



# **Minneapolis-St. Paul International Airport (MSP) 2022 Annual Noise Contour Report**

**Comparison of the 2022 Actual and the 2007 Forecast Noise Contours  
February 2023**

Table of Contents

**ES EXECUTIVE SUMMARY..... 1**

**ES.1 MSP AIRPORT NOISE MITIGATION PROGRAM .....1**

**ES.2 PART 150 PROGRAM (1992-2006 PROGRAM) .....1**

**ES.3 AIRPORT NOISE LITIGATION AND CONSENT DECREE (2007-2014 PROGRAM).....1**

**ES.4 THE AMENDED CONSENT DECREE (2017-2024 PROGRAM).....2**

**ES.5 THE THIRD AMENDED CONSENT DECREE (2025-2032 PROGRAM).....2**

**ES.4 2022 NOISE CONTOURS .....4**

**ES.5 2017-2024 PROGRAM ELIGIBILITY .....4**

**ES.6 2017-2024 PROGRAM MITIGATION STATUS .....4**

**ES.7 2025-2032 PROGRAM ELIGIBILITY .....5**

**1. INTRODUCTION AND BACKGROUND..... 9**

**1.1 PART 150 PROGRAM (1992-2006 Program) .....9**

**1.2 2007 FORECAST CONTOUR .....12**

**1.3 AIRCRAFT NOISE LITIGATION .....14**

**1.4 NOISE MITIGATION SETTLEMENT AND ANNUAL NOISE CONTOUR (2007-2014 Program) .....15**

**1.5 FINAL MSP 2020 IMPROVEMENTS EA/EAW AND AMENDED CONSENT DECREE (2017-2024 PROGRAM) .....17**

**1.6 THIRD AMENDMENT TO THE CONSENT DECREE (2025-2032 PROGRAM) .....19**

**2. 2022 ACTUAL CONTOUR ..... 19**

**2.1 DEVELOPMENT OF THE 2022 ACTUAL CONTOUR .....19**

        2.1.1 Noise Modeling .....19

        2.1.2 2022 Aircraft Operations and Fleet Mix .....20

        2.1.3 2022 Runway Use .....22

        2.1.4 2022 Flight Tracks.....25

        2.1.5 Custom Departure Profiles .....25

        2.1.6 2022 Atmospheric Conditions .....26

**2.2 2022 MODELED VERSUS MEASURED DNL VALUES .....27**

**2.3 2022 NOISE CONTOUR IMPACTS .....29**

**3. COMPARISON OF THE 2022 ACTUAL AND THE 2007 FORECAST CONTOUR..... 32**

**3.1 COMPARISON OF NOISE CONTOUR INPUTS.....32**

- 3.1.1 Noise Model Considerations .....32
- 3.1.2 Aircraft Operations and Fleet Mix Comparison.....32
- 3.1.3 Runway Use Comparison.....33
- 3.1.4 Flight Track Considerations .....34
- 3.1.5 Atmospheric Conditions Comparison.....34
- 3.2 COMPARATIVE NOISE MODEL GRID POINT ANALYSIS .....35**
- 3.3 CONTOUR COMPARISON SUMMARY .....35**
- 4. 2022 ANNUAL NOISE CONTOUR ..... 37**
- 4.1 2022 ACTUAL CONTOUR NOISE MITIGATION IMPACT .....37**
- 4.2 2017-2024 PROGRAM ELIGIBILITY .....40**
- 4.3 2017-2024 PROGRAM MITIGATION STATUS .....40**
- 4.4 2025-2032 PROGRAM ELIGIBILITY .....41**

## ES EXECUTIVE SUMMARY

### ES.1 MSP AIRPORT NOISE MITIGATION PROGRAM

Minneapolis-St. Paul International Airport (MSP) has a long history of quantifying and mitigating noise impacts in a manner responsive to concerns raised by communities around the airport and consistent with federal policy.

In 1992, the Metropolitan Airports Commission (MAC) established the MSP Airport Noise Mitigation Program after initiating a Noise Compatibility Program (NCP) study under Title 14 Code of Federal Regulations Part 150 (Part 150 Study). Since its establishment, the MSP Airport Noise Mitigation Program has provided sound insulation to single-family and multi-family residences and schools and acquired residential properties within eligible noise contour areas.



The Federal Aviation Administration's (FAA) threshold standard for mitigation eligibility is 65 decibel (dB) Day-Night Average Sound Level (DNL). The DNL metric is used to represent the total accumulation of all sound energy (decibels or dB) averaged uniformly over a 24-hour period.

### ES.2 PART 150 PROGRAM (1992-2006 PROGRAM)

The 1992-2006 Noise Mitigation Program (1992-2006 Program) was a large and visible part of the MSP Part 150 Study. Mitigation was conducted within the 65 dB DNL contour and included a combination of improvements to windows and doors; adding attic insulation; baffling of attic vents, mail slots and chimneys; and installing central air-conditioning. By 2006, sound insulation had been provided to 7,846 single-family homes, 1,327 multi-family units and 19 schools. Additionally, 437 residential properties were acquired around MSP in the highest aircraft noise impacted areas. The total cost of the program was approximately \$386 million.

The Dual-Track Airport Planning Process (Dual Track), an effort that the Minnesota Legislature directed the MAC to undertake in 1989, concluded in 1998 with the Legislature voting that MSP would expand in its current location versus moving to a new location. As part of the Dual-Track process, the MAC was asked to propose an expansion of noise mitigation efforts beyond the federally recognized standard threshold of 65 dB DNL if MSP were to stay in its current location. In 1999, the MAC began its Part 150 Update, which included significant focus on the mitigation program. Through the Part 150 Update process, the MAC developed a mitigation package for homes located in the 60-64 dB DNL noise contour area.

### ES.3 AIRPORT NOISE LITIGATION AND CONSENT DECREE (2007-2014 PROGRAM)

The cities located around MSP expressed dissatisfaction with the Part 150 Update associated with the expanded noise mitigation proposal for homes in the 60-64 dB DNL noise contour area. In early 2005, the

Cities of Minneapolis, Eagan, and Richfield and the Minneapolis Public Housing Authority filed a lawsuit in Hennepin County District Court against the MAC. In September 2005, plaintiffs seeking class action certification, filed a separate action against the MAC alleging breach of contract claims associated with mitigation in the 60-64 dB DNL noise contours.

In 2007, the Cities of Minneapolis, Eagan, and Richfield, the Minneapolis Public Housing Authority and the MAC entered into a Consent Decree that settled the litigation. The terms in the Consent Decree specified multiple levels of sound insulation for homes within a fixed boundary of projected aircraft noise exposure around MSP and established the 2007-2014 Noise Mitigation Program (2007-2014 Program).

Upon the completion of the 2007-2014 Program in 2014, more than 15,000 single-family homes and 3,303 multi-family units around MSP were provided noise mitigation. The total cost to implement mitigation under the 2007 Consent Decree was \$95 million, raising the MAC's expenditures related to its noise mitigation program efforts to more than \$480 million by the end of 2014.

#### **ES.4 THE AMENDED CONSENT DECREE (2017-2024 PROGRAM)**

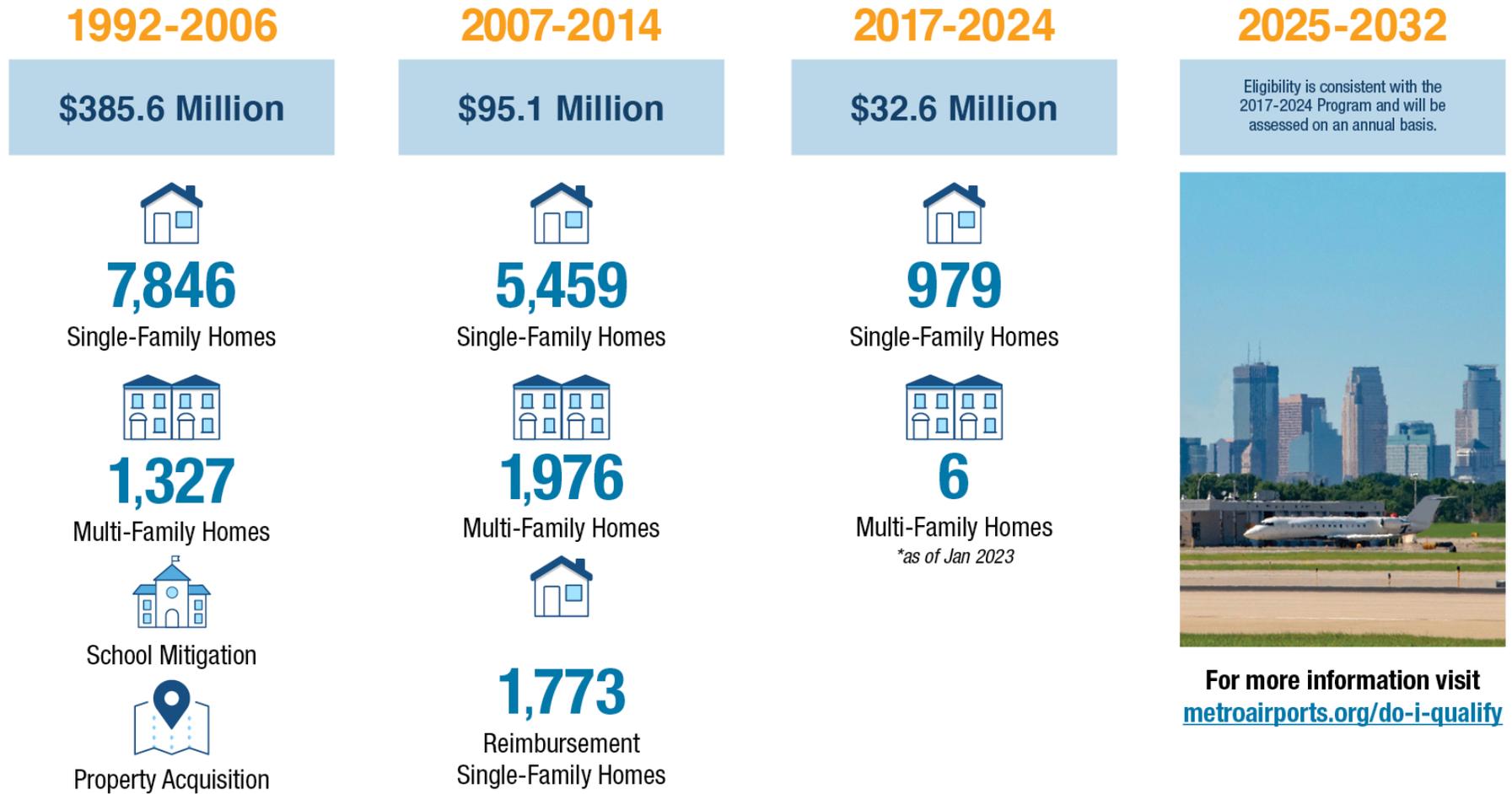
The 2007 Consent Decree was first amended in 2013 in response to concerns expressed by the MSP Noise Oversight Committee (NOC) over the MSP 2020 Improvements Environmental Assessment/Environmental Assessment Worksheet. This amendment created the 2017-2024 Noise Mitigation Program (2017-2024 Program), which established mitigation eligibility based on annual assessments of actual MSP aircraft activity rather than projections. To be eligible for noise mitigation, a home would need to be located for three consecutive years in a higher aircraft noise mitigation area when compared to the home's status under the terms of the 2007 Consent Decree. The first of the three years must occur by 2020. The Full 5-decibel Reduction Package is offered to single-family homes meeting these criteria inside the actual 63 dB DNL noise contour, while the Partial Noise Reduction Package is offered to single-family homes in the actual 60-62 dB DNL noise contours. A uniform Multi-Family Noise Reduction Package is offered to multi-family units within the actual 60 dB DNL noise contour. Homes will be mitigated in the year following their eligibility determination. The 2013 Actual Contour marked the first year in assessing this new mitigation program.

A second amendment was made to the 2007 Consent Decree in 2017. This amendment allowed for the use of the Aviation Environmental Design Tool (AEDT) to develop the actual noise contours each year, beginning with the 2016 Actual Contour. In 2015, AEDT replaced the Integrated Noise Model (INM) as the federally approved computer model for determining and analyzing noise exposure and land use compatibility issues around airports in the United States. The second amendment also provided clarity on the Opt-Out Eligibility criteria of the 2017-2024 Program. Specifically, single-family homes that previously opted out of the Partial Noise Reduction Package may participate in the Full 5-Decibel Reduction Package, provided the home meets the eligibility requirements. Figure ES-1 provides a program history overview.

#### **ES.5 THE THIRD AMENDED CONSENT DECREE (2025-2032 PROGRAM)**

In 2022, a third amendment was made to the 2007 Consent Decree that will provide eligibility criteria and aircraft noise relief packages consistent with the 2017-2024 Program through 2032.

Figure ES-1: Mitigation Program History



## **ES.4 2022 NOISE CONTOURS**

There was an increase in aircraft noise exposure from flight activity at MSP in 2022 compared to 2021. The number of aircraft operations (takeoffs and landings) is a prominent factor in noise contour calculation. In 2022, MSP supported 310,235 aircraft operations versus 303,884 in 2021, 244,877 in 2020 and 406,073 in 2019. The largest reduction in air travel demand in aviation history occurred in 2020 due to the COVID-19 pandemic.

MSP made progress in 2022 to continue its recovery from the ongoing impacts of the COVID-19 pandemic. While the pandemic continues to take a toll on global air travel, passenger levels in 2022 showed a steady and promising increase. The total number of passengers at MSP increased to 31.2 million in 2022, 24 percent more than in 2021.

Because the total number of operations at MSP in 2022 (310,235) was less than half the number forecasted in 2007 (582,366), the actual 2022 60 dB DNL contour is approximately 42 percent smaller than the 2007 Forecast Contour, and the 2022 65 dB DNL contour is approximately 52 percent smaller than the 2007 Forecast Contour. The contraction of the contours from the 2007 Forecast to the 2022 Actual Contour scenarios is driven by the reduction in aircraft operations due to airlines operating larger aircraft and by the advancements in noise reduction technology on modern aircraft. There were 746 fewer average operations per day in 2022 compared to what was forecasted in 2007.

## **ES.5 2017-2024 PROGRAM ELIGIBILITY**

2020 was the final year that homes could become eligible under the terms of the program. The 2022 Actual Contour does not qualify any additional homes for mitigation as outlined by the terms of the 2017-2024 Program. The MAC will continue to implement the mitigation program for homes that remain eligible according to previous years analyses.

## **ES.6 2017-2024 PROGRAM MITIGATION STATUS**

### *2017 Mitigation Program*

Single-family: In 2017 the MAC began the project to provide mitigation to 138 single-family homes that became eligible by virtue of the 2015 Actual Contour. As of January 19, 2023, 118 homes have been completed; 9 homes declined to participate; 6 homes were moved to the 2019 program; 6 homes were moved to the 2020 program.

Multi-family: Two multi-family structures were eligible to participate in the Multi-Family Mitigation Program in 2017. One property is completed, and one property declined to participate.

The total cost for the 2017 Mitigation Program was \$2,442,685. The 2017 Mitigation Program is complete.

### *2018 Mitigation Program*

Single-family: In 2018, the MAC began the project to provide mitigation to 283 single-family homes that became eligible by virtue of the 2016 Actual Contour. As of January 19, 2023, 230 homes have been

completed; 8 homes declined to participate while 21 homes were moved to the 2019 program; 16 homes were moved to the 2020 program.

Multi-family: The 2018 Mitigation Program did not include any multi-family properties.

The total cost for the 2018 Mitigation Program was \$7,294,999. The 2018 Mitigation Program is complete.

#### *2019 Mitigation Program*

Single-family: In 2019, the MAC began the project to provide mitigation to 429 single-family homes that became eligible by virtue of the 2017 Actual Contour. As of January 19, 2023, including the homes transitioned from the 2017 and 2018 programs, 371 homes have been completed and 55 homes declined to participate.

Multi-family: The 2019 Mitigation Program did not include any multi-family properties.

The total cost for the 2019 Mitigation Program to date is \$13,333,018.

#### *2020 Mitigation Program*

Single-family: In 2020, the MAC began the project to provide mitigation to 243 single-family homes that became eligible by virtue of the 2018 Actual Contour. As of January 19, 2023, including the homes transitioned from the 2018 and 2019 programs; 247 homes have been completed; 13 homes are in the construction or pre-construction phase; 26 homes declined to participate.

Multi-family: The 2020 Mitigation Program does not include any multi-family properties.

The total cost for the 2020 Mitigation Program to date is \$9,243,291.

#### *2021 Mitigation Program*

Single-family: In 2021, the MAC began the project to provide mitigation to 16 single-family homes that became eligible by virtue of the 2019 Actual Contour. As of January 19, 2023, 13 homes have been completed; 2 homes are in the construction phase; 1 home declined to participate.

Multi-family: The 2021 Mitigation Program does not include any multi-family properties.

The total cost for the 2021 Mitigation Program to date is \$240,802.

## **ES.7 2025-2032 PROGRAM ELIGIBILITY**

There are no single- or multi-family homes that achieved the first year of eligibility as a result of the 2022 Actual Contour as outlined by the terms of the 2025-2032 Program.

Figure ES-2: 2022 Contours and Mitigation Program Eligibility

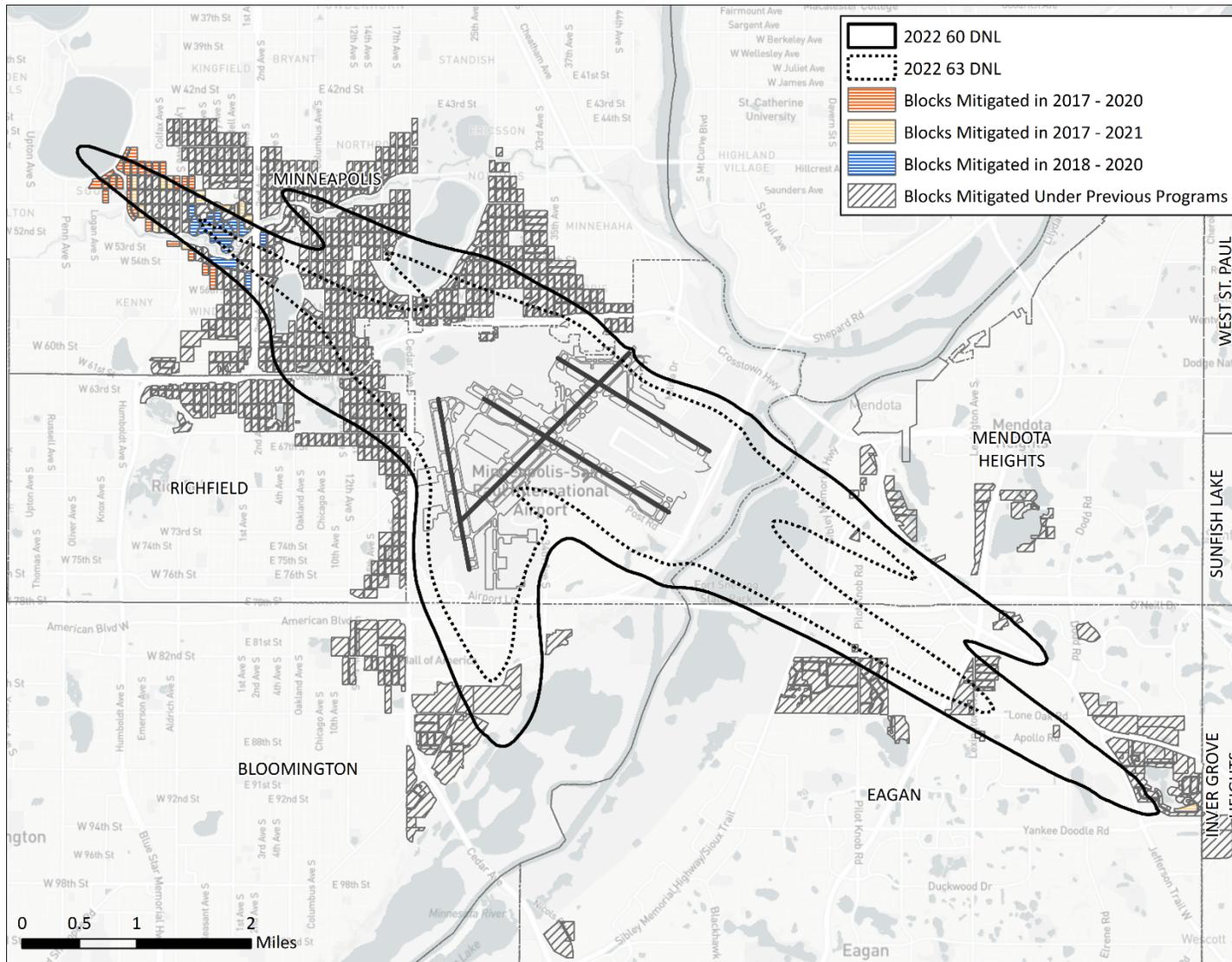


Figure ES-3: 2022 Contours and Mitigation Program Eligibility – City of Minneapolis

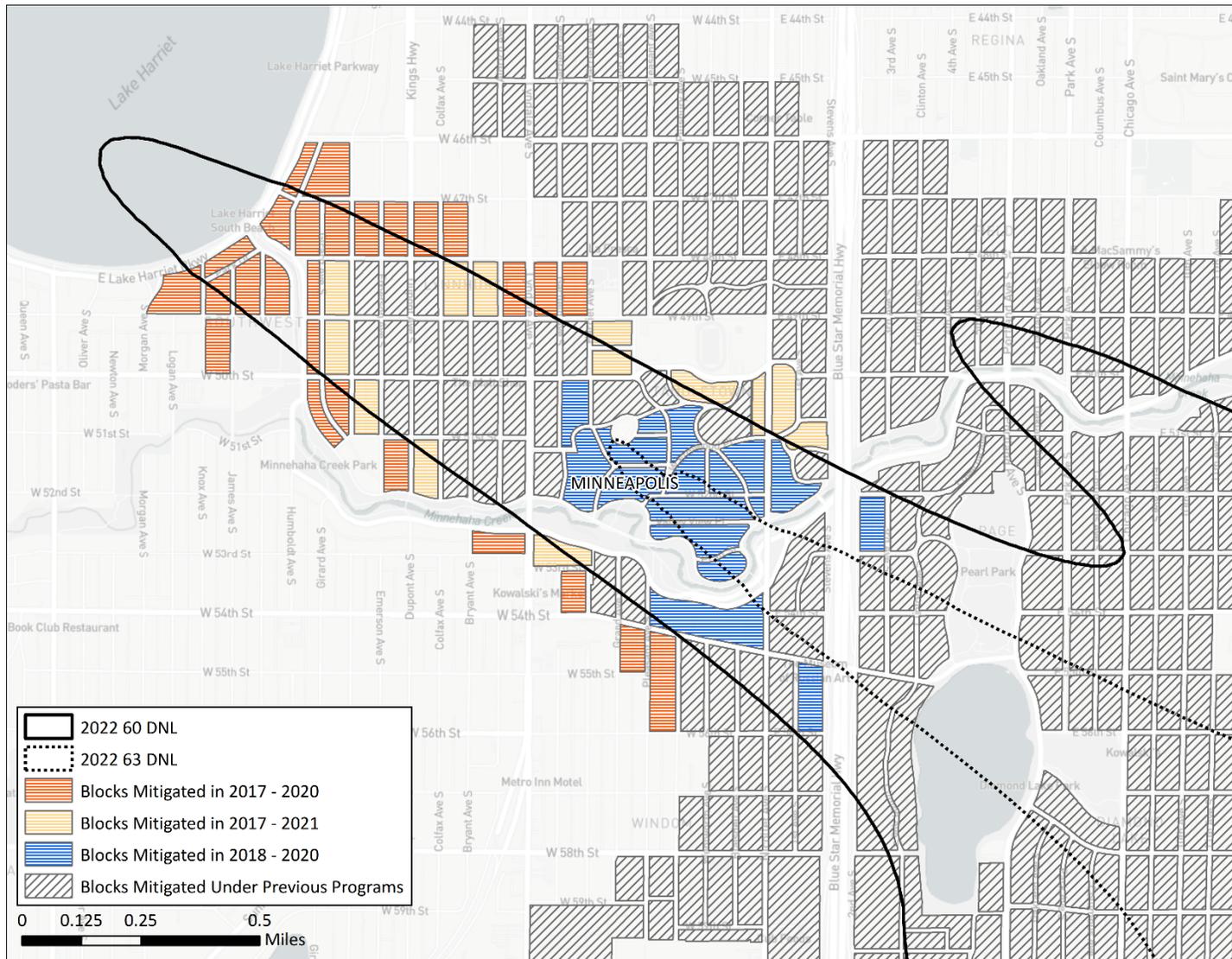
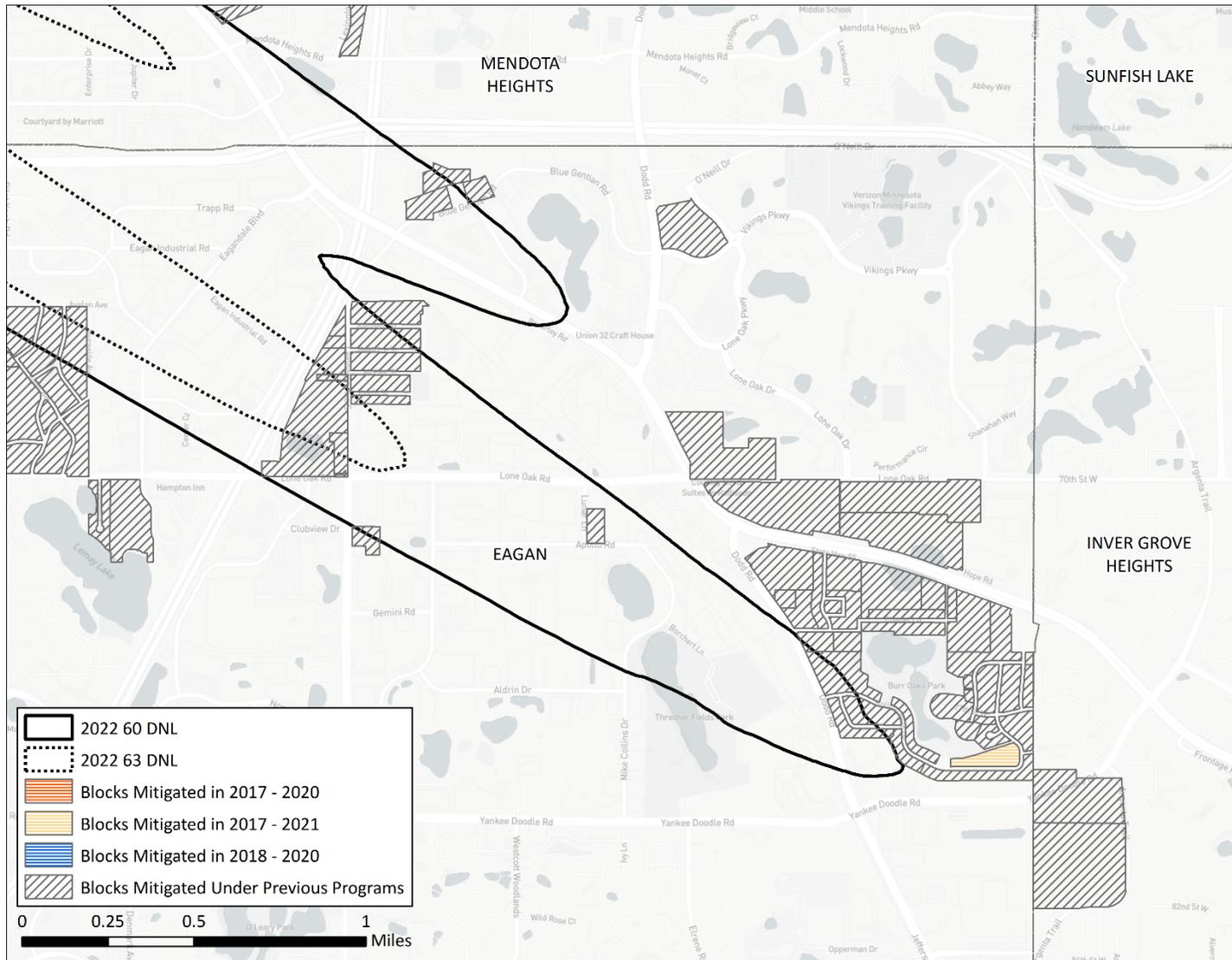


Figure ES-4: 2022 Contours and Mitigation Program Eligibility – City of Eagan



## 1. INTRODUCTION AND BACKGROUND

The issue of aircraft noise related to the Minneapolis-St. Paul International Airport (MSP) includes a long history of local efforts to quantify and mitigate noise impacts in a manner that is responsive to concerns raised by the communities around the airport and consistent with federal policy. The Metropolitan Airports Commission (MAC) has led the way with these efforts in the conceptualization and implementation of many initiatives to reduce noise impacts to communities around MSP. One of the most notable of these initiatives has been the sound insulation program originally implemented under Title 14 Code of Federal Regulations Part 150 (Part 150).

