter	1,686.4
DHC8	DeHavilland DHC-8-100	19.2
DC1010	Boeing DC-10-10 series	1,103.6
DC820	Boeing DC-8- series 50	1.5
DC860	Boeing DC-8 series 60	1.0
DC870	Boeing DC-8 series 70	295.3
DC93LW	Boeing DC-9-30 series	9,967.0
DC9Q9	Boeing DC-9-30 series	28.2
DC95HW	Boeing DC-9-50 series	9,972.1
EMB145	Embraer ERJ145-ER	6,299.6
F-18	Boeing F/A-18 Hornet	4.5
727EM1	Boeing 727-100 series	1.0
727EM2	Boeing 727-200 series	840.2
GII	Gulfstream II	380.7
GIIB	Gulfstream II-B	56.6
GIV	Gulfstream IV-SP	388.2
GV	Gulfstream G500	13,286.0
HS748A	Hawker HS748-2	29.8
KC-135	Boeing KC-135 Stratotanker	9.1
L1011	Lockheed L-1011 Tristar	12.1
LEAR25	Bombardier Learjet 25	1,131.8
LEAR35	Bombardier Learjet 36	1,791.5
MD11GE	Boeing MD-11	208.8
MD81	Boeing MD-81	6,003.3
MD9025	Boeing MD-90	132.5
MU3001	Mitsubishi MU-300 Diamond	1,660.1
PA31	Piper PA-31 Navajo	137.5
PA28	Piper PA-28 Cherokee series	7.1
S70	Sikorsky UH-60 Black Hawk	1.0
SD330	Shorts 330-200 series	27.8
SF340	Saab 340-B	21,222.3
T1	Rockwell T-2 Buckeye	19.2
T34	Raytheon Beech Bonanza 36	1.0
U21	Raytheon King Air 90	10.6
Grand Total		224,371.4

Source: MAC INM Input files for 2008 DNL contour; HNTB Analysis, 2009.

TABLE 5.13: FLEET MIX AND LTO ANNUAL OPERATIONS – 2030

INM Type	EDMS Type	LTO Annual
GASEPF	Cessna 172 Skyhawk	413.8
GASEPV	Cessna 182	109.7
A109	Agusta A-109	9.3
A300-622R	Airbus A300B4-600 series	1,073.7
A310-304	Airbus A310-300 series	95.3
A319-131	Airbus A319-100 series	16,800.0
A320-211	Airbus A320-200 series	27,240.2
A320-232	Airbus A320-200 series	10,474.4
A321-232	Airbus A321-200 series	8,319.1
A330-301	Airbus A330-300 series	1,409.3
A330-343	Airbus A330-300 series	1,786.2
IA1125	Israel IAI-1125 Astra	174.7
B206L	Bell 206 JetRanger	11.6
BEC58P	Raytheon Beech Baron 58	3,513.6
1900D	Raytheon Beech 1900-D	1,055.6
737QN	Beoing 737-200 series	26,543.6
737300	Boeing 737-300 series	5.4
737400	Boeing 737-400 series	1,275.7
737700	Boeing 737-700 series	123.3
737800	Boeing 737-800 with winglets	47,566.7
747400	Boeing 747-400 series	397.2
757RR	Boeing 757-200 series	1,836.6
757300	Boeing 757-300 series	6.4
767CF6	Boeing 767-200 series	2,718.5
767300	Boeing 767-300 series	3,020.1
777200	Boeing 777-200-ER	1,617.7
777300	Boeing 777-300 series	1,178.9
C-130E	Lockheed C-139 Hercules	952.2
C130	Lockheed C-139 Hercules	22.5
C17	Boeing C-17A	15.0
C5A	Lockheed C-5 Galaxy	3.8
CNA172	Cessna 172 Skyhawk	26.7
CNA208	Cessna 208 Caravan	449.3
CNA55B	Cessna 550 Citation II	213.9
CNA500	Cessna 500 Citation 1	542.1
CIT3	Cessna 500 Citation 1	1,581.7
CNA750	Cessna 750 Citation X	1,229.2
CL600	Bombardier Challenger 600	838.6
CL601	Bombardier Challenger 601	49,481.4
CNA441	Cessna 441 Conquest II	161.1