Part 150 provides a framework for airport operators to develop a comprehensive aircraft noise plan for an airport in the form of a Noise Compatibility Program (NCP). An NCP is a key component of the Part 150 process and is comprised of two fundamental approaches to addressing noise impacts around an airport: (1) Land Use Measures, and (2) Noise Abatement (NA) Measures (operational measures to reduce noise).

Another key component of the Part 150 process is the development of a Noise Exposure Map (NEM). NEMs are commonly referred to as noise contours. The NEM, or noise contours, characterize aircraft noise in terms of Day-Night Average Sound Level (DNL). This metric represents the total accumulation of all sound energy (decibels or dB) averaged uniformly over a 24-hour period and factors an additional 10-decibel penalty for each aircraft noise event occurring between 10:00 PM and 7:00 AM. The current federally established threshold for significant aircraft noise is 65 dB DNL. Forecast mitigated noise contours depict areas that may be eligible for Land Use Measures around an airport based on forecasted aircraft operations levels. Land Use Measures can include compatible land use plans, property acquisition, residential relocation, and sound mitigation (modifications to homes to insulate against sound protrusions).

Development of a NEM typically includes a Base Case NEM and a five-year forecast NEM, with and without noise abatement measures. Including noise abatement measures in NEM development is important because the way an airport is used by aircraft (i.e.: runway use, time of flight, etc.) and the way flight procedures (i.e., power settings, flight paths, etc.) are executed have a direct effect on an airport's noise contour.

The MAC was one of the first airport sponsors to submit a Part 150 Study to the Federal Aviation Administration (FAA) and did so for MSP in October 1987. The study's NEM was accepted by the FAA in October 1989, and portions of the study's NCP were approved in April 1990. The five-year forecast NEMs with and without noise abatement measures used forecasted operations, not actual operations. Beginning in 2013, the MAC began modeling MSP noise contours on an annual basis using actual operations. The 1990 NCP identified areas eligible for remedial land use measures including the soundproofing of residences, schools and other public buildings.

A 1992 update to the NCP and NEM included a five-year forecast 65 dB DNL noise contour (1996 65 dB DNL). This update established the MAC's MSP Airport Noise Mitigation Program and marked the beginning of corrective mitigation measures within the 1996 65 dB DNL noise contour.

### 1.1 PART 150 PROGRAM (1992-2006 Program)

The 1992-2006 Airport Noise Mitigation Program (1992-2006 Program) was a large and visible part of the MSP Part 150 Study. The MAC designed the 1992-2006 Program using FAA structural Noise Level

Reduction (NLR) documentation. This included establishing product-specific Sound Transmission Class (STC) ratings and associated NLR goals, creative bidding practices, and cooperative prioritization and funding efforts. Through innovative approaches to enhancing the program as new information and technologies became available, the MSP Airport Noise Mitigation Program quickly became a national model for aircraft noise mitigation.

NLR is a number rating that describes the difference between indoor and outdoor noise levels. The FAA uses this number to evaluate the effectiveness of sound mitigation measures. Per FAA guidelines, the objective of a noise mitigation program is to achieve a 5-dB reduction in interior noise with mitigation measures in place, and to reduce the average interior noise levels to a level below 45 dB. Testing and evaluation of single-family homes near MSP indicated that most homes provided an average 30 dB of exterior to interior sound reduction, or NLR, with no mitigation efforts by the MAC, in most cases already achieving an interior noise level of 45 dB or below. This led the MAC to develop a Full 5-decibel Reduction Package for single-family homes within the 65 dB DNL and greater noise contours to meet FAA objectives.

This package provided an average noise reduction level of 5 dB, ensuring a noticeable level of reduction. The Full 5-decibel Reduction Package offered a menu of sound insulation measures that the MAC could install to achieve an average 5-dB noise reduction in an individual home. The options included treating or replacing windows and prime doors; installing or increasing attic insulation; baffling attic vents, mail slots and chimneys; and adding central air-conditioning. The MAC determined which specific measures were necessary for a home after assessing the home's existing condition.



As a result of detailed and extensive project management and quality control, the program achieved an excellent record of homeowner satisfaction. Throughout the duration of the program, when homeowners were asked if the improvements were effective at reducing aircraft noise at least 95 percent responded yes.

The MAC reached a significant accomplishment for its industry-leading aircraft noise mitigation program in 2006, when it completed the mitigation of 165 single-family homes in the 2007 forecast 65 dB DNL noise contour. This marked the completion of the mitigation program for all eligible and participating

homes within the 1996 65 dB DNL and the 2007 65 dB DNL contours. In total, more than 7,800 single-family homes were mitigated around MSP.

Annual average mitigation costs per single-family home ranged from a low of \$17,300 in 1994 to a high of \$45,000 in 2001. The MAC spent a total of approximately \$229.5 million on the single-family home mitigation program during the 1992-2006 Program's 15-year lifespan.

In addition to the single-family mitigation program, the MAC also mitigated multi-family units and schools, and engaged in property acquisition and relocation. The multi-family component of the 1996-2006



Program began in 2001 and was significantly smaller in both the number of structures mitigated and the associated costs. With the completion of multi-family structures in the 1996 65 dB DNL noise contour, the MAC mitigated approximately 1,327 multi-family units at a total cost of approximately \$11.1 million. There were no additional multi-family structures inside the 2007 Forecast Contour. All eligible and participating multi-family structures within the 2007 Forecast Contour were mitigated by 2006.

Also, since 1981, the MAC has mitigated 19 schools located around MSP, which represents all the schools located within the 1996 65 dB DNL noise contour. In response to the Minnesota Legislature's directives, the MAC also provided mitigation to certain schools located outside the 1996 65 dB DNL noise contour. The costs of insulating individual schools varied from \$850,000 to \$8 million. A total of approximately \$52 million was spent on mitigating schools, marking the completion of the school mitigation efforts in 2006.

In addition to the residential and school noise mitigation programs, the MAC implemented a residential property acquisition program in 2002 that removed structures such as residential buildings from aircraft noise impact areas. The intent of the residential acquisition program was to address impacted properties in the 1996 65 dB DNL noise contour. The MAC worked with the property owners and the city in which the respective property resided, agreeing that acquisition was the desirable means of mitigating the homes. As a result, the MAC acquired approximately 437 residential properties. In total, the MAC expended approximately \$93 million on the residential property acquisition program. The financial investment in the 1996-2006 Program was among the largest in the nation for such programs. Table 1.1 provides a summary of activity completed and dollars spent between 1992 and 2006.

**Table 1.1: 1992-2006 Program Summary**

<b>Corrective Action</b>	<b>Number</b>	<b>Total Cost (in millions)</b>
Single-Family Residential	7,846	\$229.5
Multi-Family Residential	1,327	\$11.1
Schools	19	\$52
Residential Property Acquisition	437	\$93
<i>Total</i>	--	<i>\$385.6</i>

## 1.2 2007 FORECAST CONTOUR

In late 1998, the MAC authorized an update to the MSP Part 150 Study. The update process began in 1999 with the development of noise contours, noise abatement and land use measures. The MAC published a draft Part 150 Update document in October 2000 and submitted the study, including a 2005 forecast NEM and revised NCP, to the FAA for review. In May 2002, after further consideration of the reduction in flight operations and uncertainties in the aviation industry resulting from the events of September 11, 2001, the MAC withdrew the study to update the forecast and associated noise contours.

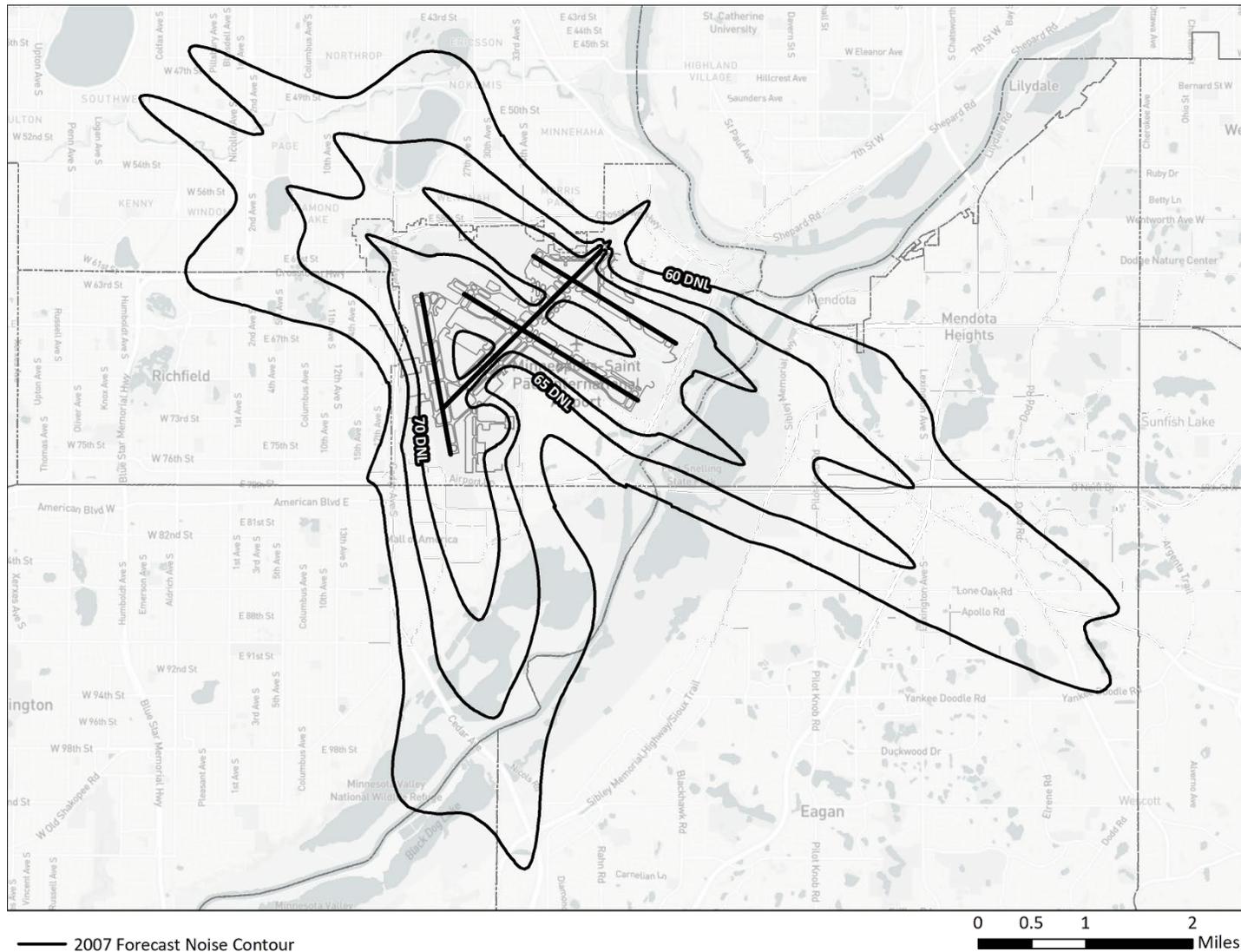
The forecast update process began in February 2003. This effort focused on updating the Base Case year from a 2000 scenario to a 2002 scenario and updating the forecast year from 2005 to 2007. The purpose of the forecast update was to ensure that the noise contours considered the impacts of the events of September 11, 2001 and ongoing changes in the MSP aircraft fleet. In addition to updating the forecast, the MAC and the MSP Noise Oversight Committee (NOC) conducted a review of the FAA-approved noise model input methodology and data to ensure continued consensus with the contour development process.

On November 17, 2003, the MAC approved the revised forecast and fleet mix numbers and noise model input methodology and data for use in developing the 2002 Base Case and 2007 Forecast NEMs. In March 2004, the MAC revised the forecast to incorporate corrections in general aviation numbers and to reflect Northwest Airlines' announcement that it would resume service of five aircraft that had been taken out of service previously.

The 2004 Part 150 Update resulted in a comprehensive NCP recommendation. In addition to several land use measures around MSP, the NCP included operational noise abatement measures. These measures focused on aircraft operational procedures, runway use, departure and arrival flight tracks, voluntary operational agreements with the airlines, and provisions for further evaluation of technology. The MAC implemented these operational noise abatement measures (more information is available at <https://metroairports.org/msp-noise-abatement-efforts>).

Based on the estimate of 582,366 total operations in the 2007 forecast scenario with noise abatement measures in place, approximately 7,234 acres were in the 65 dB DNL noise contour and approximately 15,708 acres were in the 60 dB DNL noise contour. All eligible and participating homes within the 2007 Forecast Contour have been mitigated. A depiction of the 2007 Forecast Contour is provided in Figure 1.

Figure 1: 2007 Forecast Contour



### 1.3 AIRCRAFT NOISE LITIGATION

One of the largest discussion items in the Part 150 Update process focused on the mitigation program that the MAC would offer in the 60-64 dB DNL noise contour area. The FAA recognizes sensitive land uses, such as residential land uses eligible for noise mitigation under Part 150, but only within the 65 dB DNL noise contour or greater. However, as part of the Dual-Track Airport Planning Process (a process that examined moving MSP versus expanding it in its current location, undertaken at the direction of the Minnesota Legislature), the MAC made a policy decision to provide some level of noise mitigation out to the 60 dB DNL noise contour area surrounding MSP. During the Dual-Track Airport Planning Process, an MSP Noise Mitigation Committee was developed and tasked with proposing a noise mitigation plan to be considered in conjunction with the expansion of MSP at its present location. The MSP Noise Mitigation Committee developed a final recommendation for the MAC to provide mitigation to the 60 dB DNL contour.

In the 2004 Part 150 Update, the MAC's recommendation for mitigation in the 60-64 dB DNL contours called for providing central air-conditioning to single-family homes that did not have it, with a possible homeowner co-pay based on the degree of noise impact. The MAC applied block-intersect methodology to the 2007 Forecast Contour to determine mitigation eligibility. With the block-intersect methodology, if any portion of a city block intersects the 60-64 dB DNL contour, all homes located on that city block would be eligible.

The cities located around MSP expressed dissatisfaction with the MAC proposal, asserting that the MSP Noise Mitigation Committee had recommended that the Full 5-decibel Reduction Package be expanded to all properties in the 60-64 dB DNL noise contours. The MAC countered that the proposal provided mitigation to the 60-64 dB DNL noise contour area and that the MSP Noise Mitigation Committee's recommendations did not specify the mitigation package that must be included. Additionally, the MAC clarified that, because homes in Minnesota have higher than the national average pre-existing noise reduction characteristics, the Full 5-decibel Reduction Package was not necessary outside the 65 dB DNL contour to achieve desired aircraft noise level reduction.

In early 2005, the Cities of Minneapolis, Eagan, and Richfield and the Minneapolis Public Housing Authority filed suit in Hennepin County District Court claiming, among other things, that the MAC violated environmental quality standards and the Minnesota Environmental Rights Act (MERA) by failing to provide the Full 5-decibel Reduction Package to single-family homes in the 60-64 dB DNL contours. In September 2005, plaintiffs seeking class action certification filed a separate action against the MAC, alleging breach of contract claims associated with mitigation in the 60-64 dB DNL contours. In January 2007, Hennepin County District Judge Stephen Aldrich granted the cities partial summary judgment. The court found, among other things, that the MAC, by virtue of implementing the Full 5-decibel Reduction Package, created an environmental standard that the MAC violated by recommending different mitigation in the 64 to 60 DNL noise contour area. In February 2007, the court held a trial on the cities' MERA and mandamus claims. However, before the court entered final judgment post-trial, the parties negotiated a global settlement, a Consent Decree, resolving the cities' case and the class action suit.

## 1.4 NOISE MITIGATION SETTLEMENT AND ANNUAL NOISE CONTOUR (2007-2014 Program)

On October 19, 2007, Judge Stephen Aldrich approved a Consent Decree entered into by the MAC and the Cities of Minneapolis, Eagan, and Richfield and the Minneapolis Public Housing Authority that settled the litigation. The Consent Decree provided that it became effective only if: (1) the FAA advised the MAC in writing by November 15, 2007 that the Decree was an appropriate use of airport revenue and was consistent with the MAC's federal grant obligations; and (2) that the court approved a settlement in the class action case by January 17, 2008. Both conditions were ultimately met, and in 2008 the MAC began implementing the 2007-2014 Airport Noise Mitigation Program (2007-2014 Program), providing single-family and multi-family mitigation out to the 2007 Forecast 60 dB DNL noise contours, and mitigation reimbursement funds out to the 2005 Forecast 60 dB DNL noise contours, as the Consent Decree required. Mitigation activities of the 2007-2014 Program varied based on aircraft noise exposure. Homes with the highest aircraft noise exposure were eligible for more extensive mitigation than those with less aircraft noise exposure.

The 2007-2014 Program provided that approximately 457 homes in the 2007 63-64 dB DNL Forecast noise contours were eligible to receive the Full 5-decibel Reduction Package, which was the same level of noise mitigation that the MAC provided in the 1992-2006 Program. The 2007 63-64 dB DNL noise contour mitigation program was designed to achieve 5 dB of noise reduction on average, with mitigation measures that depended upon the home's existing condition. These methods included central air-conditioning; exterior and storm window repair or replacement; prime door and storm door repair or replacement; wall and attic insulation installation; and/or baffling of roof vents and chimney treatment. As required by the Consent Decree, the MAC completed mitigation in the 2007 63-64 dB DNL noise contours by December 31, 2009. A total of 404 homes participated in the program.

In addition, under the Decree, owners of the approximately 5,428 single-family homes in the 2007 60-62 dB DNL noise contours were eligible for one of two sound insulation packages: 1) homes that did not have



central air-conditioning as of September 1, 2007 would receive it and up to \$4,000 (including installation costs) in other noise mitigation products and services they could choose from a menu provided by the MAC; or 2) owners of homes that already had central air-conditioning installed as of September 1, 2007 or who chose not to receive central air-conditioning were eligible for up to \$14,000 (including installation costs) in noise mitigation products and services they could choose from a menu provided by the MAC. The menu of options included acoustical modifications such as: exterior and storm window repair or replacement; prime door and storm door repair or replacement; wall and attic insulation installation; and/or baffling of roof vents and chimney treatment. These packages collectively became known as the Partial Noise Reduction Program. As required by the Consent Decree, the MAC completed the Partial Noise Reduction Program by December 1, 2012. A total of 5,055 homes participated in the program.

According to the provisions in the Consent Decree, single-family homes that met the eligibility for the 2007-2014 Program whose owners opted out of the previously-completed 1992-2006 Program, but had new owners on September 1, 2007, were eligible to opt in and receive noise mitigation. If the total cost to the MAC of the opt-in mitigation was less than \$7 million, any remaining funds were used to reimburse owners of single-family homes between the 2005 Forecast 60 dB DNL contour and the 2007 Forecast Contour for purchase and installation of products included on a menu provided by the MAC. The amount each homeowner received was determined by subtracting dollars spent for the opt-in program from the total \$7 million budget, and then by dividing the remainder of funds among the total number of single-family homes within the 2005 60 dB DNL and 2007 60 dB DNL contours. This program became known as the Homeowner Reimbursement Program. In September 2014, the MAC completed the Homeowner Reimbursement Program for a total of 1,773 participating single-family homes.

The MAC completed the Multi-Family Noise Reduction Package in 2010 by installing acoustical covers on air conditioners or installing new air conditioners in 1,976 dwelling units.

All phases of the 2007-2014 Program required under the original 2007 Consent Decree were completed by September 2014. The total cost to implement mitigation under the 2007-2014 Program was approximately \$95 million (which is inclusive of the \$7 million for opt-in mitigation and single-family mitigation reimbursement). A summary of actions taken is provided in Table 1.2.

**Table 1.2: 2007-2014 Program Summary**

<b>Corrective Action</b>	<b>Number</b>	<b>Total Cost (in millions)</b>
Single-Family Residential (full mitigation)	404	\$11.2
Single-Family Residential (partial mitigation)	5,055	\$72.6
Single-Family Residential (homeowner reimbursement)	1,773	\$5.2
Multi-Family Residential	1,976	\$6.1
<i>Total</i>		<i>\$95.1</i>

In addition to the MAC's mitigation obligations, the Consent Decree releases legal claims that the cities and homeowners have against the MAC in exchange for the actions that the MAC would perform as directed by the Consent Decree. The releases cease to be effective for a certain location if the average annual aircraft noise level in DNL at that location is at or above 60 dB DNL and is at least 2 dB DNL higher than the Base Case DNL Noise Level.

The Base Case DNL Noise Level is established by the actual DNL noise level the year a home becomes eligible for noise mitigation under the Consent Decree. The Base Case DNL Noise Level for homes that are not eligible for mitigation under the Consent Decree is established using the 2007 Forecast Contour.

MAC staff and representatives from the Cities of Minneapolis, Eagan, and Richfield met in February 2008 to discuss and finalize the annual report format. This report is prepared in accordance with the requirements of the Consent Decree and the format agreed upon by the parties. The actual contour that the MAC must develop under Section 8.1(d) of the Consent Decree is relevant to the release provisions in Section 8.1 as well as the determination of mitigation eligibility as defined by an amendment to the Consent Decree, described in Chapter 4 of this report.

## **1.5 FINAL MSP 2020 IMPROVEMENTS EA/EAW AND AMENDED CONSENT DECREE (2017-2024 PROGRAM)**

In January 2013, the MAC published the Final MSP 2020 Improvements Environmental Assessment/Environmental Assessment Worksheet (EA/EAW), which reviewed the potential and cumulative environmental impacts of MSP terminal and landside developments needed through 2020.

As is detailed in the EA/EAW, the FAA's Finding of No Significant Impact/Record of Decision (FONSI/ROD), and summarized in the MAC's related Findings of Fact, Conclusions of Law and Order, the Preferred Alternative scenario did not have the potential for significant environmental effects. The forecasted noise contours around MSP were driven by natural traffic growth that was anticipated to occur with or without implementation of the 2020 Improvements proposed in the EA/EAW.

Despite this, many of the public comments on the EA/EAW focused on future noise mitigation efforts. The past noise mitigation activities surrounding MSP, the terms of the 2007 Consent Decree and local land use compatibility guidelines defined by the Metropolitan Council were factors in the public dialogue. Additionally, the anticipated completion of the 2007-2014 Program raised community interest regarding the future of noise mitigation at MSP.

In response, MAC staff, in consultation with the MSP NOC, began the process of developing a noise mitigation plan to be included in the EA/EAW. The noise mitigation plan they recommended based eligibility upon actual noise contours that the MAC would prepare for MSP on an annual basis and required that a home would need to be located for three consecutive years in a higher noise mitigation impact area when compared to the home's status under the terms of the 2007-2014 Program.

The Final MSP 2020 Improvements EA/EAW detailed the following mitigation program elements:

- Mitigation eligibility would be assessed annually based on the actual noise contours for the previous year.
- The annual mitigation assessment would begin with the actual noise contour for the year in which the FAA FONSI/ROD for the EA/EAW was issued.
- For a home to be considered eligible for mitigation it must be located within the actual 60 dB DNL noise contour, within a higher noise impact mitigation area when compared to its status relative to the 2007-2014 Program, for a total of three consecutive years, with the first of the three years beginning no later than 2020.
- The noise contour boundary would be based on the block-intersect methodology.
- Homes would be mitigated in the year following their eligibility determination.

On January 7, 2013, the FAA published the Final MSP 2020 Improvements EA/EAW and the Draft FONSI/ROD, which included the following position regarding the proposed noise mitigation program:

*"The FAA is reviewing MAC's proposal for noise mitigation of homes for consistency with the 1999 FAA Policy and Procedures concerning the use of airport revenue and other applicable policy guidance."*

During the public comment period on the FAA's Draft FONSI/ROD many communities submitted comments urging the FAA to approve the MAC's revised noise mitigation proposal.

On March 5, 2013, the FAA approved the FONSI/ROD for the Final MSP 2020 Improvements EA/EAW. Specifically, the FAA stated that noise mitigation would not be a condition of FAA approval of the MSP 2020 Improvements project because “[n]o areas of sensitive land uses would experience a 1.5 dB or greater increase in the 65 dB DNL noise contour when comparing the No Action Alternative for 2020 and 2025 with the Proposed Action for the respective years.” However, the FAA included a letter dated March 5, 2013, as an attachment to the FONSI/ROD that addresses the conditions under which airport revenue may be used for off-airport noise mitigation. In that letter, the FAA stated:

*“As a matter of general principle mitigation measures imposed by a state court as part of a consent decree are eligible for use of airport revenue. Conceptually MAC could use airport revenues if it were to amend the 2007 consent decree to include the proposed mitigation.”*

Based on the FAA guidance, the MAC initiated discussions with the other parties to the Consent Decree (Cities of Minneapolis, Richfield and Eagan and the Minneapolis Public Housing Authority) to begin the amendment process. Additionally, at the March 20, 2013 NOC meeting, the Committee was updated on the progress of this issue and voted unanimously, supporting the following position:

*“NOC supports the noise mitigation program as detailed in the final EA/EAW in principle and supports follow-up negotiations between the parties to the Consent Decree to establish mutually agreeable terms for the modification of the Consent Decree consistent with the March 5<sup>th</sup> FAA letter in Appendix D of the FONSI ROD, for consideration by the Court.”*

On July 31, 2013, the Cities of Minneapolis, Richfield and Eagan, the Minneapolis Public Housing Authority and the MAC jointly filed the first amendment to the Consent Decree to Hennepin County Court. On September 25, 2013, Hennepin County Court Judge Ivy S. Bernardson approved the first amendment to the 2007 Consent Decree. The first amendment contains language that binds the MAC to provide noise mitigation services consistent with the noise mitigation terms described in the EA/EAW and established the 2017-2024 Airport Noise Mitigation Program (2017-2024 Program).

The 2013 Actual Contours established the first year of candidate eligibility based on the criteria detailed in the EA/EAW. The Full 5-decibel Reduction Package is offered to single-family homes meeting the eligibility criteria inside the actual 63 dB DNL noise contour while the Partial Noise Reduction Package is offered to single-family homes in the actual 60-62 dB DNL noise contours. A uniform Multi-Family Noise Reduction Package is offered to multi-family units within the actual 60 dB DNL noise contour. Homes will be mitigated in the year following their eligibility determination. The 2013 Actual Contour marked the first year in assessing the amended mitigation program.

In 2017, the MAC began mitigating homes meeting the eligibility requirements. The program included 138 single-family homes and 88 multi-family units as part of the 2017 program, 283 single-family homes in the 2018 program, 429 single-family homes in the 2019 program, 243 single-family homes in the 2020 program, and 16 single-family homes in the 2021 program. As of January 2023, \$32,554,795 has been spent on mitigating homes pursuant to the 2017-2024 Program.

In 2016, the Cities of Minneapolis, Richfield and Eagan, the Minneapolis Public Housing Authority and the MAC drafted a second amendment to the 2007 Consent Decree. This amendment: 1) allows the use of the Aviation Environmental Design Tool (AEDT) to run the actual noise contours each year (beginning with the 2016 Actual Contour; 2) provides clarity on the Opt-Out Eligibility criteria; and 3) provides a safeguard for homes that may fall out of consecutive year mitigation eligibility by virtue of a change in the model used to generate the noise contours. The clarification to the Opt-Out Eligibility criteria states: (1)

homeowners who failed to participate in the reimbursement program are not considered “Opt-Outs” and may participate in future programs provided the home meets the eligibility requirements; and (2) single-family homes that previously opted out of the Partial Noise Reduction Package may participate in the Full 5-decibel Reduction Package provided the home meets the eligibility requirements.

In November 2016, the parties to the Consent Decree signed the second amendment. In December 2016, the FAA responded that the second amendment “constitute a proper use of airport revenue” and “is consistent with the MAC’s grant obligations.” On January 31, 2017, Judge Bernardson approved the second amendment to the 2007 Consent Decree.

## **1.6 THIRD AMENDMENT TO THE CONSENT DECREE (2025-2032 PROGRAM)**

The 2017-2024 Program will expire on December 31, 2024. For a home to be eligible for the program it must achieve its first year of eligibility no later than 2020. The MSP 2020 Annual Noise Contour did not qualify any new homes as directed by the first amendment. Consequently, all homes that will be mitigated under the 2017-2024 Program have been identified and invited to participate.

The 2017-2024 Program is the current iteration of the MAC’s airport noise mitigation program, which is the most expansive program in the country and represents the most direct form of tangible relief to neighbors most affected by aircraft noise from MSP air traffic.

In July 2021, the NOC voted to support the continuation of the noise mitigation program in a manner consistent with the provisions of the Consent Decree and requested that MAC staff explore the continuation of the program with the parties of the Consent Decree. MAC staff then brought this request from the NOC forward to the MAC Board. The MAC Board voted to support the NOC’s request and directed staff to explore continuing the program for future consideration by the Consent Decree parties.

Following that direction, the parties to the Consent Decree met to discuss the framework for a possible third amendment to the Consent Decree. The parties subsequently agreed to language to establish a third amendment to the Consent Decree that provides eligibility criteria and noise relief packages consistent with the 2017-2024 Program through 2032. The third amendment was signed by the parties in December 2021. In January 2022, the FAA responded that the third amendment “constitute[s] a proper use of airport revenue” and “is consistent with MAC’s grant obligations.” On April 18, 2022, Fourth Judicial District Court Judge, Bridget Sullivan approved the third amendment to the 2007 Consent Decree, establishing the 2025-2032 Airport Noise Mitigation Program (2025-2032 Program).

## **2. 2022 ACTUAL CONTOUR**

### **2.1 DEVELOPMENT OF THE 2022 ACTUAL CONTOUR**

#### **2.1.1 Noise Modeling**

According to the amended Consent Decree, the MAC is required to prepare actual noise contours reflecting the noise exposure from MSP aircraft operations during the previous calendar year by March 1 of each year. The availability of federal or airport-generated funds for the purpose of noise mitigation is contingent upon the development of noise contours in a manner consistent with FAA requirements. One of these requirements is the use of the DNL noise assessment metric to determine and analyze aircraft noise exposure. The DNL metric is calculated by averaging cumulative sound levels over a 24-hour period.

This average cumulative sound exposure includes a 10-decibel penalty to aircraft noise exposures occurring during the nighttime (10:00 PM to 7:00 AM) to account for relatively low nighttime ambient noise levels and because most people are asleep during these hours.

In May 2015, AEDT version 2b was released by the FAA to replace a series of legacy tools. According to the FAA, there was overlap in functionality and underlying methodologies between AEDT and the legacy tools, however updates were made in AEDT that result in differences when comparing outputs from AEDT and the legacy tools. The updates related to noise modeling include smaller flight segments to more accurately model aircraft noise levels for a larger number of aircraft positions and states along a flight path; a new standard (SAE-ARP-5534) for computing the effects of weather on noise; correcting misidentified aircraft engine mounted locations for three aircraft types; and moving from recursive grids to dynamic grids for noise contour generation.

The most recent version of AEDT, version 3e, was released for use on May 9, 2022. This version was used to develop the 2022 Actual Contour. AEDT 3e updated the historical airport weather database with the most recent 10-year average (2012 through 2021) recorded at the Integrated Surface Database (ISD) from the National Oceanic and Atmospheric Administration (NOAA). AEDT 3e also included an update to the aircraft fleet database to include data for two new aircraft models, the Boeing 787-900 and the Boeing 747-400RN, and the departure profile of the BD-700-1A11 (Bombardier Global Express) was updated.

Noise contours depict an annualized average day of aircraft noise impacts using model inputs, such as runway use, flight track use, aircraft fleet mix, aircraft performance and thrust settings, topography, and atmospheric conditions. Quantifying aircraft-specific noise characteristics in AEDT is accomplished using a comprehensive noise database that has been developed under 14 CFR Part 36. As part of the airworthiness certification process, aircraft manufacturers are required to subject aircraft to a battery of noise tests. Using federally adopted and endorsed algorithms, this aircraft-specific noise information is used in the generation of DNL contours. Justification for such an approach is rooted in national standardization of noise quantification at airports.

### **2.1.2 2022 Aircraft Operations and Fleet Mix**

Most aircraft operations at MSP are conducted by passenger airlines. Thus, changes in operation numbers are impacted by airline decisions. For several years, airlines operating at MSP and nationwide frequently chose to increase passenger capacity when upgrading aircraft. The result was they were able to accommodate the same number of passengers with fewer flights. Prior to the pandemic, MSP experienced ten consecutive years of total passenger growth, reaching a record 39 million passengers in 2019.

MSP made progress in 2022 to continue its recovery from the on-going impacts of the COVID-19 pandemic. The total number of passengers at MSP increased to 31.2 million in 2022, 24 percent more than in 2021, marking a 79 percent recovery to the 39.6 million total passengers in 2019. This is similar to losses suffered by other U.S. airports and airlines during the COVID-19 pandemic, which continues to take a toll on global air travel.

The MAC used its Noise and Operations Monitoring System (MACNOMS) for the 2022 fleet mix data as well as the FAA's Operations Network (OPSNET) total operations counts in the development of the actual 2022 noise contours. The MACNOMS total operations number was 1.3 percent lower than the operations number reported by OPSNET. To reconcile this difference, MACNOMS data was adjusted upward to equal the OPSNET number. In 2022, there were 310,235 (per FAA data) total operations at MSP, an average of

850.0 daily flights—a 2 percent increase compared to 2021, but still 24 percent below 2019 levels. Of those, 89 percent occurred between the DNL-defined daytime hours of 7:00 AM and 10:00 PM. The remaining 11 percent occurred at night between the hours of 10:00 PM and 7:00 AM resulting in 93.2 average daily nighttime operations. This figure is up from the 84.1 average daily nighttime operations that occurred in 2021 but remains below the 119.8 average daily nighttime operations that occurred in 2019.

**Table 2.1: Summary of 2022 Average Daily Flight Operations**

Average Daily Flight Operations	Day	Night	Total	% of Total Operations
Manufactured to be Stage 3+	733.6	92.1	825.7	96.9%
Hushkit Stage 3 Jets	0.1	0.0	0.1	0.0%
Microjet	0.8	0.0	0.8	0.1%
Propeller	21.6	1.0	22.6	2.7%
Helicopter	0.1	0.0	0.1	0.0%
Military	0.6	0.0	0.6	0.1%
<i>Total</i>	<i>756.7</i>	<i>93.2</i>	<i>850.0</i>	<i>100.0%</i>
<i>% of Total Operations</i>	<i>89.0%</i>	<i>11.0%</i>	<i>100.0%</i>	

Note: Totals may differ due to rounding.

Source: MAC-provided MACNOMS data, HNTB 2022



Smaller regional jets, such as the CRJ 900 and the CRJ 200, were the most flown aircraft at MSP from 2004 to 2021. In 2022, the most flown passenger aircraft at MSP became the Boeing B737-800, a narrowbody jet. The Airbus A321 was the second most flown aircraft, with slightly more operations than the CRJ 900, which ranked third in number of operations. The next two most flown aircraft types were the Boeing 737-900 and the Airbus A319. These five aircraft types accounted for more than 56% of all commercial jet operations at MSP in 2022.



A summary of the 2022 fleet mix is provided in Table 2.1. A more detailed presentation of the 2022 aircraft fleet mix is provided in Appendix 1.

### 2.1.3 2022 Runway Use

The FAA's control and coordination of runway use throughout the year for arrival and departure operations at MSP has a notable effect on the distribution of aircraft noise around the airport. The number of flights operating on each runway, also called runway use, is one of the factors that influences the number of people and dwellings impacted by aircraft noise.

Prior to 2005, when Runway 17/35 opened, arrival and departure operations at MSP occurred on the parallel runways (12L/30R and 12R/30L) in a manner that resulted in approximately 50 percent of the arrival and departure operations occurring to the northwest over the neighborhoods that make up south Minneapolis, and 50 percent to the southeast over the cities of Mendota Heights and Eagan. Because of the dense residential land uses to the northwest and the predominantly industrial/commercial land uses



southeast of MSP, the FAA made a concerted effort to focus departure operations over areas to the southeast as the preferred operational configuration. This tactic was effective for ensuring as few people as possible were affected by aircraft noise from MSP operations.

Runway 17/35 opened at MSP in October 2005, and provided the FAA with new runway use options. The use of the runways has changed over time as a natural result of weather and operational variables.

One noise abatement procedure in place at MSP is the Runway Use System (RUS). The RUS prioritizes

arrival and departure runways to promote flight activity over less-populated residential areas as much as possible.

The RUS was updated in 2005 to coincide with the opening of Runway 17/35. For departures, Runways 12L and 12R are the first priority (Priority 1) since aircraft are directed over non-residential (industrial use) areas to the southeast immediately after takeoff. Runway 17 is the second priority (Priority 2) departure runway and is used for departures to the south to augment the flow of air traffic using the parallel runways. The Minnesota River Valley and commercial land uses in Bloomington provide another opportunity to route aircraft over an unpopulated area. There are, however, residential areas to the south, impacted by Runway 17 departures turning eastbound after crossing the Minnesota River.

Even with the RUS in place, its use is constrained by the number of aircraft landing and departing at any time, as well as by weather conditions. In 2020, the use of Runway 17/35 was largely unnecessary due to the reduction in operations caused by the pandemic. In March 2021, aircraft departures returned to a level that necessitated the use of Runway 17 to relieve constraints on the Priority 1 departure runways. Departures used Runway 17 throughout 2022, with the exception of a five-week construction project in September and October to rebuild portions of the Runway 17-35 safety area.

A summary of other notable changes in runway use percentages between 2021 to 2022 is provided in Table 2.2 below. Figure 2.1 on the next page shows the runway layout at MSP. Table 2.3 provides the average annual runway use distribution in 2022.

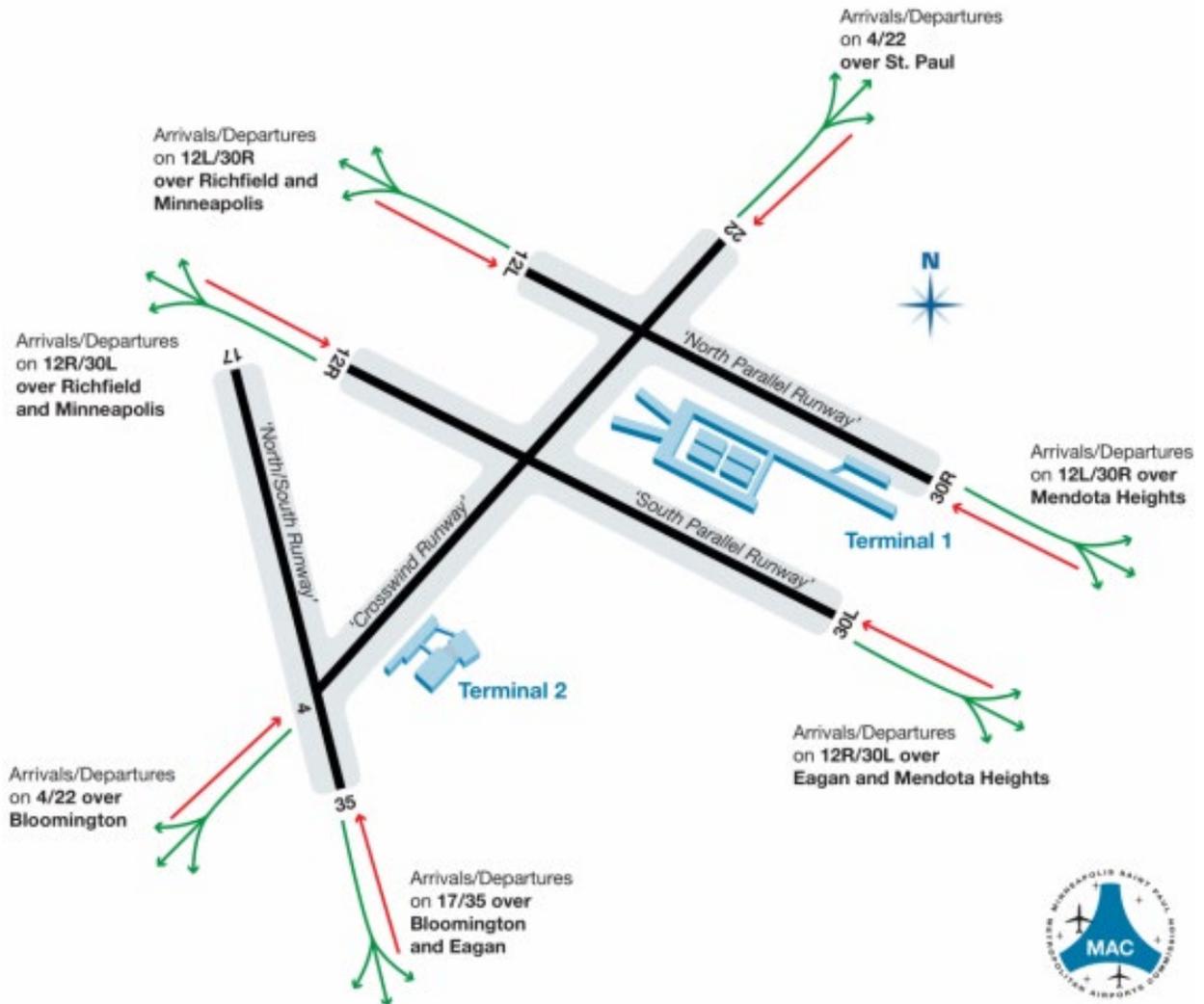
**Table 2.2: Average Annual Runway Use Comparison**

Operation	Runway	2021	2022	Difference
Arrivals	4	0.0%	0.0%	0.0%
	12L	21.1%	18.0%	(3.1%)
	12R	28.2%	27.6%	(0.6%)
	17	0.2%	0.1%	(0.1%)
	22	0.1%	0.3%	0.2%
	30L	29.3%	32.5%	3.2%
	30R	20.7%	21.3%	0.6%
	35	0.5%	0.2%	(0.3%)
Departures	4	0.0%	0.0%	0.0%
	12L	16.5%	13.8%	(2.7%)
	12R	15.0%	10.7%	(4.3%)
	17	22.7%	26.1%	3.4%
	22	0.1%	0.3%	0.2%
	30L	23.3%	27.7%	4.4%
	30R	22.4%	21.5%	(0.9%)
	35	0.0%	0.0%	0.0%

Note: Total may not add up due to rounding. Helicopters are excluded. (X.X%) indicates reduction in use.

Source: MAC-provided MACNOMS Data, HNTB 2023

Figure 2.1: MSP Runway Layout



**Table 2.3: Summary of 2022 Average Annual Runway Use**

Operation	Runway	Day	Night	Total
Arrivals	4	0.0%	0.0%	0.0%
	12L	18.8%	12.6%	18.0%
	12R	27.2%	30.4%	27.6%
	17	0.1%	0.1%	0.1%
	22	0.3%	0.3%	0.3%
	30L	31.5%	39.1%	32.5%
	30R	22.1%	15.9%	21.3%
	35	0.0%	1.6%	0.2%
Departures	4	0.0%	0.0%	0.0%
	12L	13.9%	12.4%	13.8%
	12R	9.0%	26.9%	10.7%
	17	27.7%	9.5%	26.1%
	22	0.3%	0.2%	0.3%
	30L	26.9%	35.3%	27.7%
	30R	22.1%	15.6%	21.5%
	35	0.0%	0.0%	0.0%

Note: Total may not add up due to rounding. Helicopters are excluded.

Source: MAC-provided MACNOMS Data, HNTB 2023

#### 2.1.4 2022 Flight Tracks

Modeled departure and arrival flight tracks were developed using actual flight track data. The model tracks used in the 2022 Actual Contour were identical to those used for the 2021 Actual Contour. Sub-tracks are added to each of the backbone arrival and departure model tracks. The distribution of operations among the backbone and sub-tracks in AEDT use a standard “bell curve” distribution, based on the number of sub-tracks developed.

The same methodology used in previous MSP annual reports was also used to assign actual 2022 flight tracks to the modeled tracks. The correlation process employs a best-fit analysis of the actual flight track data based on linear trends. This approach provides the ability to match each actual flight track directly to the appropriate model track.

Graphics of model flight tracks and the percent that each was used in 2022 are provided in Appendix 2.

#### 2.1.5 Custom Departure Profiles

Aircraft departures at MSP continue to use the distant noise abatement departure procedure. Historically, the noise modeling has utilized custom noise model input in the form of custom profiles for the loudest and most frequent aircraft types. The current set of custom profiles were developed in 2011 and updated in 2014 and 2018.

The use of departures with custom profiles decreased from 63 percent in 2017 to 61 percent in 2018. After new custom profiles were added in 2018, the use of departures with custom profiles increased to 74 percent in 2019. In 2022, 63 percent of departures were modeled using custom profiles.

### 2.1.6 2022 Atmospheric Conditions

With the release of AEDT 3e, the weather data in the AEDT airport database has been updated. This default data that is used for noise and emissions inventory calculations now reflects average weather for the most recently available 10-year period, 2012 through 2021. In addition, an update to the 30-year normal temperature data for the period 1981 through 2010 is included. The weather station identifiers associated with airports were also updated as needed (due to station closures/additions for the revised data time span).

- Temperature – 46.7 degrees Fahrenheit
- Dew point – 36.5 degrees Fahrenheit
- Wind speed – 8.1 knots
- Pressure – 984.5 Millibars
- Relative humidity – 67.4 percent



## 2.2 2022 MODELED VERSUS MEASURED DNL VALUES

As part of the 2022 Actual Contour evaluation, a comparison was conducted on the actual 2022 measured aircraft noise levels at the MAC's 39 sound monitoring sites to the modeled DNL noise values from AEDT. The latitude and longitude coordinates for each sound monitoring site was used to calculate modeled DNL values in AEDT.



Table 2.4 provides a comparison of the AEDT modeled DNL noise values and the actual measured aircraft DNLs at those locations in 2022.

**Table 2.4: 2022 Measured vs. Modeled DNL Values**

Sound Monitoring Site	2022 Measured DNL (a)	2022 Modeled DNL	Difference	Absolute Difference
1	55.6	56.8	1.2	1.2
2	56.9	57.0	0.1	0.1
3	62.4	63.1	0.7	0.7
4	58.3	58.6	0.3	0.3
5	67	67.6	0.6	0.6
6	66.4	64.6	-1.8	1.8
7	58.4	57.9	-0.5	0.5
8	53.4	53.9	0.5	0.5
9	45.5	44.5	-1.0	1.0
10	47.6	49.9	2.3	2.3
11	30.3	43.1	12.8	12.8
12	29.4	46.1	16.7	16.7
13	52.7	53.7	1.0	1.0
14	59.5	60.3	0.8	0.8
15	54.4	54.7	0.3	0.3
16	63.9	63.2	-0.7	0.7
17	39.2	47.9	8.7	8.7
18	52.5	57.3	4.8	4.8
19	47.9	52.8	4.9	4.9
20	39.7	50.4	10.7	10.7
21	42.9	48.0	5.1	5.1
22	55.1	57.1	2.0	2.0
23	58.5	58.5	0.0	0.0
24	57.9	59.1	1.2	1.2
25	48.4	51.9	3.5	3.5
26	48.9	53.1	4.2	4.2
27	53.4	55.2	1.8	1.8
28	53	60.2	7.2	7.2
29	49.5	51.2	1.7	1.7
30	58.5	58.3	-0.2	0.2
31	43.6	48.8	5.2	5.2
32	38.4	46.8	8.4	8.4
33	44.4	48.7	4.3	4.3
34	42.2	46.7	4.5	4.5
35	46.5	49.5	3.0	3.0
36	45	45.7	0.6	0.6
37	43.9	47.2	3.3	3.3
38	47.7	49.5	1.8	1.8
39	48.7	50.5	1.8	1.8
			Average	3.1
			Median	1.8
Notes:				
All units in dB DNL				
(a) Computed from daily DNLs				
Source: MAC sound monitoring data, 2022 and HNTB, 2023				

There is an inherent difference between modeled noise results and measured noise results. AEDT modeled data only reports on aircraft noise. It cannot replicate the various other sources of community noise that exist and contribute to ambient conditions. AEDT cannot replicate the exact operating characteristics of each aircraft that is input into the model. AEDT uses average weather conditions instead of actual weather conditions at the time of the flight. AEDT also uses conservative aircraft substitutions when new aircraft are not yet available in the model. Conversely, RMT measured data is highly impacted by community sound. The MACNOMS system must set thresholds for events to attempt to eliminate occurrences of community sound events being assigned to aircraft sound. While some of the data is evaluated by staff, most events are assumed to be aircraft if a flight track existed during the time of the event. The factors that may contribute to the difference include site terrain, building reflection, foliage and ground cover, ambient noise level as well as atmospheric conditions. These variables will impact the propagation of sound differently.

The use of absolute values provides a perspective of total difference between the modeled values and the measured values. The average absolute difference between modeled and measured DNL is approximately 3.1 dB compared with 3.9 dB in 2021, 4.8 dB in 2020, 3.4 dB in 2019, and 3.3 dB in 2018. The absolute median difference is 1.8 dB DNL compared with 2.3 dB DNL in 2021, 3.4 dB DNL in 2020, 1.8 dB DNL in 2019, and 2.4 dB DNL in 2018. The absolute median difference is considered the most reliable indicator of correlation when considering the data variability across modeled and measured data.