INM Type	EDMS Type	LTO Annual
DHC6	DeHavilland DHC-6-300 Twin Otter	795.2
DHC8	DeHavilland DHC-8-100	149.6
DHC830	DeHavilland DHC-8-300	26,998.8
DC1010	Boeing DC-10-10 series	122.3
DO328	Donier 328-100 series	21.9
ECLIPSE500	Piper PA-42 Cheyenne Series	99.9
EMB145	Embraer ERJ145-ER	6,085.2
F10062	Fokker F100	188.2
F16GE	Lockheed Martin F-16 Fighting Falcon	6.0
F-18	Boeing F/A-18 Hornet	5.3
FAL20	Dassault Falcon 20-D	445.1
GII	Gulfstream II	205.8
GIIB	Gulfstream II-B	27.9
GIV	Gulfstream IV-SP	1,553.7
GV	Gulfstream G500	53,806.2
H500D	Hughes 500D	2.3
HS748A	Hawker HS748-2	36.5
KC-135	Boeing KC-135 Stratotanker	5.3
LEAR25	Bombardier Learjet 25	1,309.0
LEAR35	Bombardier Learjet 36	1,840.6
MD11GE	Boeing MD-11	194.1
MD81	Boeing MD-81	22.9
MD9025	Boeing MD-90	5,660.3
MU3001	Mitsubishi MU-300 Diamond	1,400.1
PA31	Piper PA-31 Navajo	68.9
S70	Sikorsky UH-60 Black Hawk	2.3
T1	Rockwell T-2 Buckeye	10.5
T34	Raytheon Beech Bonanza 36	0.8
T-38A	T-38 Talon	14.3
U21	Raytheon King Air 90	6.8
Grand Total		315,379.3

Source: HNTB Analysis, 2009.

Table 5.14 identifies the taxi times used in the EDMS model for each year.

TABLE 5.14: TAXI TIMES (MINUTES)

Year	Taxi-out	Taxi-in
2008	19.2	8.2
2030	18.1	10.7

Source: ASPM Data extracted 11/4/2009, HNTB Analysis, 2005.

The following assumptions were made in development of the inventory:

- Default ground support equipment (GSE) and times for equipment assigned by EDMS were used for individual aircraft types.
- Default auxiliary power unit (APU) values were used (EDMS uses 13 minutes of APU for arrival and departure, a total of 26 minutes).

Version 5.1.1 of EDMS (the latest version) was used to determine aircraft-related emissions.

Results

Tables 5.15 and **5.16** provide the air pollutant emissions in tons per year from aircraft, GSE, and APU operations in 2008 and 2030, respectively. It should be noted that the 2030 GSE pollutants are much lower than 2008 due to EDMS technology assumptions for 2030 GSE. The EDMS model assumes that emission factors (EF) for equipment such as gasoline baggage tractors will be significantly reduced by the year 2030. An example of the CO EF for a baggage tractor in 2008 is 125.6 (grams/hp/hr) and in 2030 CO EF is reduced to 14.0 (grams/hp/hr). These reductions provide a significant decrease in the amount of pollutants created from GSE.

TABLE 5.15: 2008 EMISSIONS INVENTORY (TONS/YEAR)

	Pollutant					
Category	CO	VOC	NOx	SOx	PM-10	PM-2.5
Aircraft	2,210.42	369.82	2,112.56	233.22	34.23	34.23
GSE	2,265.40	79.01	267.33	7.27	8.03	7.71
APUs	99.18	4.83	66.52	8.72	8.00	8.00
Grand Total	4,574.99	453.66	2,446.41	249.20	50.25	49.94

Source: HNTB Analysis, 2009.

TABLE 5.16: 2030 EMISSIONS INVENTORY (TONS/YEAR)

	Pollutant					
Category	**CO**	**VOC**	**NOx**	**SOx**	**PM-10**	**PM-2.5**
Aircraft	3,161.21	441.15	3,260.18	351.11	48.58	48.58
GSE	416.08	17.00	37.91	4.35	2.59	2.41
APUs	108.72	5.68	104.67	13.07	10.64	10.64
Grand Total	3,686.01	463.83	3,402.77	368.54	61.82	61.64

Source: HNTB Analysis, 2009.