The large variations between measured and modeled data occur at sites that have fewer events overall. When more data is available, that variance decreases. For example, there were only 16 sites that had a modeled DNL at or above 55 dB. The average difference between the modeled DNL and measured DNL at those sites was only 1.5 dB. The median of the absolute difference was 0.8 dB at those sites. The remaining 23 sites had a modeled DNL of 55 dB or below. The average difference between the modeled DNL and measured DNL at those sites was 4.6 dB. The median of the absolute difference was 3.5 dB at those sites. There is a larger variation between the measured and modeled DNL at these sites due to fewer aircraft operations throughout the year, resulting in fewer measured aircraft events.

### **2.3 2022 NOISE CONTOUR IMPACTS**

The 2022 Actual Noise Contours increased in size compared to the 2021 Actual Noise Contours but remain smaller than the 2019 contours. The 2022 Actual 65 dB DNL Contour encompasses 3,441 acres. This represents an increase of nearly 88 acres, or 2.6 percent, from the 2021 Actual Contour. The 2022 Actual 60 dB DNL Contour encompasses approximately 9,166 acres, an increase of 594 acres, or 6.5 percent, from the 2021 Actual Contour.

The contours expanded along all arrival and departure lobes (the shape of the contours that extend out from the runways) around the airport. The most substantial increase occurred on the south parallel runway lobe, expanding into Lake Harriet to the north of the airport and past State Highway 149 to the south of the airport.

Table 2.5 contains the count of single-family (one to three units per structure) and multi-family (more than three units per structure) dwelling units in the 2022 Actual Contour. The counts are based on the block-intersect methodology where all structures on a block located within or touched by the noise contour are counted.

**Table 2.5 Summary of 2022 Actual DNL Noise Contour Unit Counts**

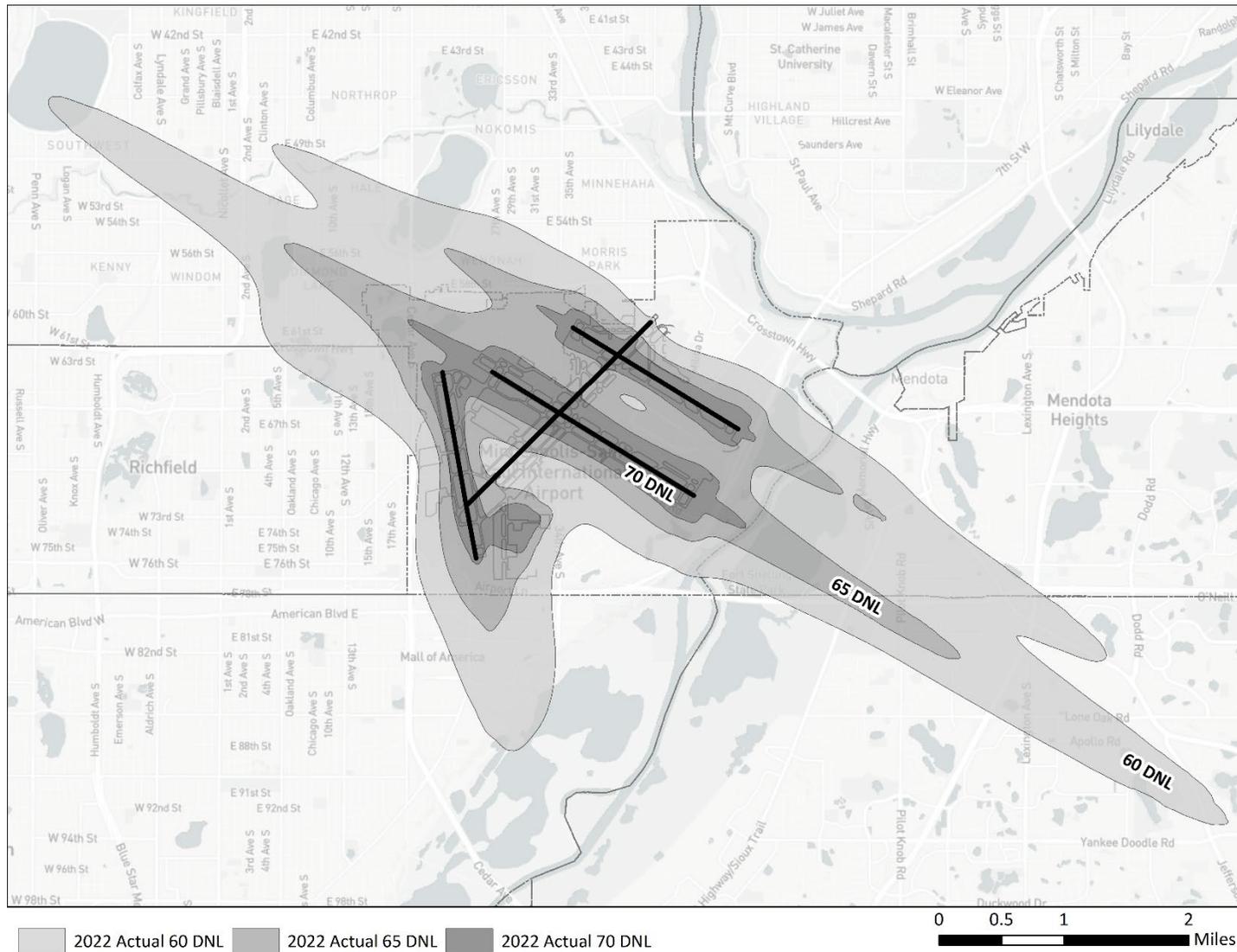
City	Dwelling Units Within dB DNL Interval									
	Single-Family					Multi-Family				
	60-64	65-69	70-74	75+	Total	60-64	65-69	70-74	75+	Total
<b>Bloomington</b>	8	-	-	-	8	151	-	-	-	151
<b>Eagan</b>	223	-	-	-	223	-	-	-	-	-
<b>Mendota Heights</b>	1	-	-	-	1	-	-	-	-	-
<b>Minneapolis</b>	6,442	1,134	-	-	7,576	803	12	-	-	815
<b>Richfield</b>	635	-	-	-	635	236	-	-	-	236
<b>All Cities</b>	7,309	1,134	-	-	8,443	1,190	12	-	-	1,202

Note: The spatial analysis was performed in Universal Transverse Mercator (UTM Zone 15).

All residential units within the 2022 Actual 60 dB DNL Noise Contour have either received noise mitigation around MSP or are part of the 2017-2024 Program. Thus, no new homes have been introduced into the 2025-2032 Program from the 2022 Actual Contour.

Further evaluation and description of the 2022 Actual Contour and the residential noise mitigation is provided in Chapter 4. A depiction of the 2022 Actual Contour is provided in Figure 2.2.

Figure 2.2: 2022 Actual Contour



### 3. COMPARISON OF THE 2022 ACTUAL AND THE 2007 FORECAST CONTOUR

#### 3.1 COMPARISON OF NOISE CONTOUR INPUTS

##### 3.1.1 Noise Model Considerations

The 2022 Actual Contour was modeled in AEDT version 3e, which incorporates updates to flight segments, atmospheric computing standards, grids used for noise contour generation and other issues that carried over from the FAA's legacy model, the Integrated Noise Model (INM). The 2007 Forecast Contour was developed using INM Version 6.2a, which was the newest version available at the time.

It is important to note that modeling modifications over time can change the size and shape of a noise contour. For example, a range of case studies revealed that improvements to lateral attenuation adjustment algorithms and flight path segmentation in INM version 7.0 were found by the FAA to increase the size of a DNL contour for a range of between 3 and 10 percent over what previous versions of INM would have modeled. Additionally, some updates incorporated into AEDT, had the effect of reducing the 60 dB DNL noise contour by 0.6 percent at MSP compared to the latest version of INM.

##### 3.1.2 Aircraft Operations and Fleet Mix Comparison

The forecasted level of operations in the 2007 Noise Contour was 582,366 annual flights, an average of 1,595.9 flights per day. In 2022, the actual number of operations at MSP was 310,235, or 850.0 flights per day. This represents a reduction of 745.9 daily flights on average, or 46.7 percent fewer flights than the 2007 forecast number. Nighttime operations decreased by 30.1 average daily flights from the 2007 forecast level to 2022 actual level. Table 3.1 provides a summary comparison of the 2022 actual and the 2007 forecast average daily operations. A more detailed comparison of the 2007 forecast fleet mix and the 2022 actual aircraft fleet mix is provided in Appendix 1.

In general, many of the aircraft groups operating at MSP showed a reduction in the number of average daily operations from the 2007 forecasted level to the 2022 actual level. There was an average of one Hushkit Stage 3 Jet operation every ten days in 2022. This is down from the 2007 forecast average of 275 Hushkit Stage 3 flights per day. Manufactured Stage 3+ average daily operations in 2022 were down by 330.8 flights per day from the 2007 forecast. The number of propeller-driven operations decreased 136.4 flights per day while the number of military aircraft operations increased slightly by 0.1 flights per day.



**Table 3.1: Summary of 2022 and 2007 Average Daily Flight Operations**

<b>Average Daily Flight Operations</b>	<b>Day</b>	<b>Night</b>	<b>Total</b>	<b>% of Total Operations</b>
<b>2022</b>				
Manufactured to be Stage 3+	733.6	92.1	825.7	96.9%
Hushkit Stage 3 Jets	0.1	0.0	0.1	0.0%
Microjet	0.8	0.0	0.8	0.1%
Propeller	21.6	1.0	22.6	2.7%
Helicopter	0.1	0.0	0.1	0.0%
Military	0.6	0.0	0.6	0.1%
<i>Total</i>	<i>756.7</i>	<i>93.2</i>	<i>850.0</i>	<i>100.0%</i>
<i>% of Total Operations</i>	<i>89.0%</i>	<i>11.0%</i>	<i>100.0%</i>	
<b>2007</b>				
Manufactured to be Stage 3+	1071.5	85.0	1156.5	72.5%
Hushkit Stage 3 Jet	253.3	21.7	275.0	17.2%
Stage 2 Jets under 75,000 lbs	4.2	0.6	4.8	0.3%
Propeller	143.0	16.0	159.0	10.0%
Helicopter	0.0	0.0	0.0	0.0%
Military	0.4	0.0	0.5	0.0%
<i>Total</i>	<i>1472.4</i>	<i>123.3</i>	<i>1595.9</i>	<i>100.0%</i>
<i>% of Total Operations</i>	<i>92.3%</i>	<i>7.7%</i>	<i>100.0%</i>	

## Notes:

Totals may differ due to rounding

As of January 1, 2016, Stage 2 aircraft below 75,000 lbs are required to be compliant with Stage 3 noise regulations.

Source: MAC-provided MACNOMS data, HNTB 2023

**3.1.3 Runway Use Comparison**

Table 3.2 provides the runway use percentages for 2022, and a comparison to the 2007 forecast runway use percentages. A general evaluation of the runway use percentages in Table 3.2 shows that the percentage of operations that used Runway 12R for arrivals and Runway 30L for arrivals and departures in 2022 is higher than what was forecasted in the 2007 noise contour.

The use of Runway 35 for total arrivals was 0.2 percent in 2022 compared to 16.5 percent during the 2007 forecast. In 2007, Runway 17 was forecasted to be used for 37 percent of all departures. In 2022, it was used for only 26.1 percent of departures.

**Table 3.2: Summary of Average Annual Runway Use in 2022 and 2007**

Operation	Runway	Day		Night		Total	
		2022 Actual	2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	2007 Forecast
Arrivals	4	0.0%	0.0%	0.0%	3.8%	0.0%	0.3%
	12L	18.8%	21.8%	12.6%	17.2%	18.0%	21.4%
	12R	27.2%	14.7%	30.4%	12.4%	27.6%	14.5%
	17	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%
	22	0.3%	0.5%	0.3%	2.4%	0.3%	0.6%
	30L	31.5%	21.1%	39.1%	25.1%	32.5%	21.4%
	30R	22.1%	25.1%	15.9%	26.4%	21.3%	25.2%
	35	0.0%	16.9%	1.6%	12.7%	0.2%	16.5%
Departures	4	0.0%	0.2%	0.0%	0.4%	0.0%	0.2%
	12L	13.9%	8.9%	12.4%	14.1%	13.8%	9.3%
	12R	9.0%	15.9%	26.9%	18.3%	10.7%	16.1%
	17	27.7%	37.2%	9.5%	34.6%	26.1%	37.0%
	22	0.3%	0.1%	0.2%	0.8%	0.3%	0.1%
	30L	26.9%	15.0%	35.3%	12.8%	27.7%	14.8%
	30R	22.1%	22.7%	15.6%	19.2%	21.5%	22.4%
	35	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Note: Total may not add up due to rounding.

Source: MAC-provided MACNOMS data, HNTB 2023. Annual runway use for 2007 Forecast was obtained from the November 2004 Part 150 document.

### 3.1.4 Flight Track Considerations

Modeled departure and arrival flight tracks were developed using actual flight track data from 2022. These flight tracks differ from those used to develop the 2007 Forecast Contour due to enhanced modeling methods and improved technologies. Sub-tracks were also added to each of the backbone tracks. Standard distribution in both INM and AEDT were used to distribute the flights to the sub-tracks.

The same methodology as in previous annual reports was used to assign actual 2022 flight tracks to the modeled tracks. The correlation process employs a best-fit analysis of the actual flight track data based on linear trends. This approach provides the ability to match each actual flight track directly to the appropriate model track.

### 3.1.5 Atmospheric Conditions Comparison

The atmospheric condition inputs vary slightly between INM and AEDT. INM used pressure values in inches of mercury, where standard atmospheric pressure is 29.92. AEDT takes pressure in millibars, where standard is 1,013.25. AEDT takes an additional input value for dew point temperature in degrees Fahrenheit. As stated in Section 2.1.5, the weather data in the AEDT airport database has been updated. This default data that is used for noise and emissions inventory calculations now reflects average weather for the most recently available 10-year period, 2012 through 2021. In addition, an update to the 30-year normal temperature data for the period 1981 through 2010 is included. The weather station identifiers associated with airports were also updated as needed (due to station closures/additions for the revised data time span).

- Temperature – 46.7 degrees Fahrenheit
- Dew point – 36.5 degrees Fahrenheit
- Wind speed – 8.1 knots
- Pressure – 984.5 Millibars
- Relative humidity – 67.4 percent

The following annual average atmospheric conditions were used in the 2007 Forecast Contour:

- Temperature – 47.7 degrees Fahrenheit
- Wind speed – 5.3 knots
- Pressure – 29.90 inches of Mercury
- Relative humidity – 64.0 percent

### **3.2 COMPARATIVE NOISE MODEL GRID POINT ANALYSIS**

AEDT was used to calculate DNL values for the center points of each city block included in the mitigation programs outlined in the amended Consent Decree. Graphics showing the actual 2022 DNL levels calculated for each block, Base Case DNL Noise Levels calculated for each block, and the block-by-block difference in DNL levels between the Base Case and the 2022 Actual Contour are contained in Appendix 3.

The Base Case DNL is established using the actual DNL noise level for that location during the year the home becomes eligible for noise mitigation under the amended Consent Decree. The Base Case DNL for homes that are not eligible for mitigation under the amended Consent Decree is established using the 2007 forecast DNL for that location.

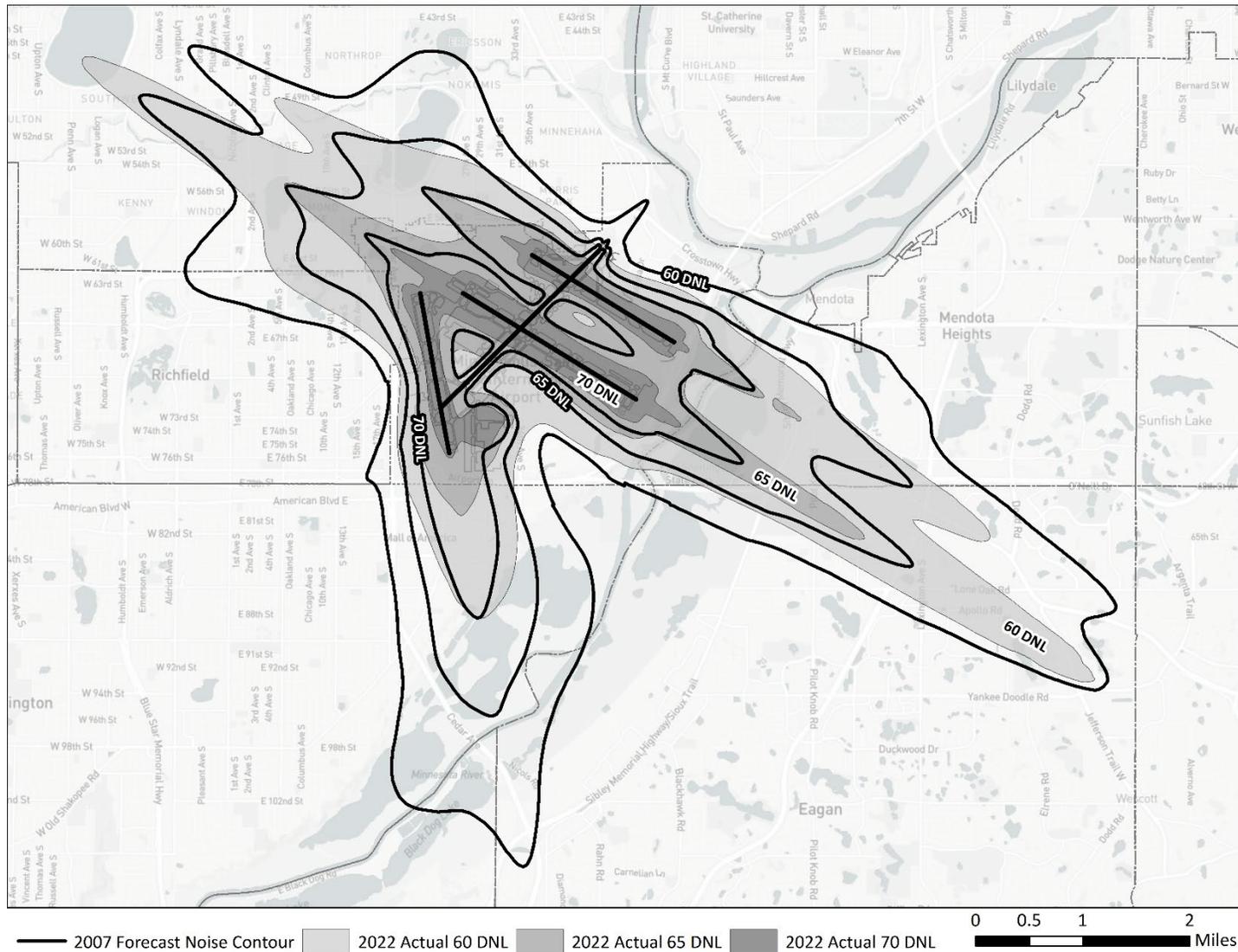
It is important to note that the 2007 forecast DNL was developed in INM Version 6.1 because this was the newest version of INM available at the time. The differences were insignificant when comparing the DNL values generated for the MACNOMS sound monitoring sites with INM 6.1 in the November 2004 Part 150 Update document to the DNL generated for those same locations with INM 6.2a.

### **3.3 CONTOUR COMPARISON SUMMARY**

In addition to modeling updates, other primary factors to consider when comparing the 2007 Forecast Contour to the 2022 Actual Contour are total operation numbers, fleet mix, nighttime operations, and runway use. The 2022 Actual Contour is smaller than the 2007 Forecast Contour by 6,542 acres, a 42 percent reduction in the 60 dB DNL contour. The 2022 Actual Contour is smaller than the 2007 Forecast Contour by 3,793 acres, a 52 percent reduction in the 65 dB DNL contour.

The contraction in the contours from the 2007 Forecast to the 2022 Actual Contour scenarios is driven primarily by the reduction in total aircraft operations, and secondarily by the reduction of Hush-kit aircraft. There were 745.9 fewer average operations per day in 2022 compared to the 2007 Forecast. There were 330.8 fewer average Hush-kit operations per day in 2022 compared to the 2007 Forecast.

Figure 3: 2022 Actual and 2007 Forecast Contour Comparison



## 4. 2022 ANNUAL NOISE CONTOUR

As discussed previously, the amended Consent Decree requires the MAC to determine eligibility for noise mitigation on an annual basis using actual noise contours, developed under Section 8.1(d) of the Consent Decree. This chapter provides detailed information about noise mitigation impacts from the 2022 Actual Contour at MSP.

### 4.1 2022 ACTUAL CONTOUR NOISE MITIGATION IMPACT

Under the provisions of the amended Consent Decree, properties must meet certain criteria to be considered eligible for participation in the MAC noise mitigation program.

First, as stated in the first and third amendments:

*The community in which the home is located has adopted local land use controls and building performance standards applicable to the home for which mitigation is sought that prohibit new residential construction, unless the construction materials and practices are consistent with the local land use controls and heightened building performance standards for homes within the 60 dB DNL Contour within the community in which the home is located.*

This criterion has been met by all incorporated cities contiguous to MSP.

Second, as stated in the third amendment:

*The home is located, for a period of three consecutive years, with the first of the three years beginning no later than calendar year 2028 (i) in the actual 60-64 dB DNL noise contour prepared by the MAC under Section 8.1(d) of this Consent Decree and (ii) within a higher noise impact mitigation area when compared to the Single-Family home's status under the noise mitigation programs for Single-Family homes provided in Sections 5.1 through 5.3 of this Consent Decree or when compared to the Multi-Family home's status under the noise mitigation programs for Multi-Family homes provided in Section 5.4 and 9.6 of this Consent Decree. The noise contour boundary will be based on the block intersect methodology. The MAC will offer noise mitigation under Section X of this Consent Decree to owners of eligible Single-Family homes and Multi-Family homes in the year following the MAC's determination that a Single-Family or Multi-Family home is eligible for noise mitigation under this Section.*

Table 4.1 provides a summary of the number of single-family living units within the 2022 60 dB DNL noise contour. Table 4.2 provides the number of multi-family living units within the 2022 60 dB DNL noise contour. The spatial analysis was performed in Universal Transverse Mercator (UTM Zone 15).

**Table 4.1: Summary of 2022 Actual Contour Single-Family Unit Counts**

Year of Eligibility	City	Mitigation	DNL Contours					Total
			60-62	63-64	65-69	70-74	75+	
No Change in Eligibility	Bloomington	In 2022 Actual Contour	8	-	-	-	-	8
No Change in Eligibility	Eagan	In 2022 Actual Contour	185	38	-	-	-	223
No Change in Eligibility	Mendota Heights	In 2022 Actual Contour	-	1	-	-	-	1
No Change in Eligibility	Minneapolis	In 2022 Actual Contour	4,744	1,698	1,134	-	-	7,576
No Change in Eligibility	Richfield	In 2022 Actual Contour	424	211	-	-	-	635
<b>Grand Total</b>			<b>5,361</b>	<b>1,948</b>	<b>1,134</b>	<b>-</b>	<b>-</b>	<b>8,443</b>

Notes: Block-Intersect Methodology; Multi-Family = 4 or more units; As a result of parcel information updated in October 2022, unit counts may differ from previous reports.

Source: HNTB provided AEDT Contours, MAC analysis 2023

**Table 4.2 Summary of 2022 Actual Contour Multi-Family Unit Counts**

Year of Eligibility	City	Mitigation	DNL Contours				Total
			60-64	65-69	70-74	75+	
No Change in Eligibility	Bloomington	In 2022 Actual Contour previously mitigated	151	-	-	-	151
No Change in Eligibility	Eagan	In 2022 Actual Contour previously mitigated	-	-	-	-	-
No Change in Eligibility	Minneapolis	In 2022 Actual Contour previously mitigated	803	12	-	-	815
No Change in Eligibility	Richfield	In 2022 Actual Contour previously mitigated	236	-	-	-	236
<b>Grand Total</b>			<b>1,190</b>	<b>12</b>	<b>-</b>	<b>-</b>	<b>1,202</b>

Notes: Block-intersect Methodology; Multi-Family = 4 or more units; As a result of parcel information updated in October 2022, unit counts may differ from previous reports.

Source: HNTB provided AEDT Contours, MAC analysis 2023

## 4.2 2017-2024 PROGRAM ELIGIBILITY

2020 was the last year that homes could become eligible under the terms of the program. The 2022 Actual Contour does not qualify any additional homes for mitigation as outlined by the terms of the 2017-2024 Program. The MAC will continue to implement the mitigation program for homes that remain eligible from previous years' analyses.

## 4.3 2017-2024 PROGRAM MITIGATION STATUS

### *2017 Mitigation Program*

Single-family: In 2017 the MAC began the project to provide mitigation to 138 single-family homes that became eligible by virtue of the 2015 Actual Contour. As of January 19, 2023, 118 homes have been completed; 9 homes declined to participate; 6 homes were moved to the 2019 program; 6 homes were moved to the 2020 program.

Multi-family: Two multi-family structures were eligible to participate in the Multi-Family Mitigation Program in 2017. One property was completed and one property declined to participate.

The total cost for the 2017 Mitigation Program was \$2,442,685. The 2017 Mitigation Program is complete.

### *2018 Mitigation Program*

Single-family: In 2018, the MAC began the project to provide mitigation to 283 single-family homes that became eligible by virtue of the 2016 Actual Contour. As of January 19, 2023, 230 homes have been completed; 8 homes declined to participate while 21 homes were moved to the 2019 program; 16 homes were moved to the 2020 program.

Multi-family: The 2018 Mitigation Program did not include any multi-family properties.

The total cost for the 2018 Mitigation Program was \$7,294,999. The 2018 Mitigation Program is complete.

### *2019 Mitigation Program*

Single-family: In 2019, the MAC began the project to provide mitigation to 429 single-family homes that became eligible by virtue of the 2017 Actual Contour. As of January 19, 2023, including the homes transitioned from the 2017 and 2018 programs, 371 homes have been completed and 55 homes declined to participate.

Multi-family: The 2019 Mitigation Program did not include any multi-family properties.

The total cost for the 2019 Mitigation Program to date is \$13,333,018.

### *2020 Mitigation Program*

Single-family: In 2020, the MAC began the project to provide mitigation to 243 single-family homes that became eligible by virtue of the 2018 Actual Contour. As of January 19, 2023, including the homes

transitioned from the 2018 and 2019 programs; 247 homes have been completed; 13 homes are in the construction or pre-construction phase; 26 homes declined to participate.

Multi-family: The 2020 Mitigation Program does not include any multi-family properties.

The total cost for the 2020 Mitigation Program to date is \$9,243,291.

#### *2021 Mitigation Program*

Single-family: In 2021, the MAC began the project to provide mitigation to 16 single-family homes that became eligible by virtue of the 2019 Actual Contour. As of January 19, 2023, 13 homes have been completed; 2 homes are in the construction phase; 1 home declined to participate.

Multi-family: The 2021 Mitigation Program does not include any multi-family properties.

The total cost for the 2021 Mitigation Program to date is \$240,802.

#### **4.4 2025-2032 PROGRAM ELIGIBILITY**

There are no single- or multi-family homes that achieved the first year of eligibility as a result of the 2022 Actual Contour as outlined by the terms of the 2025-2032 Program.



Figure 4.1: 2022 Contours and Mitigation Program Eligibility

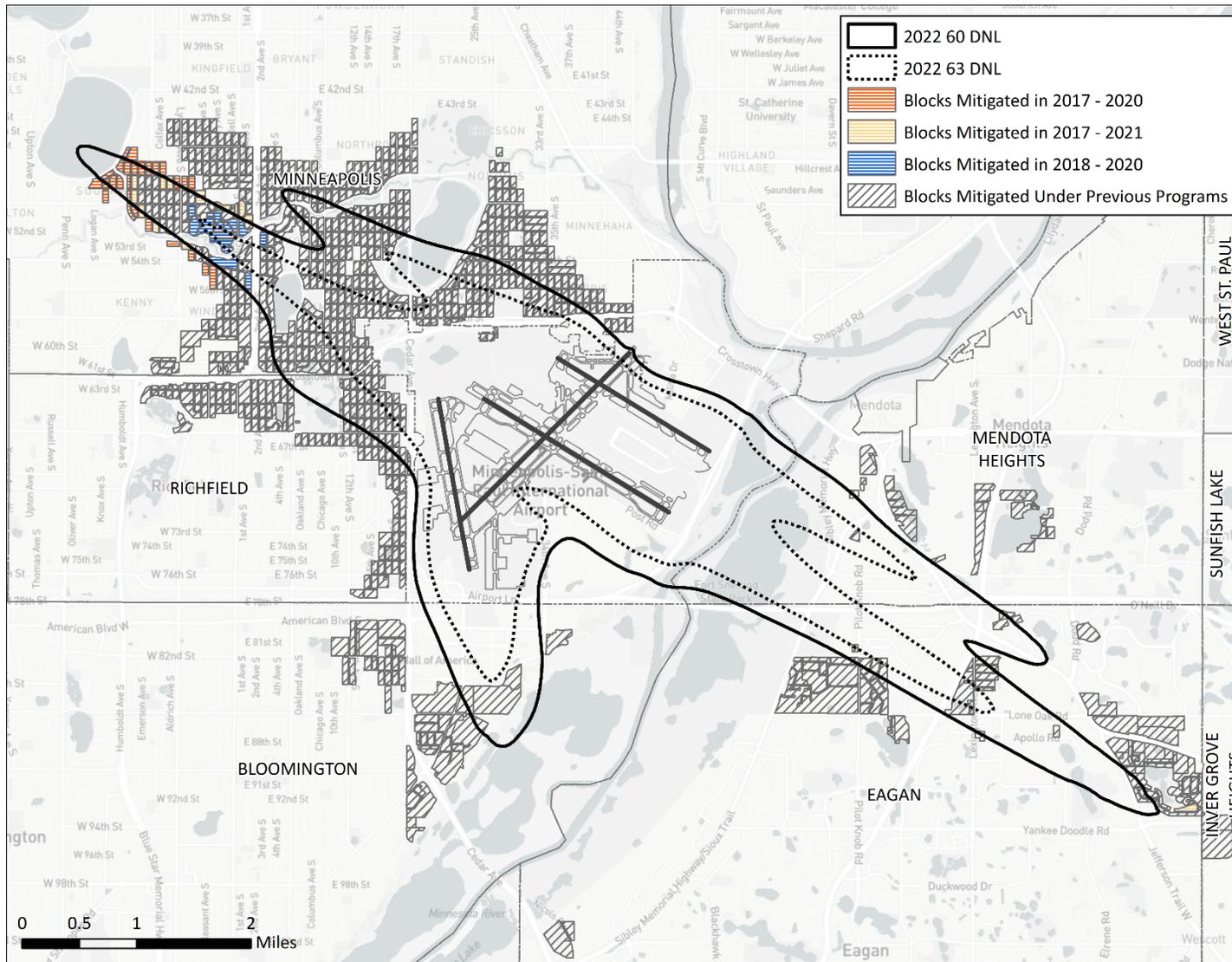


Figure 4.2: 2022 Contours and Mitigation Program Eligibility – City of Minneapolis

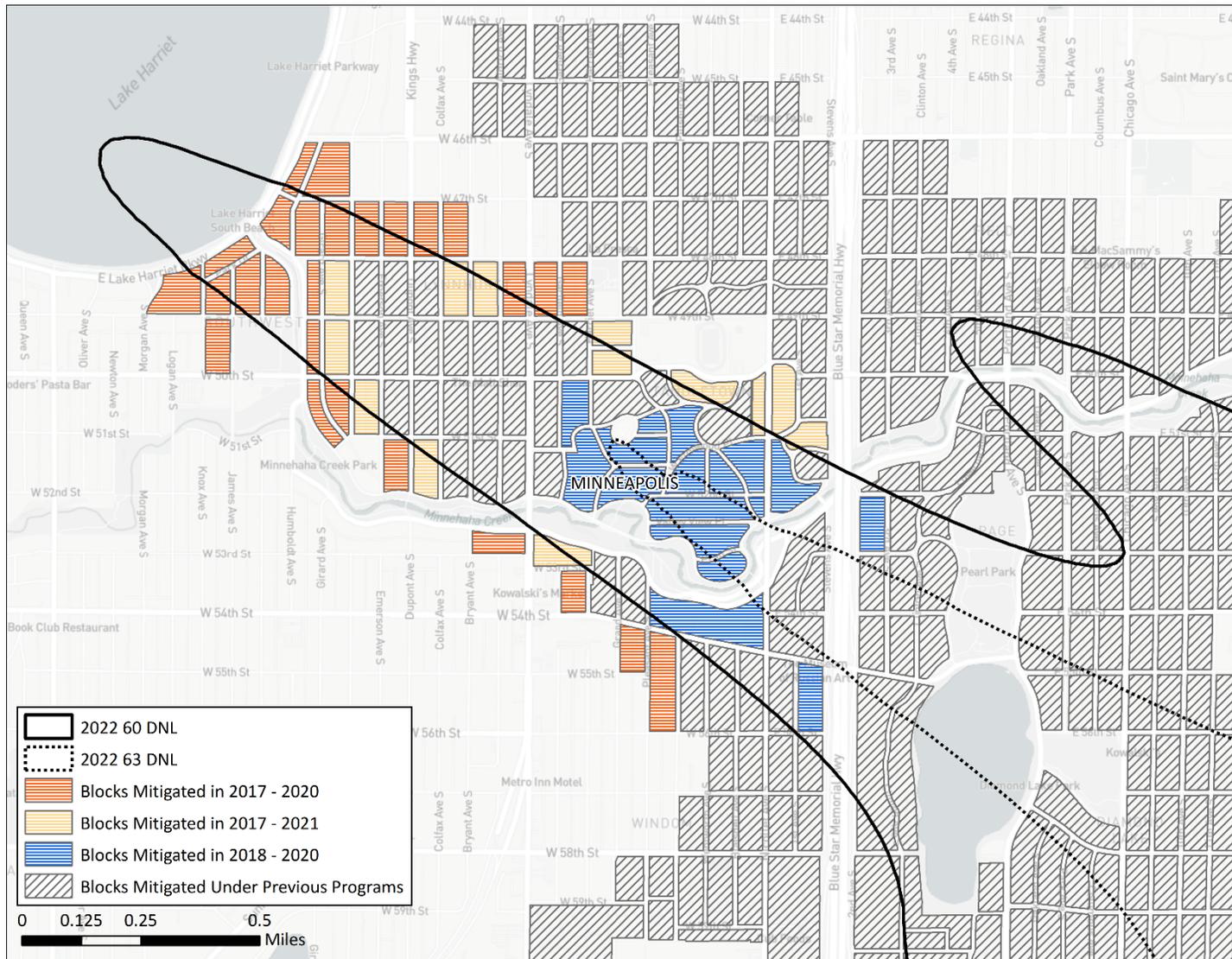
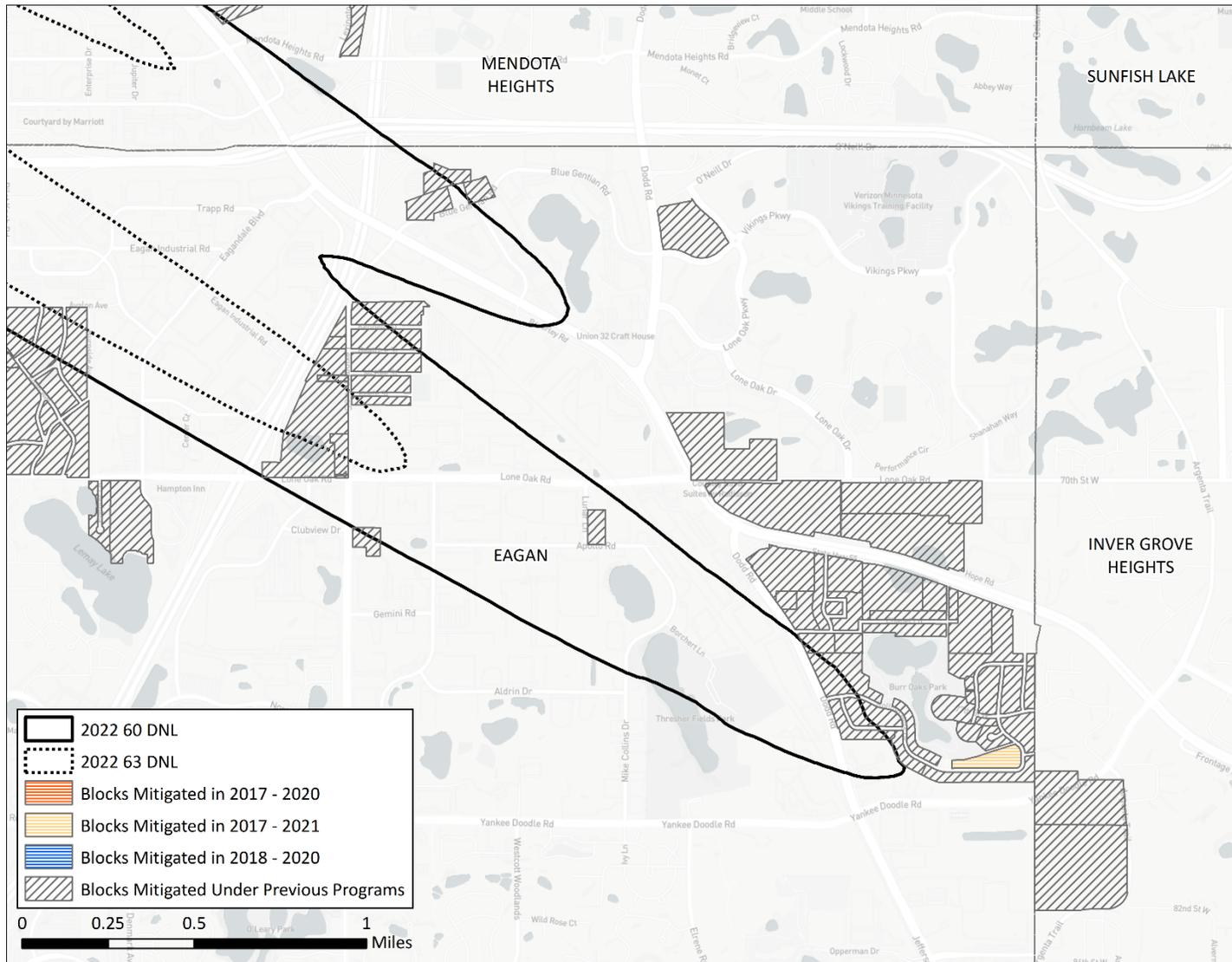


Figure 4.3: 2022 Contours and Mitigation Program Eligibility – City of Eagan





**Metropolitan Airports Commission**

MAC Community Relations Office and HNTB Corporation

6040 28<sup>th</sup> Avenue South · Minneapolis, MN 55450

[metroairports.org](http://metroairports.org)

## List of Appendices

<b>Appendix 1</b>	<b>Detailed Aircraft Fleet Mix Average Daily Operations</b>
<b>Appendix 2</b>	<b>2022 Model Flight Track and Use</b>
<b>Appendix 3</b>	<b>Noise Model Grid Point Maps</b>

## Appendix 1: Detailed Aircraft Fleet Mix Average Daily Operations

<i>Table</i>	<i>Content</i>	<i>Page</i>
<b>Table A1-1</b>	2022 Aircraft Fleet Mix Average Daily Operations	A-3
<b>Table A1-2</b>	Comparison of 2007 Forecast Fleet Mix and 2022 Actual Fleet Mix Average Daily Operations	A-8

Table A1-1: 2022 Aircraft Fleet Mix Average Daily Operations

Group	Aircraft Code	AEDT Aircraft (ANP)	AEDT Aircraft Description	2022 Day	2022 Night	2022 Total
Manufactured to be Stage 3+	A20N	A320-271N	Airbus A320-NEO	4.07	0.82	4.88
	A21N	A321-232	Airbus A321-NEO	0.73	0.03	0.76
	A306	A300-622R	Airbus A300F4-600 Series	0.16	0.21	0.37
	A319	A319-131	Airbus A319-100 Series	68.02	4.51	72.53
	A320	A320-211	Airbus A320-200 Series	37.48	2.57	40.05
	A320	A320-232	Airbus A320-200 Series	7.19	1.61	8.80
	A321	A321-232	Airbus A321-200 Series	87.45	11.29	98.74
	A332	A330-301	Airbus A330-200 Series	0.50	0.00	0.50
	A332	A330-343	Airbus A330-200 Series	0.71	0.02	0.72
	A333	A330-301	Airbus A330-300 Series	3.22	0.37	3.59
	A333	A330-343	Airbus A330-300 Series	1.57	0.22	1.78
	A339	A330-343	Airbus A330-300 Series	2.85	0.06	2.91
	A343	A340-211	Airbus A340-300 Series	0.01	-	0.01
	A350	A350-941	Airbus A350-1000 Series	0.01	-	0.01
	A359	A350-941	Airbus A350-900 series	0.64	0.05	0.70
	A35K	A350-941	Airbus A350-1000 Series	0.00	0.00	0.01
	ASTR	IA1125	Israel IAI-1125 Astra	0.01	-	0.01
	B38M	7378MAX	Boeing 737-8	2.61	1.28	3.89
	B39M	7378MAX	Boeing 737-9	1.34	0.15	1.49
	B712	717200	Boeing 717-200 Series	17.89	1.29	19.18
	B732	737N17	Boeing 737-200 Series	0.01	-	0.01
	B733	737300	Boeing 737-300 Series	0.08	0.01	0.09
	B734	737400	Boeing 737-400 Series	1.55	0.58	2.13
	B735	737500	Boeing 737-500 Series	0.04	0.00	0.04
	B737	737700	Boeing 737-700 Series	16.29	3.85	20.15
	B738	737800	Boeing 737-800 Series	75.73	23.81	99.53
	B739	737800	Boeing 737-900 Series	65.90	8.71	74.61
	B744	747400	Boeing 747-400 Series	0.38	0.19	0.57
	B748	7478	Boeing 747-8	0.54	0.30	0.84
	B752	757PW	Boeing 757-200 Series	14.53	3.47	18.00
	B752	757RR	Boeing 757-200 Series	1.91	1.73	3.65
	B753	757300	Boeing 757-300 Series	8.46	0.26	8.72
	B762	767CF6	Boeing 767-200 Series	0.06	0.04	0.11
	B762	767JT9	Boeing 767-200 Series Freighter	0.02	0.01	0.03
	B763	767300	Boeing 767-300 Series	1.34	0.90	2.24
	B763	767300	Boeing 767-300 ER Freighter	-	0.01	0.01
	B763	7673ER	Boeing 767-300 ER	0.32	0.02	0.34
	B763	7673ER	Boeing 767-300 ER Freighter	6.74	2.39	9.13
	B764	767400	Boeing 767-400 ER	0.48	0.02	0.50
	B772	777200	Boeing 777-200-ER	0.62	0.04	0.66
	B77L	777300	Boeing 777-200-LR	0.01	-	0.01
	B77W	7773ER	Boeing 777-300 ER	0.03	-	0.03
	B788	7878R	Boeing 787-8 Dreamliner	0.01	-	0.01
	B789	7879	Boeing 787-9 Dreamliner	0.30	0.05	0.35
	BCS1	737700	Airbus A220-100	6.95	0.23	7.18
	BCS3	737700	Airbus A220-300	7.10	0.49	7.59
	BE40	MU3001	Raytheon Beechjet 400	0.73	0.03	0.76
	C25A	CNA500	Cessna CitationJet CJ2 (Cessna 525A)	0.11	0.01	0.11
	C25B	CNA525C	Cessna CitationJet CJ3 (Cessna 525B)	0.48	0.02	0.50
	C25C	CNA525C	Cessna CitationJet CJ4 (Cessna 525C)	0.14	-	0.14
C25M	CNA525C	Cessna CitationJet CJ/CJ1 (Cessna 525)	0.04	0.00	0.04	

Group	Aircraft Code	AEDT Aircraft (ANP)	AEDT Aircraft Description	2022 Day	2022 Night	2022 Total
Manufactured to be Stage 3+	C501	CNA500	Cessna 501 Citation ISP	0.02	-	0.02
	C525	CNA525C	Cessna CitationJet CJ/CJ1 (Cessna 525)	0.12	0.00	0.13
	C550	CNA55B	Cessna 550 Citation Bravo	0.16	0.01	0.18
	C551	CNA55B	Cessna S550 Citation S/II	0.01	-	0.01
	C55B	CNA55B	Cessna 550 Citation Bravo	0.06	-	0.06
	C560	CNA560E	Cessna 560 Citation Encore	0.01	-	0.01
	C560	CNA560U	Cessna 560 Citation Ultra	0.24	0.01	0.25
	C560	CNA560XL	Cessna 560 Citation Excel	0.33	0.00	0.33
	C56X	CNA560XL	Cessna 560 Citation Excel	2.25	0.09	2.34
	C650	CIT3	Cessna 650 Citation III	0.15	0.03	0.18
	C680	CNA680	Cessna 680-A Citation Latitude	2.06	0.05	2.11
	C68A	CNA680	Cessna 680-A Citation Latitude	2.34	0.12	2.45
	C700	CNA680	Cessna 700 Citation Longitude	0.54	0.01	0.56
	C750	CNA750	Cessna 750 Citation X	1.27	0.05	1.33
	CL30	CL600	Bombardier Challenger 300	1.63	0.11	1.74
	CL35	CL600	Bombardier Challenger 350	3.22	0.14	3.36
	CL60	CL600	Bombardier Challenger 600	1.31	0.06	1.36
	CRJ2	CL600	Bombardier CRJ-200	62.69	4.70	67.40
	CRJ7	CRJ9-ER	Bombardier CRJ-700	12.74	0.93	13.66
	CRJ9	CRJ9-ER	Bombardier CRJ-900	91.56	7.00	98.56
	DC91	DC93LW	Boeing DC-9-10 Series	0.00	0.00	0.01
	E135	EMB145	Embraer ERJ135-LR	1.00	0.01	1.01
	E145	EMB145	Embraer ERJ145	2.30	0.02	2.32
	E170	EMB170	Embraer ERJ170-LR	3.71	0.37	4.09
	E190	EMB190	Embraer ERJ190	2.14	1.03	3.17
	E35L	EMB145	Embraer Legacy 600	0.11	0.01	0.11
	E550	CNA55B	Embraer Phenom 300 (EMB-505)	0.10	0.01	0.10
	E55P	CNA55B	Embraer Phenom 300 (EMB-505)	1.91	0.09	2.00
	E75L	EMB175	Embraer ERJ175	66.53	4.04	70.57
	E75S	EMB175	Embraer ERJ175	9.53	0.54	10.07
	F2TH	CNA750	Dassault Falcon 2000	0.76	0.06	0.82
	F900	FAL900EX	Dassault Falcon 900	1.56	0.06	1.62
	FA10	LEAR35	Dassault Falcon 10	0.01	-	0.01
	FA50	FAL900EX	Dassault Falcon 50	0.19	-	0.19
	FA7X	GIV	Falcon 7X	0.21	0.01	0.22
	FA8X	GIV	Dassault Falcon 8X	0.01	-	0.01
	G150	IA1125	Gulfstream G150	0.05	0.00	0.05
	G280	CL601	Gulfstream G280	1.86	0.07	1.94
	GA5C	GV	Gulfstream Aerospace Gulfstream G500 (G-7)	0.06	0.01	0.07
	GA6C	GV	Gulfstream G600	0.04	0.00	0.04
	GALX	CNA750	Gulfstream G200	0.38	0.01	0.39
	GL5T	BD-700-1A11	Bombardier Global 5000	0.15	0.01	0.16
	GL7T	BD-700-1A10	Bombardier Global 7500	0.05	0.01	0.06
	GLEX	BD-700-1A10	Bombardier Global Express	0.43	0.04	0.47
	GLF4	GIV	Gulfstream IV-SP	0.89	0.08	0.97
	GLF5	GV	Gulfstream G550	1.30	0.14	1.43
	GLF6	G650ER	Gulfstream G650ER	0.79	0.07	0.86
	H25A	LEAR35	Hawker HS-125 Series 1	0.01	-	0.01
	H25B	LEAR35	Raytheon Hawker 800	0.73	0.04	0.77
	H25C	LEAR35	Raytheon Hawker 1000	0.07	0.01	0.08
HA4T	CNA750	Raytheon Hawker 4000 Horizon	0.02	0.00	0.02	
HDJT	CNA680	Honda HA-420 Hondajet	0.08	0.01	0.08	
HDJT	MU3001	Honda HA-420 Hondajet	0.08	0.01	0.08	

Group	Aircraft Code	AEDT Aircraft (ANP)	AEDT Aircraft Description	2022 Day	2022 Night	2022 Total
Manufactured to be Stage 3+	J328	CNA750	Dornier 328 Jet	4.07	0.01	4.08
	LJ31	LEAR35	Bombardier Learjet 31	0.01	-	0.01
	LJ35	LEAR35	Bombardier Learjet 35	0.22	0.02	0.24
	LJ40	LEAR35	Bombardier Learjet 40	0.05	-	0.05
	LJ45	LEAR35	Bombardier Learjet 45	0.72	0.05	0.77
	LJ55	LEAR35	Bombardier Learjet 55	0.05	0.01	0.06
	LJ60	LEAR35	Bombardier Learjet 60	0.47	0.02	0.49
	LJ70	LEAR35	Bombardier Learjet 70	0.02	0.00	0.02
	LJ75	LEAR35	Bombardier Learjet 75	0.01	-	0.01
	MD11	MD11GE	Boeing MD-11	0.26	0.10	0.36
	MD11	MD11PW	Boeing MD-11	0.35	0.19	0.54
	MD81	MD81	Boeing MD-81	0.03	0.01	0.03
	MD83	MD83	Boeing MD-83	0.01	-	0.01
	PC24	CNA55B	Pilatus PC-24	0.11	0.00	0.12
	PRM1	CNA55B	Raytheon Premier I	0.06	-	0.06
	SB20	HS748A	Saab 2000	0.05	0.01	0.06
	SBR1	LEAR35	Rockwell Sabreliner 65	0.01	-	0.01
WW24	IA1125	Israel IAI-1124 Westwind I	0.01	-	0.01	
<b>Manufactured to be Stage 3+ Total</b>				<b>733.59</b>	<b>92.11</b>	<b>825.71</b>

Group	Aircraft Code	AEDT Aircraft (ANP)	AEDT Aircraft Description	2022 Day	2022 Night	2022 Total
Hushkit	B722	727EM2	Boeing 727-200 Series	0.01	0.01	0.01
	FA20	FAL20	Dassault Falcon 20-D	0.06	0.01	0.06
<b>Hushkit Total</b>				<b>0.06</b>	<b>0.01</b>	<b>0.07</b>

Group	Aircraft Code	AEDT Aircraft (ANP)	AEDT Aircraft Description	2022 Day	2022 Night	2022 Total
Military	A400	C130	AIRBUS A-400M	0.01	-	0.01
	BE55	T42	Raytheon Beech 55 Baron	0.02	-	0.02
	C130	C130	Lockheed C-130 Hercules	0.27	0.01	0.28
	C130	C130E	Lockheed C-130 Hercules	0.27	0.01	0.28
	C17	C17	Boeing C-17A	0.03	-	0.03
	C30J	C130AD	Lockheed C-130 Hercules ANP:C130AD	0.02	-	0.02
<b>Military Total</b>				<b>0.62</b>	<b>0.02</b>	<b>0.64</b>

Group	Aircraft Code	AEDT Aircraft (ANP)	AEDT Aircraft Description	2022 Day	2022 Night	2022 Total
Microjet	C510	CNA510	CESSNA CITATION 510	0.06	-	0.06
	E50P	CNA510	Embraer Phenom 100 (EMB-500)	0.01	-	0.01
	E545	CNA510	Embraer Legacy 450 (EMB-545)	0.51	0.02	0.52
	EA50	ECLIPSE500	Eclipse 500 / PW610F	0.17	0.01	0.18
	SF50	CNA510	CIRRUS SF-50 Vision	0.05	0.00	0.05
<b>Microjet Total</b>				<b>0.79</b>	<b>0.03</b>	<b>0.82</b>