5.5.2 ROADWAY AND PARKING EMISSIONS – MSP 2008 AND 2030

Roadway and parking emissions are estimated for existing (2008) vehicle volumes and projected 2030 volumes, assuming development occurs as described in this Long Term Comprehensive Plan Update.

Because the Twin Cities Metropolitan Region is a designated maintenance area for carbon monoxide (CO), the primary pollutant of concern from vehicular traffic is CO. The Minnesota Pollution Control Agency generated CO emission factors from the US Environmental Protection Agency data. However, for this assessment, all criteria pollutants addressed by the EDMS model have also been evaluated.

Default CO emission rates used in the EDMS model were compared with those used by the Minnesota Pollution Control Agency and the Metropolitan Council and found to inadequately represent regional CO emissions. Some reasons for these differences are: the default EDMS evaluation month is July while the Minnesota evaluation month is January, when assumed minimum and maximum temperatures are more than 30 degrees lower; the Reid Vapor Pressure assumed in Minnesota is almost 70% higher than the EDMS default value; the EDMS model uses a national default average vehicle mix, while a vehicle mix unique to the Twin Cities Metropolitan Area is used by the Metropolitan Council. The EDMS default Mobile 6.2 input files do include, however, various fuel-related factors that are not assumed in the Minnesota model since these do not affect CO emissions. Pollutant emission rate predictions for 2008 and 2030 were therefore generated using the Mobile 6.2 emissions model with merged Minnesota and EDMS inputs rather than using the EDMS model directly. In this way, the model reflects regional vehicle registration and age data for the Twin Cities Metropolitan Area and Minnesota temperature and fuel-related parameters, along with fuel-related assumptions in the EDMS model for calculating non-CO emission rates. A range of predicted speeds from 2.5 mph to 65 mph was used in this evaluation for predictions in parking ramps, arterial/collector roads and freeways.

Roadway Emissions

Roadway emissions are based upon traffic forecasts provided by the Metropolitan Council, for public roadways on and surrounding MSP. Traffic estimates on these roadways associated with the Lindbergh Terminal and the Humphrey Terminal parking ramps were generated for 2009 and for 2030 without the MSP 2030 improvements. The increase in background traffic between these two years was small; it is therefore reasonable to assume that 2009 volumes can be used for 2008. The 2030 public roadway volumes were adjusted upwards to account for the MSP 2030 plan using the Average Daily Traffic volume growth on Glumack Drive projected in Section 3.6. This growth factor, based on **Table 3.3**, is 1.366.

The allocation of traffic on Lindbergh Terminal roadways developed in the MSP 2015 Terminal Expansion Environmental Assessment was assumed in this study but with volumes adjusted upward using the growth factor noted above. Limited growth was assumed on the airport road servicing the air cargo area.

An estimate of criteria pollutant emissions on major roadways around the perimeter of MSP and within the airport was made for each roadway segment for which traffic volumes were available.

Emissions were based upon daily travel volumes, average travel speed, and emission factors. As noted above, emission factors were generated with the Mobile 6.2 model for the Twin Cities Metropolitan Area. Annual traffic volumes were estimated from daily traffic, assuming traffic occurs 365 days per year. Summaries of roadway emissions for 2008 and 2030 are presented below in **Table 5.17** and **Table 5.18**, respectively.

TABLE 5.17: ROADWAY CRITERIA POLLUTANTS EMISSIONS 2008 (SHORT TONS PER YEAR)