Group	Aircraft Code	AEDT Aircraft (ANP)	AEDT Aircraft Description	2022 Day	2022 Night	2022 Total
Propeller	AT43	DHC8	ATR 42-300	1.11	0.13	1.25
	AT73	ATR72-212A	ATR 72-500	0.10	0.01	0.11
	B190	1900D	Raytheon Beech 1900-D	1.81	0.04	1.85
	B350	DHC6	Raytheon Super King Air 300	0.57	0.04	0.61
	BE10	DHC6	Raytheon King Air 100	0.01	-	0.01
	BE20	DHC6	Raytheon Super King Air 200	0.37	0.04	0.41
	BE30	DHC6	Raytheon Super King Air 300	0.38	0.14	0.53
	BE33	GASEPV	Beechcraft Bonanza 33 (FAS)	0.01	-	0.01
	BE35	GASEPV	Beechcraft Bonanza 35 (FAS)	0.03	-	0.03
	BE36	GASEPV	Raytheon Beech Bonanza 36	0.04	0.00	0.05
	BE58	BEC58P	Raytheon Beech Baron 58	0.04	0.00	0.04
	BE65	BEC58P	Beechcraft Queen Air 65/70/80 (FAS)	6.61	0.22	6.83
	BE99	DHC6	Raytheon Beech 99	3.65	0.09	3.74
	BE9L	DHC6	Raytheon King Air 90	0.18	0.03	0.21
	BE9T	DHC6	Raytheon King Air 90	0.01	0.01	0.01
	C172	CNA172	Cessna 172 Skyhawk	0.03	0.02	0.05
	C182	CNA182	Cessna 182	0.01	-	0.01
	C185	CNA206	Cessna 185 Skywagon	0.01	-	0.01
	C206	CNA206	Cessna 206	0.02	-	0.02
	C208	CNA208	Cessna 208 Caravan	0.03	0.01	0.03
	C210	GASEPV	Cessna 210 Centurion	0.01	0.01	0.02
	C310	BEC58P	Cessna 310	0.06	0.02	0.08
	C320	BEC58P	Cessna 320 (FAS)	0.01	-	0.01
	C340	BEC58P	Cessna 340	0.03	-	0.03
	C402	BEC58P	Cessna 402	0.06	0.01	0.08
	C414	BEC58P	Cessna 414	0.01	-	0.01
	C421	BEC58P	Cessna 421 Piston	0.04	-	0.04
	C425	CNA441	Cessna 425 Conquest I	0.03	0.00	0.03
	C441	CNA441	Cessna 441 Conquest II	0.06	0.00	0.07
	C82R	CNA182	Cessna 182 R (FAS)	0.01	-	0.01
	E110	DHC6	Embraer EMB110 Bandeirante	0.01	-	0.01
	E120	EMB120	Embraer EMB120 Brasilia	0.04	0.01	0.05
	EPIC	CNA208	EPIC LT/Dynasty	0.01	-	0.01
	M20P	GASEPV	Mooney M20-K	0.02	-	0.02
	M20T	GASEPV	Mooney M20-K	0.02	-	0.02
	MU2	DHC6	Mitsubishi MU-2	0.01	-	0.01
	P180	DHC6	Piaggio P.180 Avanti	0.02	-	0.02
	P28B	GASEPF	Piper PA-28 Cherokee Series	0.01	-	0.01
	P28R	GASEPF	Piper PA-28 Cherokee Series	0.01	-	0.01
	P32R	GASEPV	Piper PA-32 Cherokee Six	0.02	-	0.02
	P46T	GASEPV	Piper PA46-TP Meridian	0.02	-	0.02
	PA24	GASEPV	Piper PA-24 Comanche	0.02	-	0.02
	PA28	PA28	Piper PA-28 Cherokee Series	0.02	0.01	0.03
	PA31	BEC58P	Piper PA-31 Navajo	0.01	-	0.01
	PA46	PA31	Piper PA46 (Piston)	0.01	-	0.01
	PAT4	CNA441	Piper PA-31T Cheyenne	0.01	-	0.01
	PAY2	CNA441	Piper PA-31T Cheyenne	0.00	0.03	0.03
	PC12	CNA208	Pilatus PC-12	0.49	0.03	0.52
	S22T	COMSEP	Cirrus SR22 Turbo (FAS)	0.05	-	0.05
	SF34	SF340	Saab 340-A	0.01	-	0.01
SR22	COMSEP	Cirrus SR20	0.21	0.01	0.22	
STL5	GASEPF	Stinson (FAS)	0.01	-	0.01	

Group	Aircraft Code	AEDT Aircraft (ANP)	AEDT Aircraft Description	2022 Day	2022 Night	2022 Total
Propeller	SW4	DHC6	Fairchild SA-227-AC Metro III	5.13	0.11	5.25
	TBM7	GASEPV	EADS Socata TBM-700	0.04	0.01	0.04
	TBM8	CNA441	SOCATA TBM 850	0.01	-	0.01
	TBM9	CNA208	DAHER TBM 900/930	0.06	-	0.06
<b>Propeller Total</b>				<b>21.59</b>	<b>1.03</b>	<b>22.61</b>

Group	Aircraft Code	AEDT Aircraft (ANP)	AEDT Aircraft Description	2022 Day	2022 Night	2022 Total
Helicopter	A109	A109	Agusta A-109	-	0.00	0.00
	AS50	SA350D	Aerospatiale SA-350D Astar (AS-350)	0.00	-	0.00
	B412	S76	Sikorsky S-76 Spirit	0.01	-	0.01
	B429	B429	Bell 429	0.02	0.03	0.05
	H120	SA341G	Eurocopter EC 120	0.02	-	0.02
	H269	H500D	Schweizer S269D/330	0.00	-	0.00
	R44	R44	Robinson R44 Raven / Lycoming O-540-F1B5	0.01	-	0.01
	S92	S70	Sikorsky S-92	0.01	-	0.01
<b>Helicopter Total</b>				<b>0.07</b>	<b>0.03</b>	<b>0.10</b>

Group	2022 Day	2022 Night	2022 Total
Manufactured to be Stage 3+	733.59	92.11	825.71
Hushkit	0.06	0.01	0.07
Microjet	0.79	0.03	0.82
Military	0.62	0.02	0.64
Propeller	21.59	1.03	22.61
Helicopter	0.07	0.03	0.10
<b>Total</b>	<b>756.73</b>	<b>93.23</b>	<b>849.96</b>

**Table A1-2: Comparison of 2007 Forecast Fleet Mix and 2022 Actual Fleet Mix Average Daily Operations**

Group	Aircraft Type	Day		Night		Total		Difference
		2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	
Helicopter	A109	0.00	-	0.00	0.00	0.00	0.00	0.00
	SA350D	0.00	0.00	0.00	-	0.00	0.00	0.00
	S76	0.00	0.01	0.00	-	0.00	0.01	0.01
	B429	0.00	0.02	0.00	0.03	0.00	0.05	0.05
	SA341G	0.00	0.02	0.00	-	0.00	0.02	0.02
	H500D	0.00	0.00	0.00	-	0.00	0.00	0.00
	R44	0.00	0.01	0.00	-	0.00	0.01	0.01
S70	0.00	0.01	0.00	-	0.00	0.01	0.01	
<b>Helicopter Total</b>		<b>0.00</b>	<b>0.07</b>	<b>0.00</b>	<b>0.03</b>	<b>0.00</b>	<b>0.10</b>	<b>0.10</b>

Group	Aircraft Type	Day		Night		Total		Difference
		2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	
Hushkit Stage 3 Jet	727EM2	8.00	0.01	6.40	0.01	14.40	0.01	-14.39
	DC9Q	245.30	-	15.30	-	260.50	-	-260.50
	FAL20	0.00	0.06	0.00	0.01	0.00	0.06	0.06
<b>Hushkit Stage 3 Jet Total</b>		<b>253.30</b>	<b>0.06</b>	<b>21.70</b>	<b>0.01</b>	<b>274.90</b>	<b>0.07</b>	<b>(274.83)</b>

Group	Aircraft Type	Day		Night		Total		Difference
		2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	
Military	C130	0.00	0.28	0.00	0.01	0.00	0.29	0.29
	C130AD	0.00	0.02	0.00	-	0.00	0.02	0.02
	C-130E	7.80	0.27	0.20	0.01	8.00	0.27	-7.73
	C17	0.00	0.03	0.00	-	0.10	0.03	-0.07
	C5	0.10	-	0.00	-	0.10	-	-0.10
	F16GE	0.10	-	0.00	-	0.10	-	-0.10
	T37	0.10	-	0.00	-	0.10	-	-0.10
	T38	0.10	-	0.00	-	0.10	-	-0.10
T-42	0.00	0.02	0.00	-	0.00	0.02	0.02	
<b>Military Total</b>		<b>8.20</b>	<b>0.62</b>	<b>0.20</b>	<b>0.02</b>	<b>8.50</b>	<b>0.64</b>	<b>(7.86)</b>

Group	Aircraft Type	Day		Night		Total		Difference
		2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	
Microjet	CNA510	0.00	0.06	0.00	-	0.00	0.06	0.06
	EMB-500	0.00	0.01	0.00	-	0.00	0.01	0.01
	EMB-545	0.00	0.51	0.00	0.02	0.00	0.52	0.52
	ECLIPSE500	0.00	0.17	0.00	0.01	0.00	0.18	0.18
	SF-50	0.00	0.05	0.00	0.00	0.00	0.05	0.05
<b>Microjet Total</b>		<b>0.0</b>	<b>0.79</b>	<b>0.0</b>	<b>0.03</b>	<b>0.0</b>	<b>0.82</b>	<b>0.82</b>

Group	Aircraft Type	Day		Night		Total		Difference
		2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	
Propeller	1900D	0.00	1.81	0.00	0.04	0.00	1.85	1.85
	ATR72-212A	0.00	0.10	0.00	0.01	0.00	0.11	0.11
	BEC58	14.30	0.00	4.70	0.00	19.00	0.00	-19.00

Group	Aircraft Type	Day		Night		Total		Difference
		2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	
Propeller	BEC58P	0.00	6.87	0.00	0.25	0.00	7.12	7.12
	ATR72-212A	0.00	0.10	0.00	0.01	0.00	0.11	0.11
	CNA172	0.00	0.03	0.00	0.02	0.00	0.05	0.05
	1900D	0.00	1.81	0.00	0.04	0.00	1.85	1.85
	CNA182	0.00	0.02	0.00	-	0.00	0.02	0.02
	CNA206	0.00	0.03	0.00	-	0.00	0.03	0.03
	CNA208	0.00	0.58	0.00	0.04	0.00	0.62	0.62
	CNA441	0.00	0.11	0.00	0.04	0.00	0.15	0.15
	COMSEP	0.00	0.26	0.00	0.01	0.00	0.27	0.05
	DHC6	22.50	10.34	4.40	0.46	26.80	10.80	-16.00
	DHC6QP	0.00	-	0.00	-	0.00	-	-
	DHC8	0.00	1.11	0.00	0.13	0.00	1.25	1.25
	EMB120	0.00	0.04	0.00	0.01	0.00	0.05	0.05
	FK27	0.10	-	0.00	-	0.10	-	-0.10
	GASEPF	1.30	0.02	0.30	-	1.60	0.02	-1.58
	GASEPV	3.70	0.24	0.50	0.02	4.30	0.25	-4.05
	PA28	0.00	0.02	0.00	0.01	0.00	0.03	0.03
PA31	0.00	0.01	0.00	-	0.00	0.01	0.01	
SF340	93.30	0.01	5.90	-	99.20	0.01	-99.19	
<b>Propeller Total</b>		<b>135.2</b>	<b>21.59</b>	<b>15.8</b>	<b>1.25</b>	<b>151</b>	<b>22.62</b>	<b>(128.38)</b>

Group	Aircraft Type	Day		Night		Total		Difference
		2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	
Manufactured to be Stage 3+	7478	0.00	0.54	0.00	0.30	0.00	0.84	0.84
	7879	0.00	0.30	0.00	0.05	0.00	0.35	0.35
	717200	7.30	17.89	1.00	1.29	8.30	19.18	10.88
	737300	48.20	0.08	3.50	0.01	51.70	0.09	-51.61
	737400	0.10	1.55	0.00	0.58	0.10	2.13	2.03
	737500	5.70	0.04	0.50	0.00	6.20	0.04	-6.16
	737700	7.80	30.34	0.50	4.57	8.30	34.91	26.61
	737800	65.50	141.63	12.60	32.51	78.10	174.14	96.04
	747400	1.90	0.38	0.20	0.19	2.10	0.57	-1.53
	757300	34.10	8.46	1.10	0.26	35.10	8.72	-26.38
	767300	0.00	1.34	0.00	0.91	0.00	2.25	2.25
	767400	0.00	0.48	0.00	0.02	0.00	0.50	0.50
	777200	0.00	0.62	0.00	0.04	0.00	0.66	0.66
	777300	0.00	0.01	0.00	0.00	0.00	0.01	0.01
	7378MAX	0.00	2.61	0.00	1.28	0.00	3.89	3.89
	7379MAX	0.00	1.34	0.00	0.15	0.00	1.49	1.49
	737N17	0.00	0.01	0.00	0.00	0.00	0.01	0.01
	757PW	88.40	14.53	8.60	3.47	97.10	18.00	-79.10
	757RR	0.00	1.91	0.00	1.73	0.00	3.65	3.65
	7673ER	0.00	7.06	0.00	2.41	0.00	9.47	9.47
	767CF6	0.00	0.06	0.00	0.04	0.00	0.11	0.11
	767JT9	0.00	0.02	0.00	0.01	0.00	0.03	0.03
	7773ER	0.00	0.03	0.00	0.00	0.00	0.03	0.03
	7878R	0.00	0.01	0.00	0.00	0.00	0.01	0.01
	A300-622R	4.80	0.16	4.20	0.21	9.10	0.37	-8.73
	A319-131	149.10	68.02	3.90	4.51	153.00	72.53	-80.47
	A320-211	173.40	37.48	16.50	2.57	189.90	40.05	-149.85
	A320-232	0.00	7.19	0.00	1.61	0.00	8.80	8.80
	A320-271N	0.00	4.07	0.00	0.82	0.00	4.88	4.88
	A321-232	0.00	88.19	0.00	11.31	0.00	99.50	99.50

Group	Aircraft Type	Day		Night		Total		Difference
		2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	2007 Forecast	2022 Actual	
Manufactured to be Stage 3+	A330-301	6.2	3.72	0	0.37	6.2	4.09	-2.11
	A330-343	0	5.12	0	0.29	0	5.41	5.41
	A340-211	0.00	0.01	0.00	0.01	0.00	0.01	0.01
	A350-941	0	0.65	0	0.06	0	0.71	0.71
	BD-700-1A10	0	0.48	0	0.04	0	0.52	0.52
	BD-700-1A11	0	0.15	0	0.01	0	0.16	0.16
	CIT3	0	0.15	0	0.03	0	0.18	0.18
	CL600	0	68.86	0	5.01	0	73.86	73.86
	CL601	264.1	1.86	14.7	0.07	278.8	1.94	-276.86
	CNA500	1.4	0.12	0.1	0.01	1.4	0.13	-1.27
	CNA525C	0	0.78	0	0.02	0	0.80	0.80
	CNA55B	0	2.41	0	0.11	0	2.53	2.53
	CNA560E	0	0.01	0		0	0.01	0.01
	CNA560U	0	0.24	0	0.01	0	0.25	0.25
	CNA560XL	0	2.59	0	0.09	0	2.67	2.67
	CNA680	0	5.02	0	0.18	0	5.20	5.20
	CNA750	4.6	6.50	0.3	0.14	4.9	6.64	1.74
	CRJ9-ER	0	104.30	0	7.93	0	112.23	112.23
	DC93LW	0	0.00	0	0.00	0	0.01	0.01
	EMB145	45.3	3.41	0.2	0.04	45.5	3.45	-42.05
	EMB170	0	3.71	0	0.37	0	4.09	4.09
	EMB175	0	76.07	0	4.58	0	80.65	80.65
	EMB190	0	2.14	0	1.03	0	3.17	3.17
	FAL900EX	0	1.75	0	0.06	0	1.81	1.81
	G650ER	0	0.79	0	0.07	0	0.86	0.86
	GIV	2.6	1.10	0.2	0.09	2.8	1.19	-1.61
	GV	0.8	1.39	0.1	0.15	0.9	1.54	0.64
	HS748A	0	0.05	0	0.01	0	0.06	0.06
	IA1125	0	0.06	0	0.00	0	0.07	0.07
	LEAR35	26	2.37	2.3	0.14	28.4	2.52	-25.88
	MD11GE	0.3	0.26	0.4	0.10	0.7	0.36	-0.34
	MD11PW	0	0.35	0	0.19	0	0.54	0.54
	MD81	0.5	0.03	0	0.01	0.6	0.03	-0.57
	MD83	17	0.01	1.6	-	18.6	0.01	-18.59
	MU3001	0	0.81	0	0.04	0	0.84	0.84
	737900	5.70	0.00	0.50	0.00	6.20	0.00	-6.20
	767200	1.20	0.00	0.50	0.00	1.70	0.00	-1.70
	A310-304	1.40	0.00	1.30	0.00	2.70	0.00	-2.70
	A318	5.70	0.00	0.50	0.00	6.20	0.00	-6.20
	A340	2.10	0.00	0.00	0.00	2.10	0.00	-2.10
	ASTR	2.30	0.00	0.20	0.00	2.50	0.00	-2.50
	BA46	74.30	0.00	2.20	0.00	76.50	0.00	-76.50
BEC400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CNA650	4.90	0.00	0.60	0.00	5.50	0.00	-5.50	
DC1010	9.60	0.00	3.80	0.00	13.40	0.00	-13.40	
DC870	0.00	0.00	1.40	0.00	1.40	0.00	-1.40	
FAL20A	1.00	0.00	0.70	0.00	1.70	0.00	-1.70	
L101	0.60	0.00	0.20	0.00	0.80	0.00	-0.80	
MU300	7.20	0.00	0.60	0.00	7.80	0.00	-7.80	
SBR2	0.40	0.00	0.00	0.00	0.40	0.00	-0.40	
<b>Manufactured to be Stage 3+ Total</b>		<b>1,071.50</b>	<b>733.59</b>	<b>85.00</b>	<b>92.11</b>	<b>1,156.50</b>	<b>825.71</b>	<b>(330.79)</b>
<b>Grand Total</b>		<b>1,468.2</b>	<b>756.73</b>	<b>122.7</b>	<b>93.23</b>	<b>1,590.9</b>	<b>849.96</b>	<b>(740.94)</b>

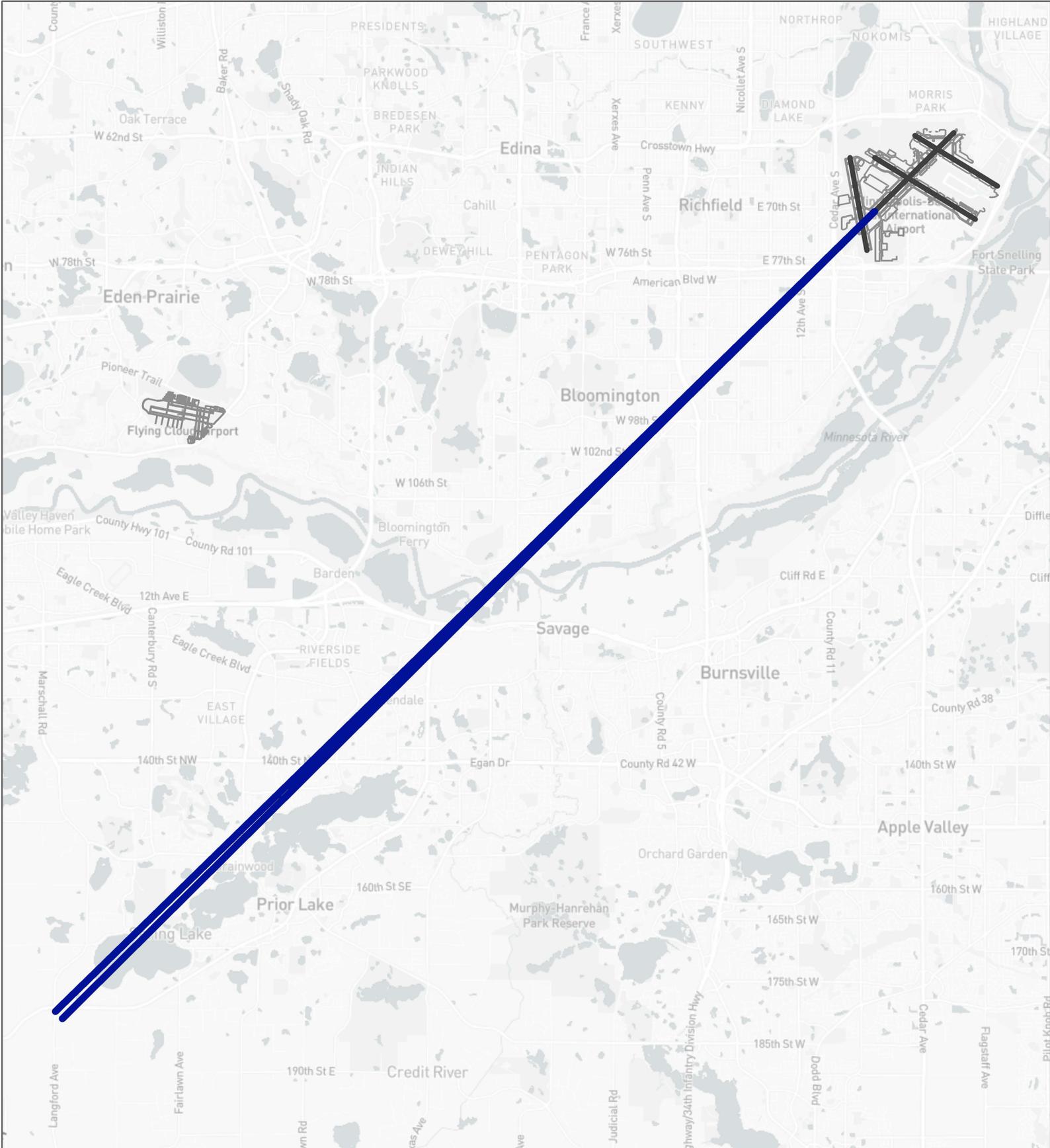
## Appendix 2: 2022 Model Flight Tracks and Use

<b>Figure</b>	<b>Content</b>	<b>Page</b>
<b>Figure 2.1</b>	Runway 4 Arrivals	A-12
<b>Figure 2.2</b>	Runway 12L Arrivals	A-13
<b>Figure 2.3</b>	Runway 12R Arrivals	A-14
<b>Figure 2.4</b>	Runway 17 Arrivals	A-15
<b>Figure 2.5</b>	Runway 22 Arrivals	A-16
<b>Figure 2.6</b>	Runway 30L Arrivals	A-17
<b>Figure 2.7</b>	Runway 30R Arrivals	A-18
<b>Figure 2.8</b>	Runway 35 Arrivals	A-19
<b>Figure 2.9</b>	Runway 4 Departures	A-20
<b>Figure 2.10</b>	Runway 12L Departures	A-21
<b>Figure 2.11</b>	Runway 12R Departures	A-22
<b>Figure 2.12</b>	Runway 17 Departures	A-23
<b>Figure 2.13</b>	Runway 22 Departures	A-24
<b>Figure 2.14</b>	Runway 30L Departures	A-25
<b>Figure 2.15</b>	Runway 30R Departures	A-26
<b>Figure 2.16</b>	Runway 35 Departures	A-27

# 2022 AEDT TRACKS - ARRIVAL RUNWAY 4

Overall Use Percentage

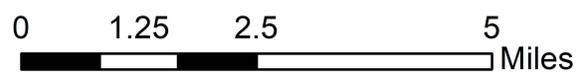
Figure 2.1



## AEDT Track Use Percentage

- < 5%
- 5 - 10%
- 10 - 20%
- 20 - 30%
- 30 - 50%
- > 50%

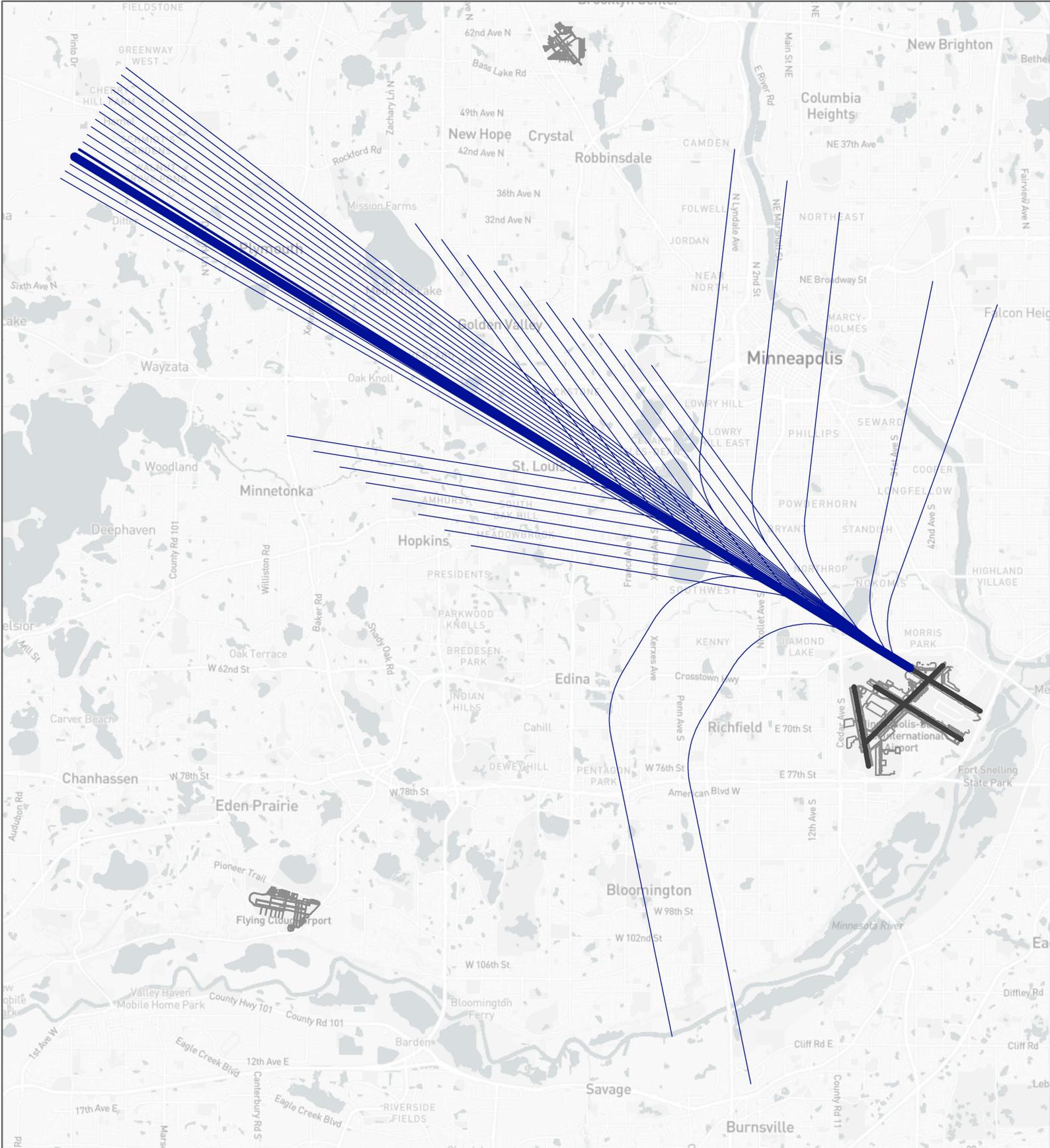
A-12



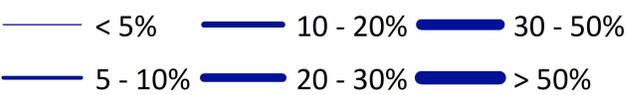
# 2022 AEDT TRACKS - ARRIVAL RUNWAY 12L

Overall Use Percentage

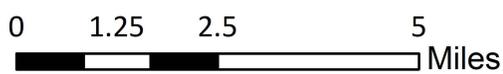
Figure 2.2



## AEDT Track Use Percentage



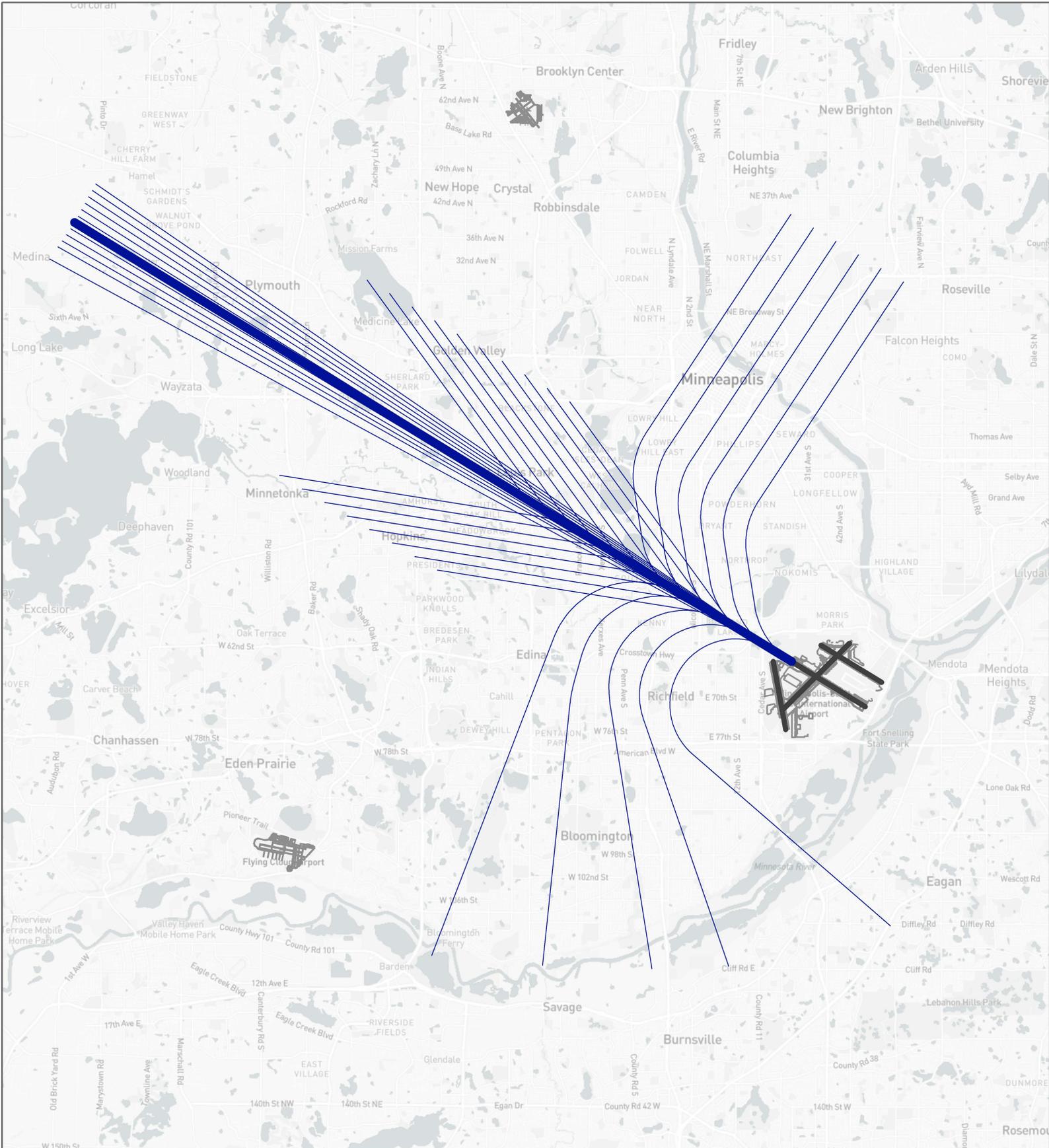
A-13



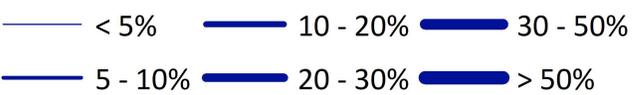
# 2022 AEDT TRACKS - ARRIVAL RUNWAY 12R

Overall Use Percentage

Figure 2.3



## AEDT Track Use Percentage



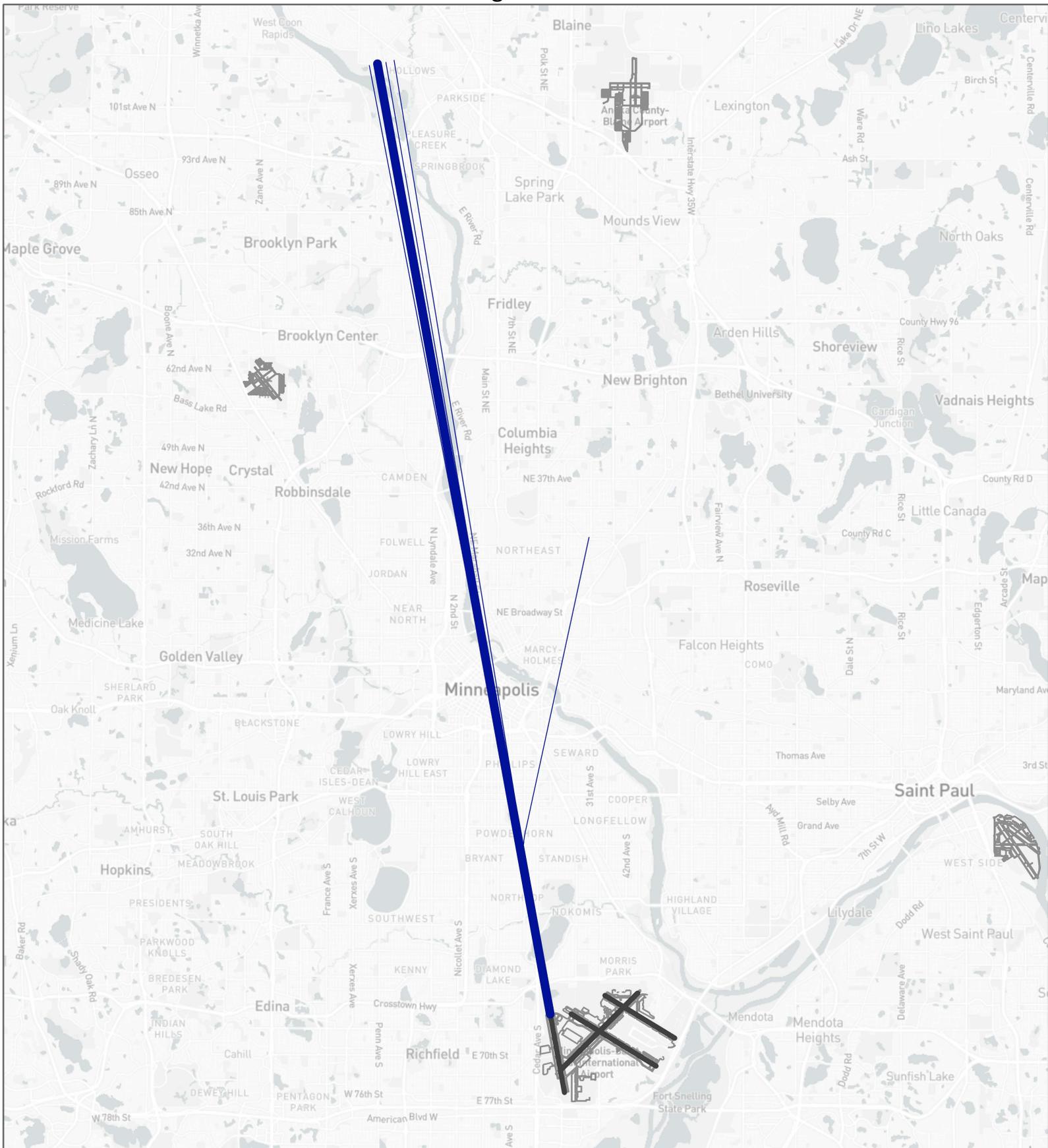
A-14



# 2022 AEDT TRACKS - ARRIVAL RUNWAY 17

Overall Use Percentage

Figure 2.4



## AEDT Track Use Percentage

< 5%    10 - 20%    30 - 50%

5 - 10%    20 - 30%    > 50%

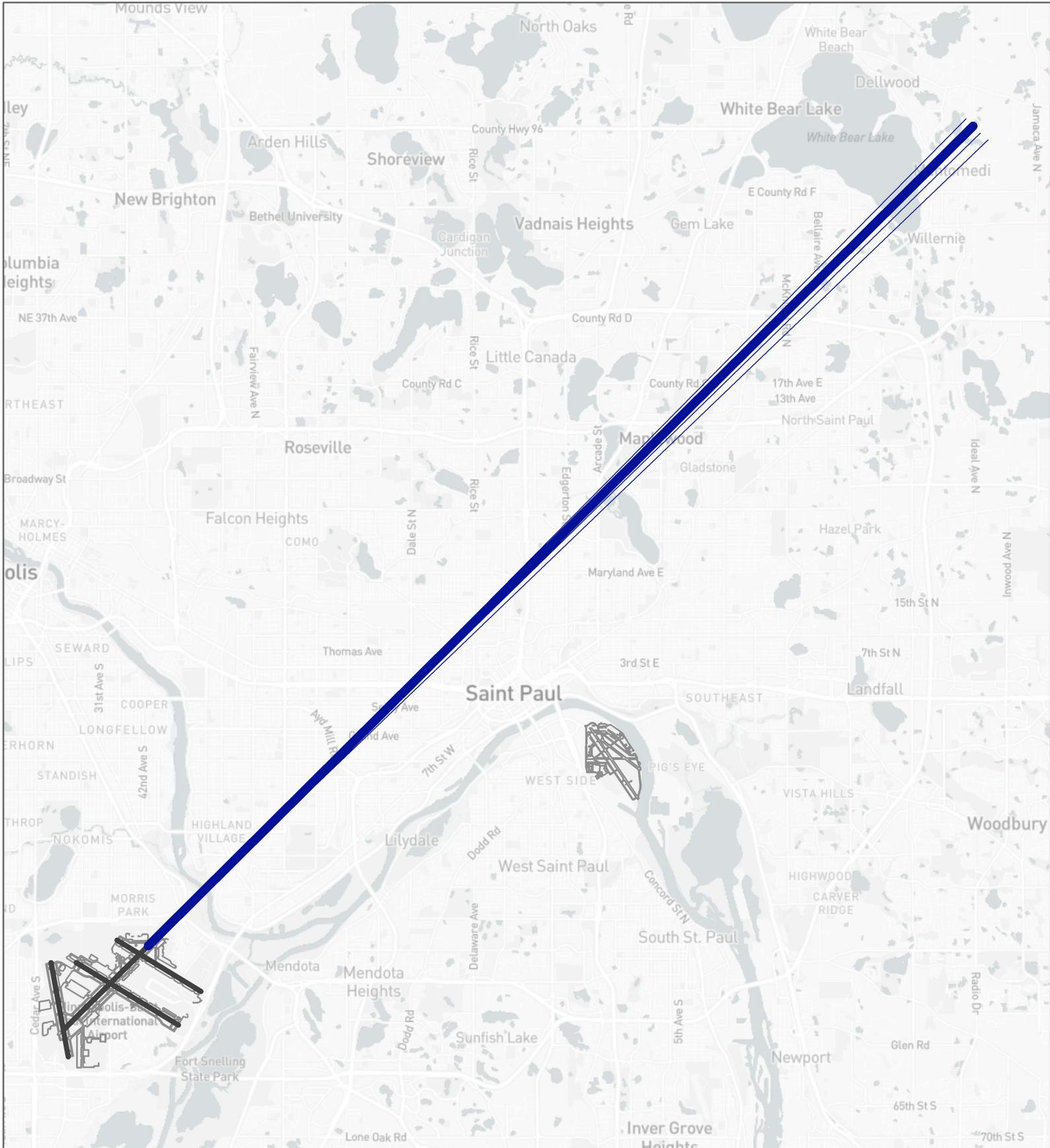
A-15



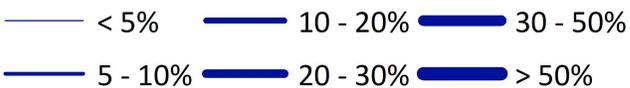
# 2022 AEDT TRACKS - ARRIVAL RUNWAY 22

Overall Use Percentage

Figure 2.5



## AEDT Track Use Percentage



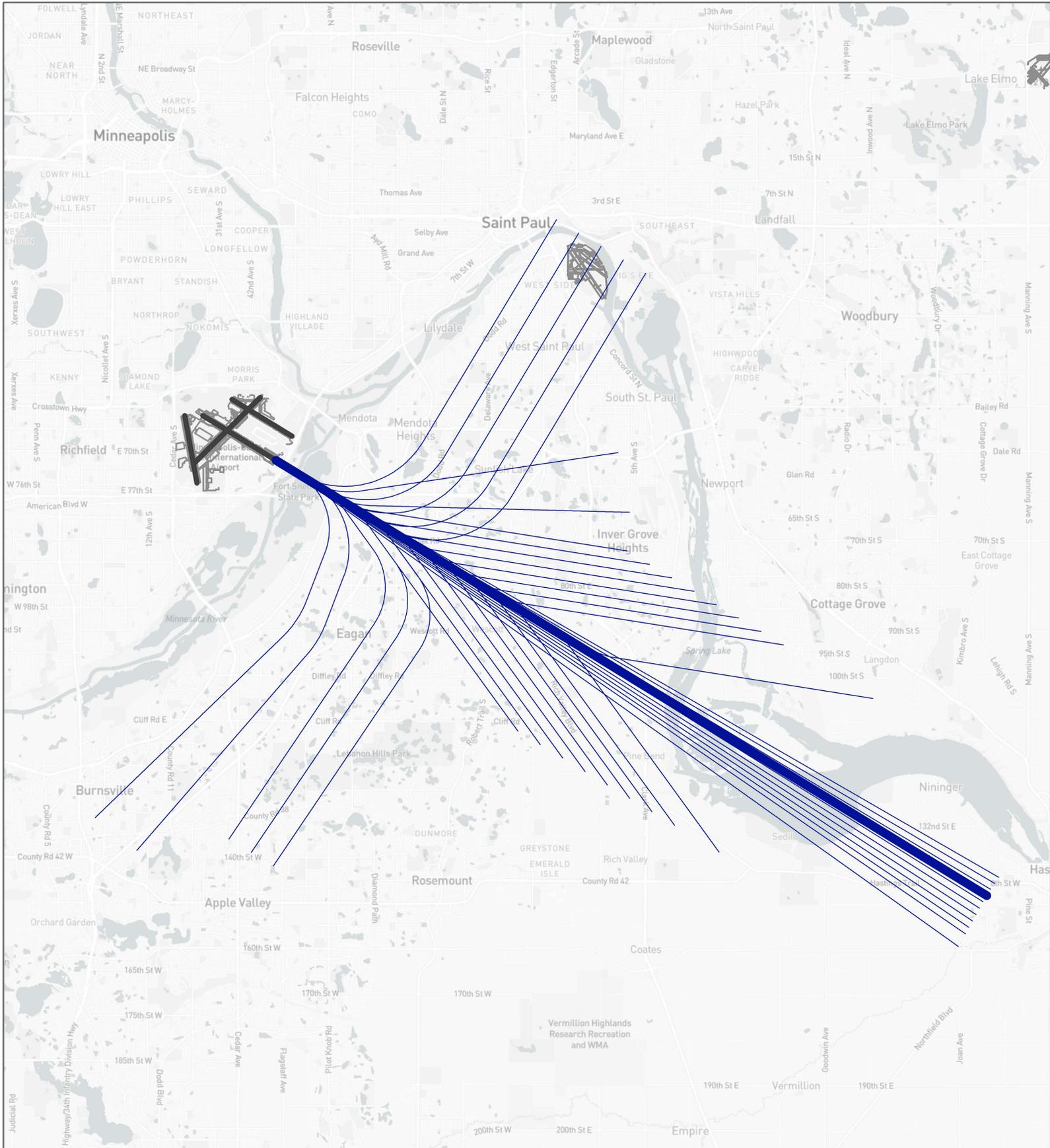
A-16



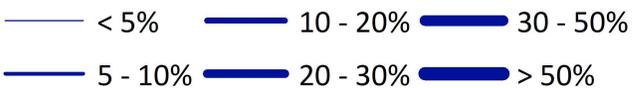
# 2022 AEDT TRACKS - ARRIVAL RUNWAY 30L

Overall Use Percentage

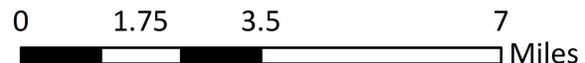
Figure 2.6



## AEDT Track Use Percentage



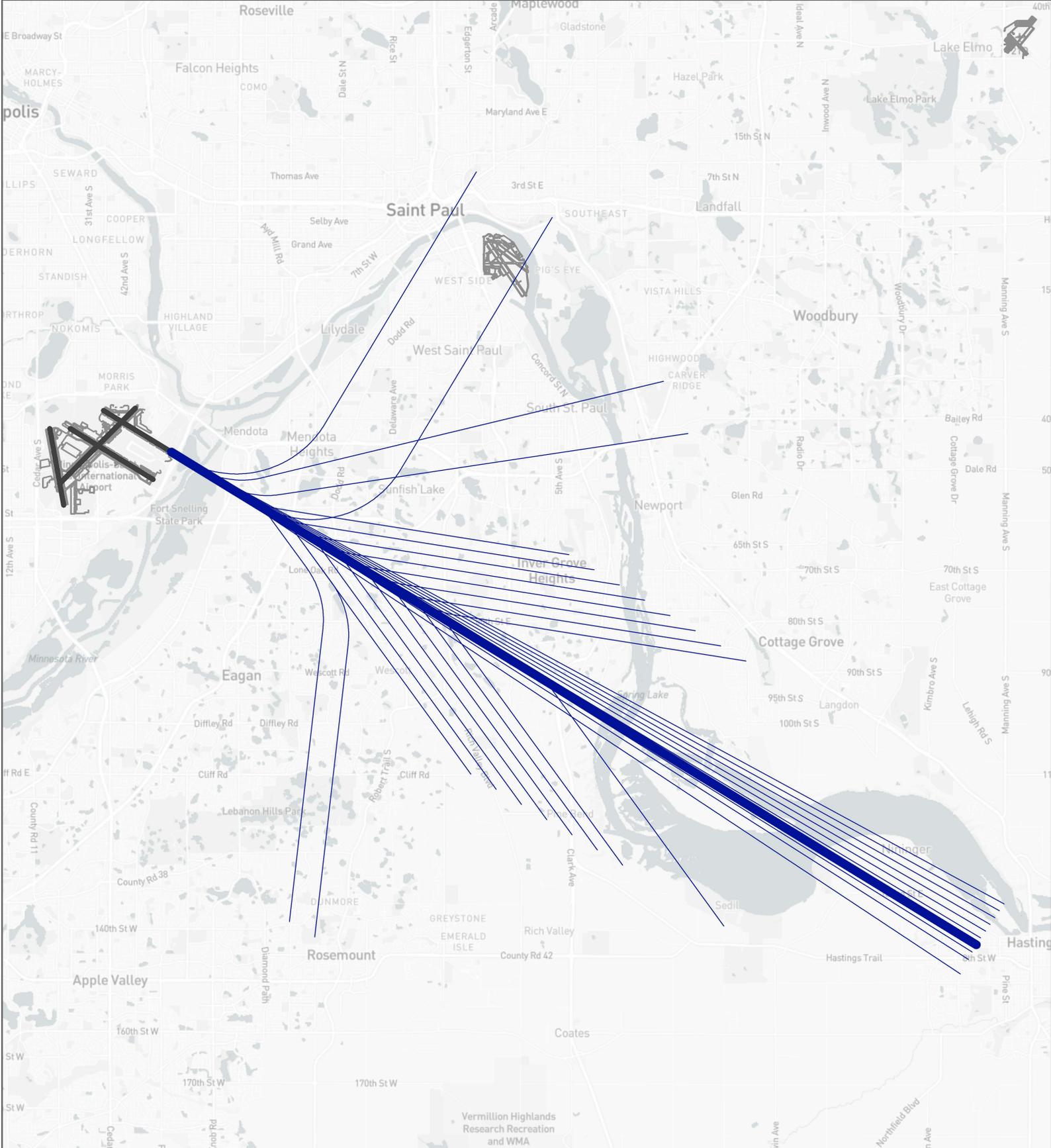
A-17



# 2022 AEDT TRACKS - ARRIVAL RUNWAY 30R

Overall Use Percentage

Figure 2.7



## AEDT Track Use Percentage

- < 5%
- 5 - 10%
- 10 - 20%
- 20 - 30%
- 30 - 50%
- > 50%

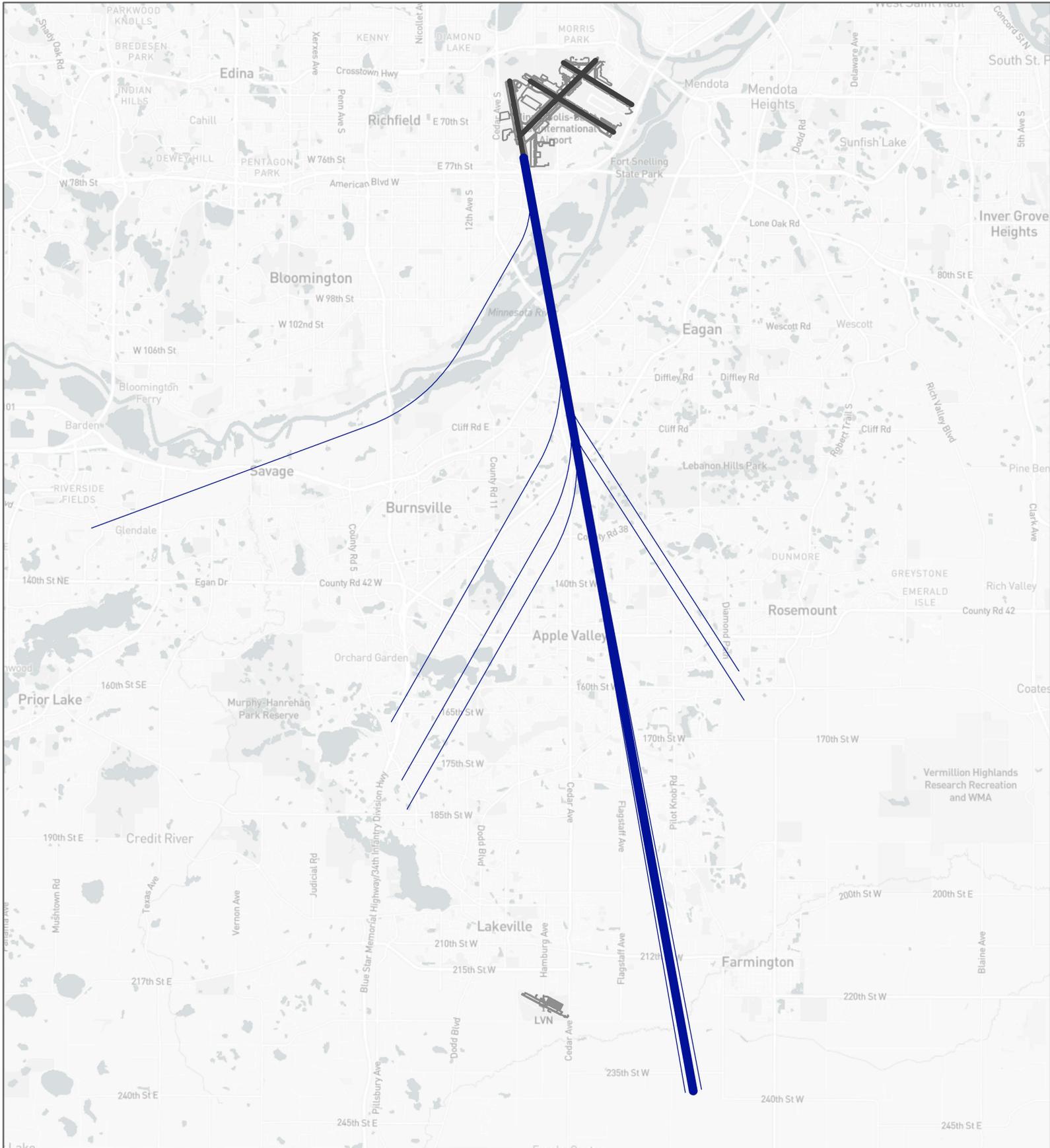
A-18



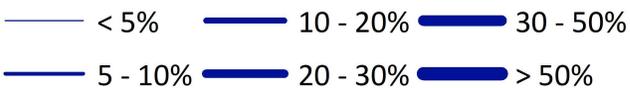