Roadway Segment	Length (mi)	MPH	ADT	CO	NMHC	VOC	TOG	NOx	SOx	PM-10	PM-2.5
34th Avenue	0.985	40	43,154	298.52	13.01	13.17	14.09	27.74	0.15	0.82	0.53
West Service Road	1.924	35	1,245	16.37	0.75	0.76	0.82	1.53	0.01	0.05	0.03
I-494 (TH77 to 24th Ave)	0.454	60	37,104	133.33	4.76	4.82	5.14	14.53	0.06	0.32	0.21
I-494 (24th Ave to 34TH Ave)	0.727	60	46,599	267.91	9.57	9.68	10.32	29.20	0.12	0.65	0.43
I-494 (34th Ave to TH5)	0.454	65	37,251	138.30	4.73	4.78	5.09	16.18	0.06	0.33	0.21
Lindbergh Exit	0.660	35	34,371	154.96	7.14	7.22	7.74	14.49	0.08	0.44	0.29
Lindbergh Entrance	0.614	35	34,371	143.99	6.63	6.71	7.19	13.47	0.07	0.40	0.27
Post Road	1.298	40	34,371	101.04	4.40	4.46	4.77	9.39	0.05	0.28	0.18
Terminal Roadways	0.677	20	10,243	96.18	5.04	5.11	5.51	9.30	0.05	0.25	0.17
TH 5 (TH55 to Entrance)	1.119	65	50,255	459.18	15.70	15.88	16.90	53.72	0.20	1.08	0.71
TH 5 (Entrance to 34th Ave)	0.510	65	43,839	182.38	6.24	6.31	6.71	21.34	0.08	0.43	0.28
TH 5 (34th Ave to I-494)	0.946	65	37,179	287.12	9.82	9.93	10.57	33.59	0.12	0.68	0.44
TH 55 (TH62 to TH5)	0.900	55	22,961	158.17	5.93	6.00	6.40	16.40	0.07	0.40	0.26
TH 62 (TH77 to 28th Ave)	0.441	60	12,468	43.49	1.22	1.28	1.21	1.52	0.02	0.07	0.04
TH 62 (36th Ave to TH55)	0.820	60	13,212	85.59	2.40	2.52	2.38	2.99	0.04	0.14	0.08
TH 77 (I-494 to 66th St)	1.470	55	4,659	52.45	1.97	1.99	2.12	5.44	0.02	0.13	0.09
TH77 (66th St to TH62)	0.849	55	4,055	26.35	0.99	1.00	1.07	2.73	0.01	0.07	0.04
Roadway Emissions (2008)				2645.33	100.30	101.62	108.01	273.56	1.22	6.53	4.25

TABLE 5.18: ROADWAY CRITERIA POLLUTANT EMISSIONS 2030 (SHORT TONS PER YEAR)

Roadway Segment	Length (mi)	MPH	ADT	CO	NMHC	VOC	TOG	NOx	SOx	PM-10	PM-2.5
34th Avenue	0.985	40	58,948	267.23	7.28	7.37	7.96	8.14	0.21	0.66	0.31
West Service Road	1.924	35	1,700	14.64	0.42	0.42	0.46	0.45	0.01	0.04	0.02
I-494 (TH77 to 24th Ave)	0.454	60	50,246	118.62	2.72	2.76	2.96	3.73	0.08	0.26	0.12
I-494 (24th Ave to 34TH Ave)	0.727	60	63,029	238.08	5.45	5.54	5.95	7.48	0.17	0.52	0.25
I-494 (34th Ave to TH5)	0.454	65	51,613	125.94	2.78	2.83	3.04	4.05	0.08	0.27	0.13
Lindbergh Exit	0.660	35	47,401	139.87	4.00	4.06	4.37	4.31	0.11	0.35	0.17
Lindbergh Entrance	0.614	35	47,401	129.97	3.71	3.77	4.06	4.01	0.11	0.33	0.16
Post Road	1.298	40	47,401	88.24	2.40	2.43	2.63	2.69	0.07	0.22	0.10
Terminal Roadways	0.677	20	13,650	86.44	2.82	2.87	3.11	2.78	0.07	0.21	0.10
TH 5 (TH55 to Entrance)	1.119	65	68,190	409.48	9.04	9.20	9.87	13.18	0.28	0.86	0.41
TH 5 (Entrance to 34th Ave)	0.510	65	60,666	165.87	3.66	3.73	4.00	5.34	0.11	0.35	0.17
TH 5 (34th Ave to I-494)	0.946	65	52,411	266.01	5.87	5.97	6.41	8.56	0.18	0.56	0.27
TH 55 (TH62 to TH5)	0.900	55	30,904	139.79	3.33	3.38	3.63	4.32	0.10	0.32	0.15
TH 62 (TH77 to 28th Ave)	0.441	60	16,049	36.78	0.84	0.86	0.92	1.16	0.03	0.08	0.04
TH 62 (36th Ave to TH55)	0.820	60	17,137	72.94	1.67	1.70	1.82	2.29	0.05	0.16	0.08
TH 77 (I-494 to 66th St)	1.470	55	5,917	43.74	1.04	1.06	1.14	1.35	0.03	0.10	0.05
TH77 (66th St to TH62)	0.849	55	5,211	22.23	0.53	0.54	0.58	0.69	0.02	0.05	0.02
Roadway Emissions (2030)				2365.86	57.58	58.51	62.91	74.53	1.70	5.33	2.55

Parking Emissions

Parking emissions are estimated from the major parking facilities on the airport that are shown in **Table 5.19**. No parking was assumed for the Econo-Lot and the Delta F Ramp.

TABLE 5.19: MAJOR MSP PARKING FACILITIES ANALYZED

Parking Area	2008 Parking Spaces	2030 Parking Spaces
Lindbergh Ramp	14,400	24,500
Humphrey Ramp	9,200	15,100
Delta B Ramp	1,700	1,700
Delta C South Lot	2,300	2,300
Delta C North Lot	1,500	1,500
Total Spaces	29,100	45,100

Emissions are not related directly to the number of parking spaces, but are related to the vehicular activity within each parking area, the average travel speed of vehicles on access roads to and from the ramp and within the ramp, and the average idling time within the ramp. Detailed activity in the Lindbergh Terminal and Humphrey Terminal ramps was developed for the MSP 2015 Terminal Expansion Environmental Assessment and has been assumed in this study. This activity (hourly inbound and outbound vehicle volumes by time of day and day of week) has not changed and is therefore still relevant for this analysis.

Assumed travel distance on ramp access roads and within the ramp, average travel speed and vehicle activity per 24-hour day are shown in **Table 5.20**. Travel distance includes the ramp access road that is separated from the terminal roadway. A speed of 35 mph is assumed along these roadways at the Lindbergh Terminal and Humphrey Terminal ramps with a ramp speed of 5 mph. Delta's (formerly Northwest's) parking demand was reduced to account for an expected reduction in work force at MSP although use of these spaces remains uncertain.

TABLE 5.20: PARKING FACILITY PARAMETERS ASSUMED FOR THE EMISSIONS ANALYSIS

Parking Facility	Travel (ft)	Speed (mph)	Veh/space Weekday	Veh/space Weekend
Lindbergh	6800	35/5	0.988	0.697
Humphrey	4500	35/5	0.727	0.531
Delta B Ramp	400	10	2.55	0.638
Delta C South	800	10	1.656	0.414
Delta C North	700	10	1.787	0.447

Note: From EA-2015 Terminal Expansion Project, August 2005.

The average weekday and weekend activity in the combined Lindbergh Terminal general and short-term parking areas and in the Humphrey Terminal ramp is presented in **Table 5.21**.

TABLE 5.21: ASSUMED ENTRY PLUS EXIT MOVEMENTS

	Lindbergh Ramp		Humphrey Ramp	
	Weekday	Weekend	Weekday	Weekend
2008	12,406	8,749	4,465	3,496
2030	24,196	17,064	10,975	8,014

Note: Adjusted from EA-2015 Terminal Expansion Project, August 2005.

For the Lindbergh ramp, the number of vehicles entering and exiting is essentially the same on weekdays and weekends. This may also be true for the Humphrey ramp in 2030 but data from actual activity were deemed more reliable.

The resulting carbon monoxide emission estimates for parking facilities in 2008 and 2030 are presented in **Table 5.22** to demonstrate the relative contributions of each ramp. Relative contributions of other pollutants are similar.

TABLE 5.22: PARKING CARBON MONOXIDE EMISSIONS (SHORT TONS/YEAR)

Parking Area	2008	2030
Lindbergh Ramp	137.88	172.87
Humphrey Ramp	34.70	53.89
Delta B Ramp	5.42	3.41
Delta C South Lot	9.22	4.30
Delta C North Lot	5.65	2.84
All spaces	192.86	237.30
Net Change		44.44

Combined Roadway and Parking Emissions

A comparison of the combined roadway and parking emissions for 2008 and 2030 is presented in **Table 5.23**.

TABLE 5.23: COMBINED ROADWAY AND PARKING CARBON MONOXIDE EMISSIONS (TONS)

	CO	NMHC	VOC	TOG	NOx	SOx	PM-10	PM-2.5
2008								
Roadway	2645.33	100.30	101.62	108.01	273.56	1.22	6.53	4.25
Parking	192.86	12.80	12.65	13.87	18.40	0.07	0.40	0.26
Total	2838.19	113.10	114.27	121.88	291.96	1.29	6.93	4.51
2030								
Roadway	2365.86	57.58	58.51	62.91	74.53	1.70	5.33	2.55
Parking	237.30	9.83	9.68	10.74	7.77	0.14	0.45	0.22
Total	2603.17	67.41	68.19	73.65	82.30	1.84	5.78	2.77
Change	-235.02	-45.69	-46.09	-48.23	-209.66	0.55	-1.14	-1.74

The change in emissions resulting from the implementation of the 2030 Long Term Comprehensive Plan Update is a decrease of 235 tons of carbon monoxide emissions and 210 tons of NOx. This result is based upon an evaluation of traffic changes in the immediate vicinity of the airport combined with parking changes on the airport. The lower emissions in 2030 are due primarily to reductions in pollutant emissions from motor vehicles that are significant enough to overcome the projected increase in airport-related vehicle volumes.

Therefore, a reduction in overall traffic and parking emissions is predicted in the immediate airport area, and no regional adverse impacts on air quality is anticipated with implementation of the 2030 Long Term Comprehensive Plan Update.

Infrastructure Emissions

Infrastructural emissions are primarily associated with heating of terminal facilities. Other point sources include vehicle fueling, paint, generators and solvents. Actual emissions from these sources for 2008 are listed below in **Table 5.24**.

According to an analysis completed by Michaud Cooley Erickson, the Metropolitan Airports Commission's energy consultant, the extension of the G Concourse at the Lindbergh Terminal is expected to generate an additional 54% of demand on the heating system. The current system has the capability to absorb the majority of this load; however, additional boiler capacity will need to be added or greater efficiencies will need to be incorporated into the building envelope to reduce the demand. The Humphrey Terminal is scheduled for significant development and will require an additional 178% of demand capacity over the existing system per this same analysis. Other sources are not anticipated to change significantly. A comparison of the 2008 and 2030 infrastructure emissions is presented in **Table 5.24**.

TABLE 5.24: INFRASTRUCTURE EMISSIONS

	CO	VOC	Lead	NOx	SOx	PM-10	PM-2.5
2008 (tons/year)							
Lindbergh Terminal	14.690	0.962	0.000	17.488	0.105	1.329	1.329
Humphrey Terminal	1.273	0.083	0.000	1.516	0.009	0.115	0.115
Other Sources	4.227	2.845	0.000	6.396	0.496	3.556	2.120
Total MAC	20.19	3.890	0.000	25.4	0.610	5.000	3.564
2030 (tons/year)							
Lindbergh Terminal	22.623	1.481	0.000	26.932	0.162	2.047	2.047
Humphrey Terminal	3.539	0.231	0.000	4.214	0.025	0.320	0.320
Other Sources	4.227	2.845	0.000	6.396	0.496	3.556	2.120
Total MAC	30.389	4.557	0.000	37.542	0.683	5.922	4.486
Change	10.199	0.667	0.000	12.142	0.073	0.922	0.922

The 2030 Long Term Comprehensive Plan Update (LTCP) terminal expansions represent an opportunity to incorporate a significant number of building efficiency improvements to address the anticipated energy needs. The Metropolitan Airports Commission may consider LEED-certified buildings, green roof designs and a number of energy sources such as solar, geothermal and wind technologies to incorporate renewable energy advancements. The above emissions estimate is expected to be a worst-case scenario, using current efficiencies and system management controls. The increase in emissions in 2030 is due to increased terminal square footage and no incorporation of energy conservation technologies.

Emissions Summary

The emissions analysis conducted for this LTCP included an evaluation of aircraft, Ground Service Equipment (GSE), Auxiliary Power Unit, roadway and parking emissions as well as infrastructure. During this planning period there will be an increase in emissions associated with infrastructure development. However, US Environmental Protection Agency and Federal Aviation Administration model assumptions incorporate significant carbon monoxide (CO) emission reductions associated with GSE and vehicles. As previously stated, the Twin Cities Metropolitan Region is a designated maintenance area for CO. The estimated reduction in CO with the 2030 development is in excess of 1100 tons.

5.6 SANITARY SEWER AND WATER

5.6.1 SANITARY SEWER

Wastewater discharges from MSP are conveyed to the Metropolitan Council Environmental Services (MCES) Metro Plant on Childs Road. This plant has a design capacity of 250 million gallons per day (MGD). The proposed projects are expected to increase passenger loads by approximately 50% between 2008 and 2030. This passenger growth will be accompanied by an approximately equivalent increase in wastewater discharges.

Wastewater is discharged to the Metro Plant through the MCES sewer interceptor system. Discharges from MSP are conveyed to the interceptor system through three different sewer systems. The majority is discharged from the airport to a tunnel near the Mississippi River that discharges into the interceptor system. A small volume of wastewater is discharged into the City of Minneapolis sewer system prior to reaching the MCES interceptors. Wastewater from the southwest portion of MSP is discharged through the City of Richfield sewer system prior to reaching the MCES interceptors.

The estimated 50% increase in passenger loads is predicted to increase the daily sanitary discharge volume by approximately 0.35 MGD. This increase would be conveyed through the tunnel and Richfield systems. Assuming a 2.5 peak loading factor, this would amount to a peak addition of approximately 37,000 gallons per hour. This increase in loading is not expected to be an issue with the Metro Plant's total capacity, because the increase amounts to less than 0.2% of the plant's daily treatment capacity. However, there could be issues with the wet-weather conveyance capacity of the interceptor system from other municipal sources. The MCES has informed Metropolitan Airports Commission (MAC) staff and consultants that there is sufficient dry-weather capacity in the MCES interceptor system to handle the proposed increase in flow (see discussion below regarding wet-weather capacity). In addition, the Richfield system is oversized to provide options for the City of Bloomington to divert its discharges through the Richfield system to the Metro Plant if Bloomington's conveyance to the Seneca Treatment Facility is obstructed. Recent upgrades to the Bloomington conveyance system make Bloomington's use of the Richfield system unlikely. Therefore, the Richfield system should have adequate capacity.

Additionally, the City of Minneapolis and the MCES have been working diligently on a Combined Sewer Overflow (CSO) separation project that will return sewer capacity and reduce the CSO problems that exist within the sanitary sewer network. Although the issue is not unique to airport growth, the MAC is considering the timing and impact of these projects in future planning for MSP.

Whether or not the proposed Capital Improvement Program projects for MSP are implemented, the MAC-owned sanitary sewer infrastructure may require upgrades to convey the higher volume of wastewater from the Lindbergh and/or Humphrey Terminals (upstream of the "tunnel" and Richfield systems). As it makes development decisions, the MAC will evaluate the existing capacity of the MAC-owned sanitary sewer system to determine where and when capacity limitations may be encountered.

The MAC has reduced the use of municipality-supplied potable water by specifying and using high-efficiency fixtures/valves, such as automatic sensors, to reduce water usage and wastewater volumes. These measures have resulted in sanitary sewer flow reduction; therefore, capacity exists for the projects planned in the LTCP.

Any environmental concerns associated with this project activity are mitigated with the acquisition and the maintenance of appropriate permits.

5.6.2 WATER SUPPLY

As noted in Chapter 1, the MSP campus currently uses approximately one million gallons of potable water per day. The uses include restrooms, concessions, tenant facilities, facility cleaning, irrigation, cargo uses, and rental car wash facilities. The proposed projects in this LTCP document include expansions to concourses at both the Lindbergh and Humphrey Terminals. These expansions will include additional restrooms and concessions, along with other water using services. The proposed plan also includes a hotel, which would be a significant user of potable water.

By 2030, the proposed projects would increase water demand at the airport. As projects are reviewed for preliminary engineering and design, water usage and fire flow demands will be incorporated. It is not expected that water usage would exceed 1.5 million gallons per day based on the proposed projects in this LTCP document.

The City of Minneapolis currently provides 100% of the water used on campus. The city's current maximum capacity is 180 million gallons per day. The maximum peak usage in the city in 2007 was approximately 145 million gallons per day. Therefore, the MAC's increased usage will not require capacity enhancements in Minneapolis. The MAC has also studied the possibility of obtaining some of its water from either the City of Richfield or the City of St. Paul. While not proposed at this time, these are alternatives that could be reviewed as a part of future ways to meet increasing water demands.

5.6.3 SOLID WASTE

The quantities of waste generated by an increase in the traveling public cannot be identified with certainty at this time; however such an increase is not expected to have a significant impact on the airport's solid waste capacity. The MAC and MSP tenants will continue efforts in waste reduction and recycling, commensurate with increased awareness and participation on the part of the traveling public.

Any increases in solid waste generation are assumed to be within the capability of the regional solid waste management system.

5.7 WATER QUALITY

Based on a review of the anticipated projects identified in this LTCP Update, there will be a minor (2 %) increase in new impervious pavement. The MAC will evaluate each phase of construction and the associated storm water runoff from the new impervious surface with respect to the drainage areas previously discussed in Chapter 1. The various project sites are located primarily on previously-developed areas. Each drainage area and the associated pond will be evaluated during the environmental review process to minimize the impacts, and measures such as green roofs and emerging technologies will be used to manage the storm water flows. Based on these measures it is not anticipated that the storm water quality will be affected; therefore storm water runoff will be able to be to be handled by the current detention ponds. It should be noted, however, that storm water from the MSP detention ponds discharges to the Minnesota River, which then flows to the Mississippi River. Both of these rivers have been identified by the MPCA as water quality impaired for a number of pollutants and stressors.

The MAC is considering utilizing a green roof concept on some of the proposed terminal expansions. This initiative may result in a reduction in the amount and rate (peak flow) of runoff entering the storm water drainage system. The retained water would be available for use by the roof vegetation instead of being added to the storm drains.

As mentioned in Chapter 1, storm water runoff from nearly all of MSP is directed to one of three storm water detention pond systems. These ponds provide protection for the Minnesota River against fuel spills and, as designed, remove total suspended solids, phosphorus and other pollutants from the storm water.

There are no known groundwater impacts in the area of the LTCP Update projects. The projects may have minor short-term localized groundwater movement but are not expected to have a significant effect on hydro-geological conditions on the airport.

If groundwater impacts are encountered during project implementation or during site prep, mitigation of the impacted water will occur in accordance with Minnesota Pollution Control Agency (MPCA) permits and regulations. Under the construction dewatering National Pollutant Discharge Elimination System permit, groundwater is brought to a water management area and, if contaminated, is either treated through a carbon system for a surface water discharge or is routed to the municipal wastewater treatment system.

Expansion of the terminals will require an expansion of the existing fuel hydrant system. Although this will not affect the groundwater, it may create a potential source of groundwater impacts should the hydrant system have an unintended release. Leak detection equipment, system maintenance procedures and Best Management Practices currently employed with the airport hydrant system will be applied to a new system to ensure that the potential for unsought releases is minimized. Additionally, the MPCA will incorporate and review any additions to the hydrant fueling system as part of the Aboveground Storage Tank permitting process.

5.8 WETLANDS

As briefly discussed in Chapter 1, very few wetlands remain on the MSP campus, aside from Mother Lake. It is unlikely that any of the proposed projects will impacts remnant wetlands. There are no obvious wetland impacts identified for the projects proposed in this LTCP Update document. However, project locations will be reviewed in more detail as part of any environmental review document completed for specific projects, with any necessary impacts and corresponding mitigation identified.