# 2022 AEDT TRACKS - ARRIVAL RUNWAY 35

Overall Use Percentage

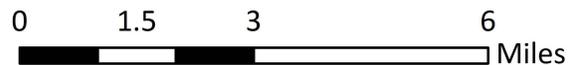
Figure 2.8



## AEDT Track Use Percentage



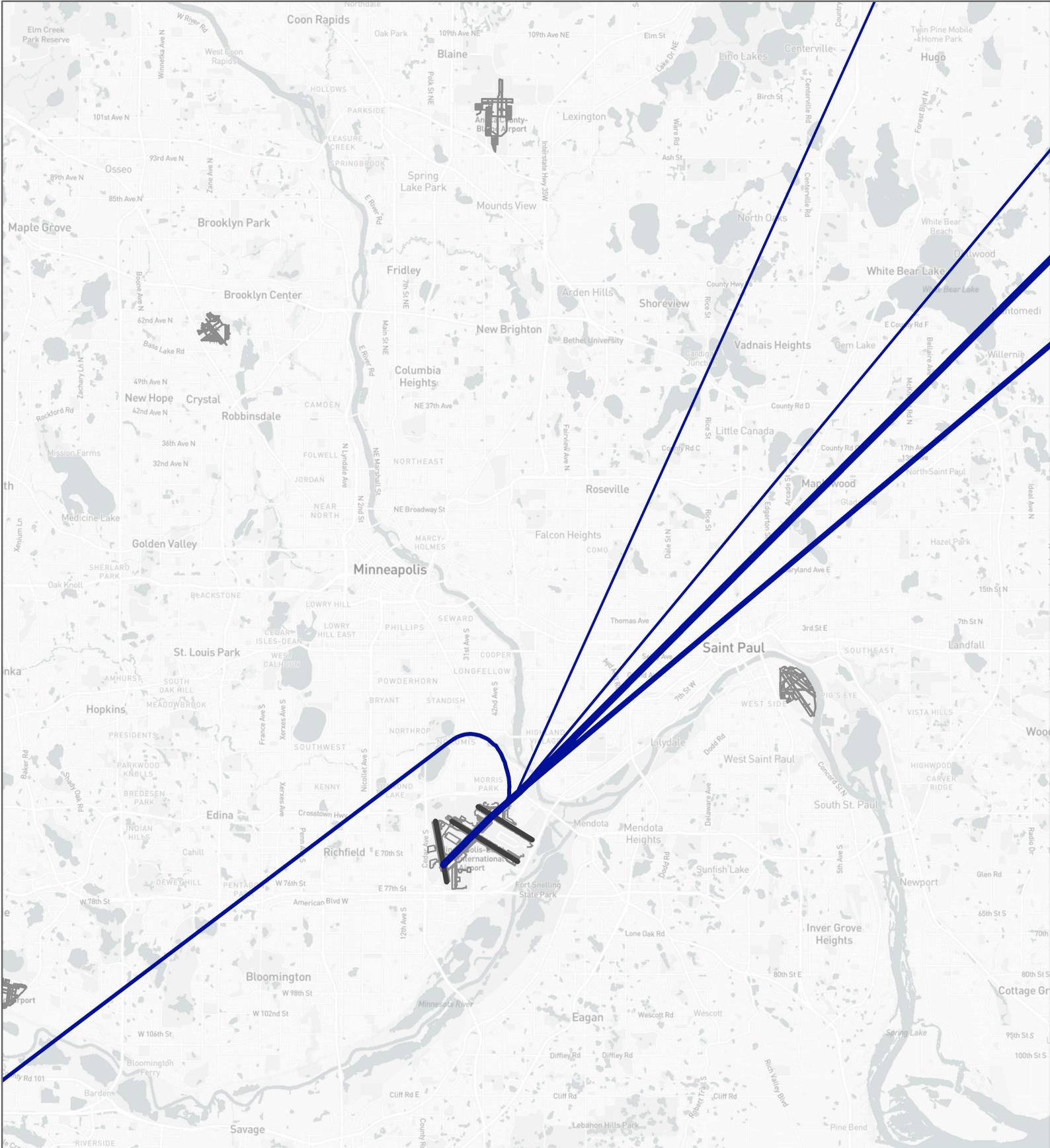
A-19



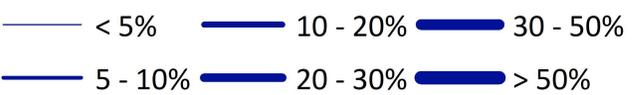
# 2022 AEDT TRACKS - DEPARTURE RUNWAY 4

Overall Use Percentage

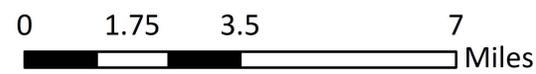
Figure 2.9



## AEDT Track Use Percentage



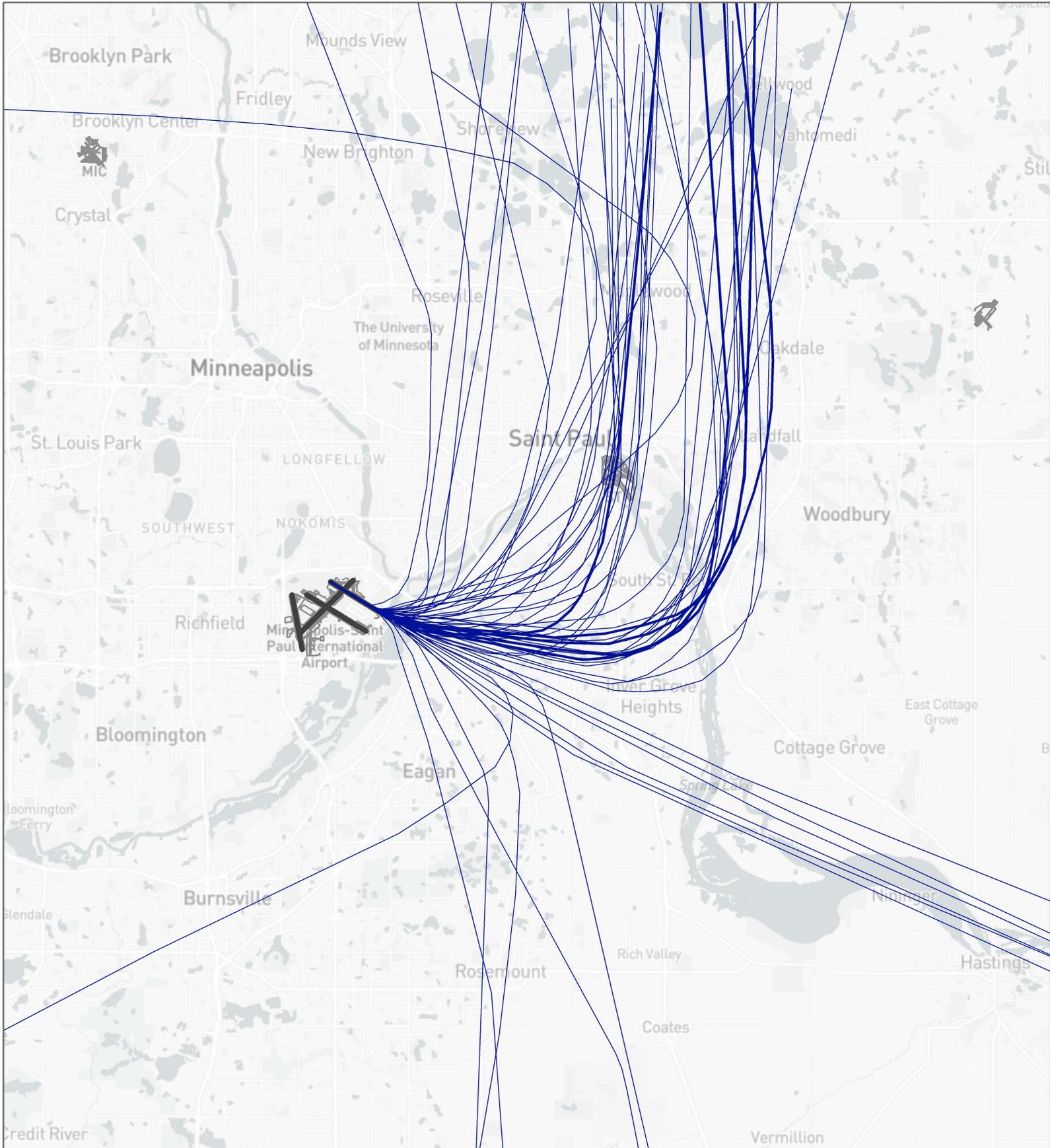
A-20



# 2022 AEDT TRACKS - DEPARTURE RUNWAY 12L

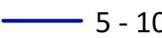
Overall Use Percentage

Figure 2.10

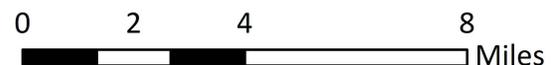


## AEDT Track Use Percentage

 < 5%     10 - 20%     30 - 50%

 5 - 10%     20 - 30%     > 50%

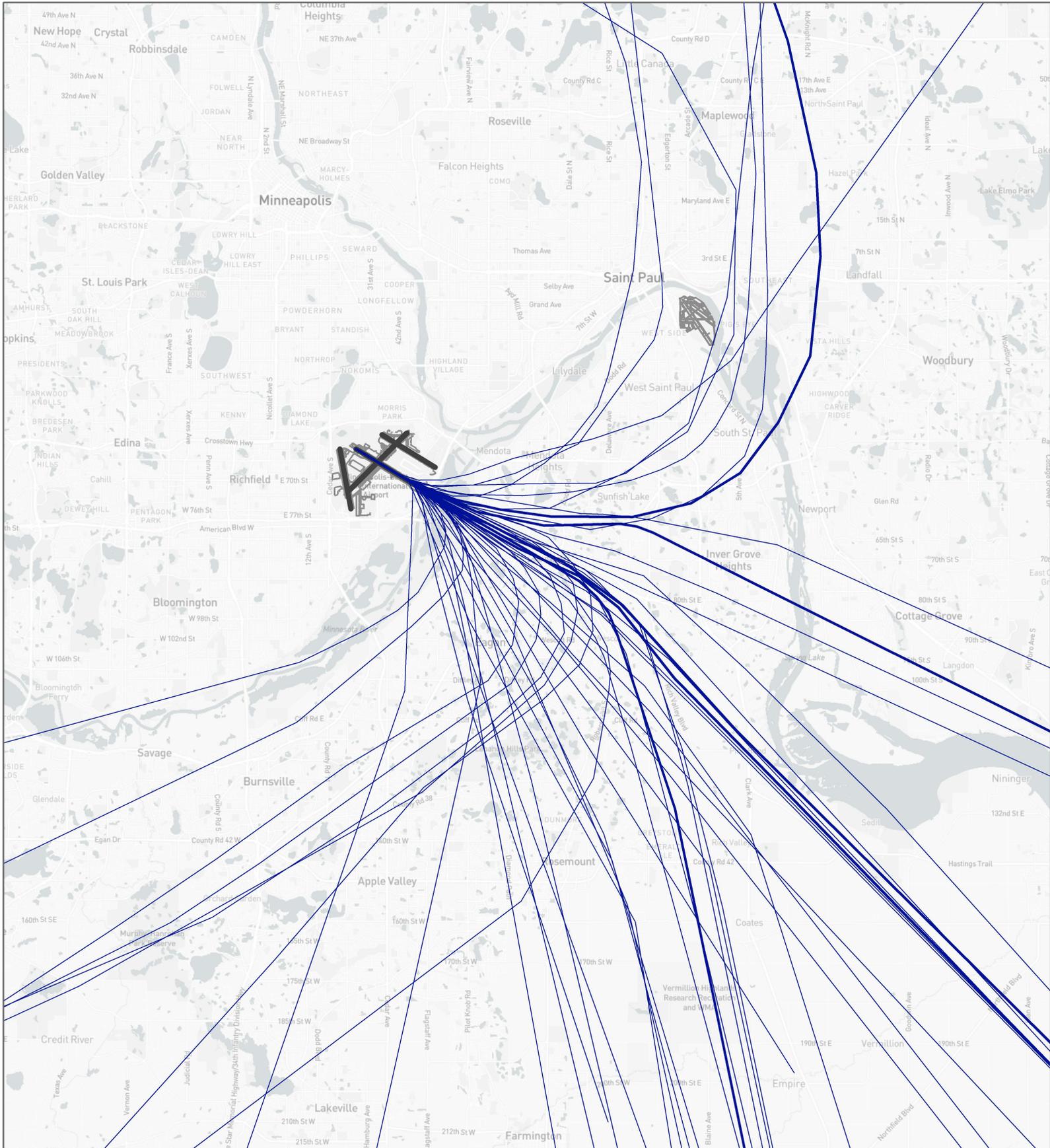
A-21



# 2022 AEDT TRACKS - DEPARTURE RUNWAY 12R

Overall Use Percentage

Figure 2.11



## AEDT Track Use Percentage

< 5%    10 - 20%    30 - 50%

5 - 10%    20 - 30%    > 50%

A-22

0

2

4

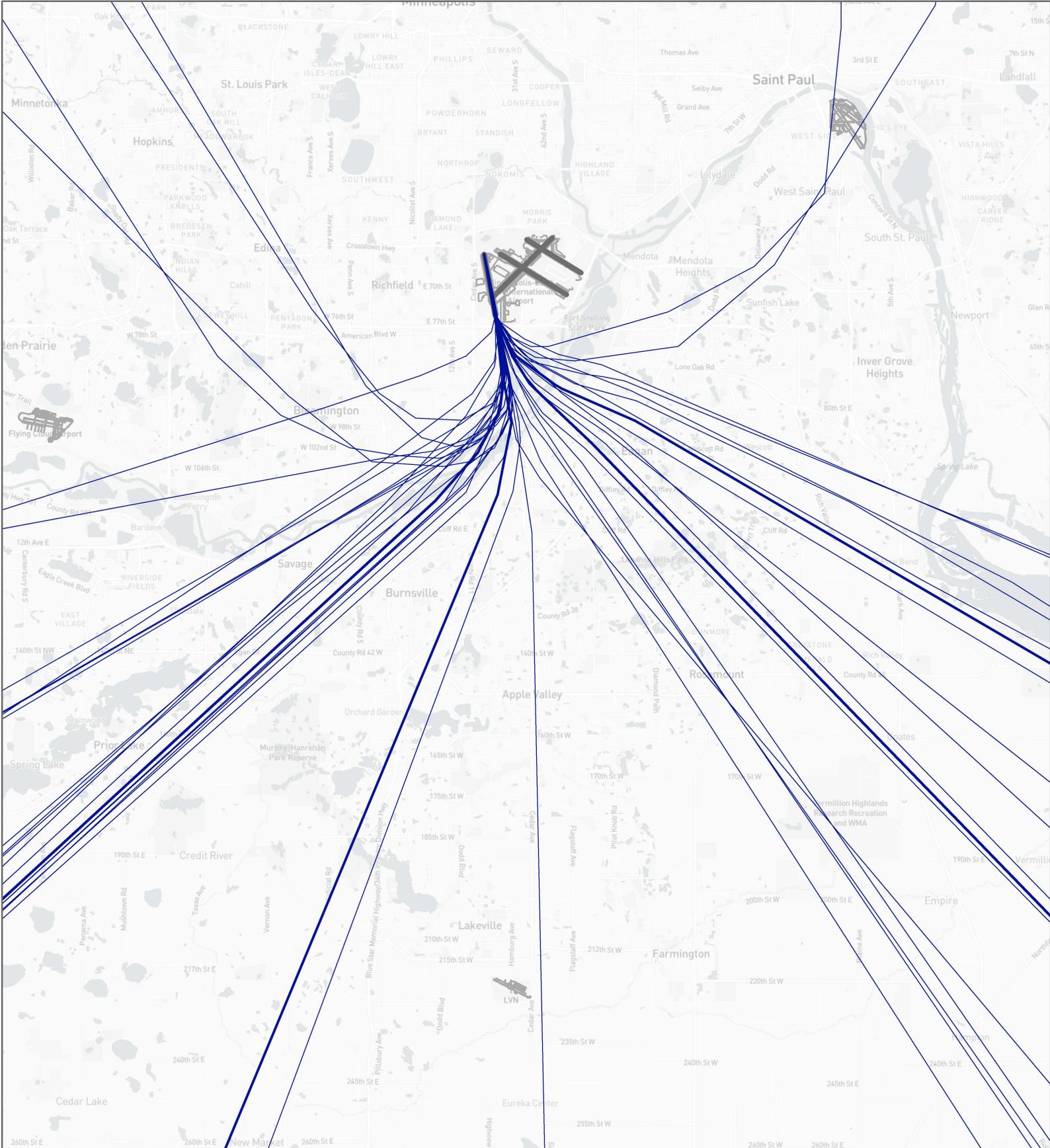
8

Miles

# 2022 AEDT TRACKS - DEPARTURE RUNWAY 17

Overall Use Percentage

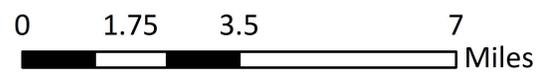
Figure 2.12



## AEDT Track Use Percentage

- < 5%
- 5 - 10%
- 10 - 20%
- 20 - 30%
- 30 - 50%
- > 50%

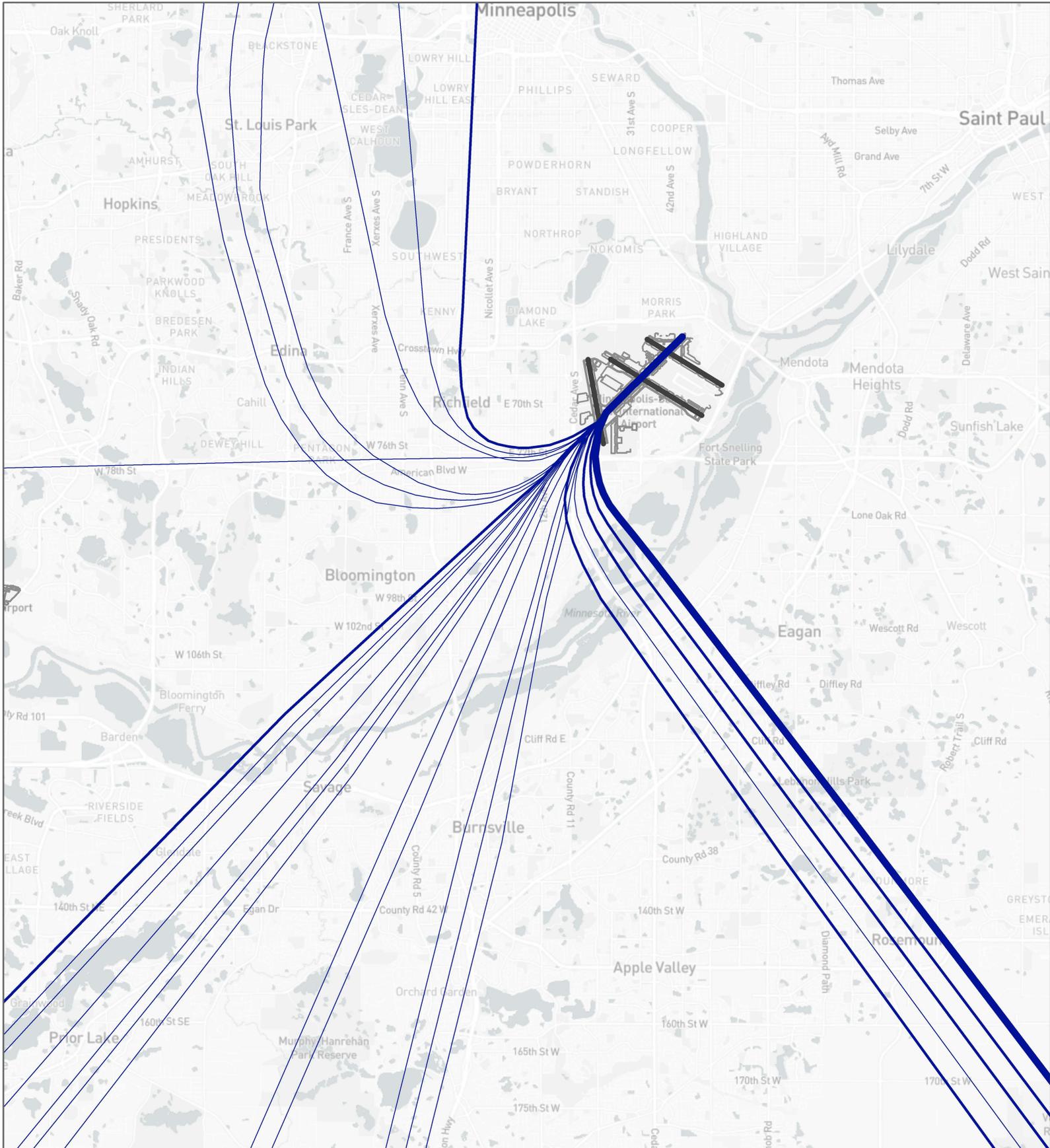
A-23



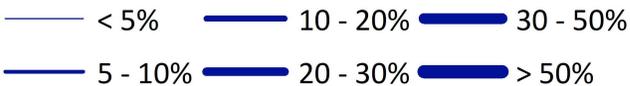
# 2022 AEDT TRACKS - DEPARTURE RUNWAY 22

Overall Use Percentage

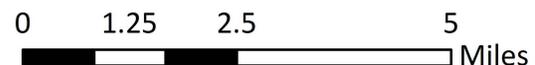
Figure 2.13



## AEDT Track Use Percentage



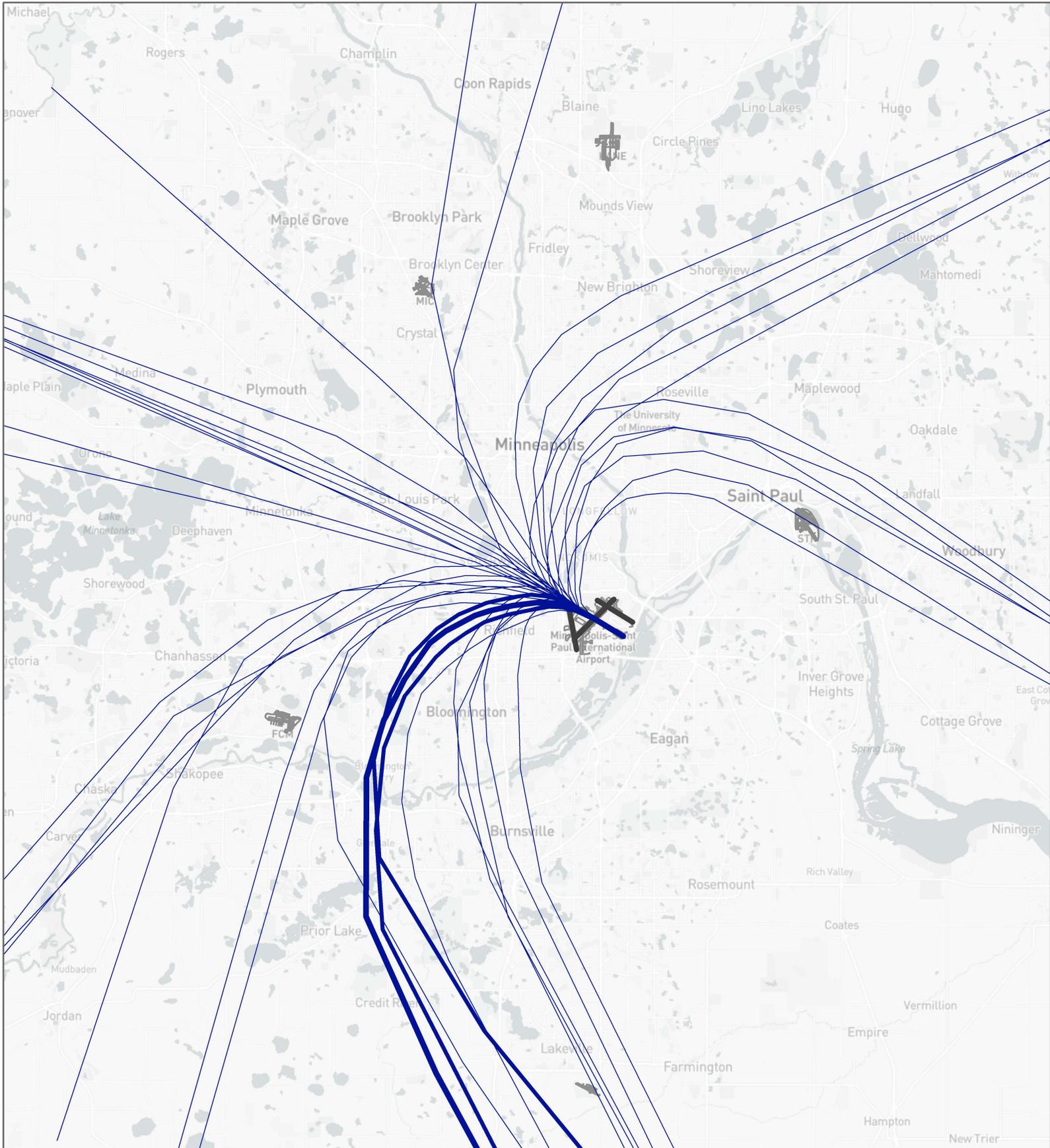
A-24



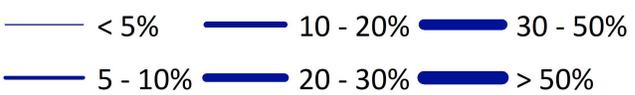
# 2022 AEDT TRACKS - DEPARTURE RUNWAY 30L

Overall Use Percentage

Figure 2.14



## AEDT Track Use Percentage



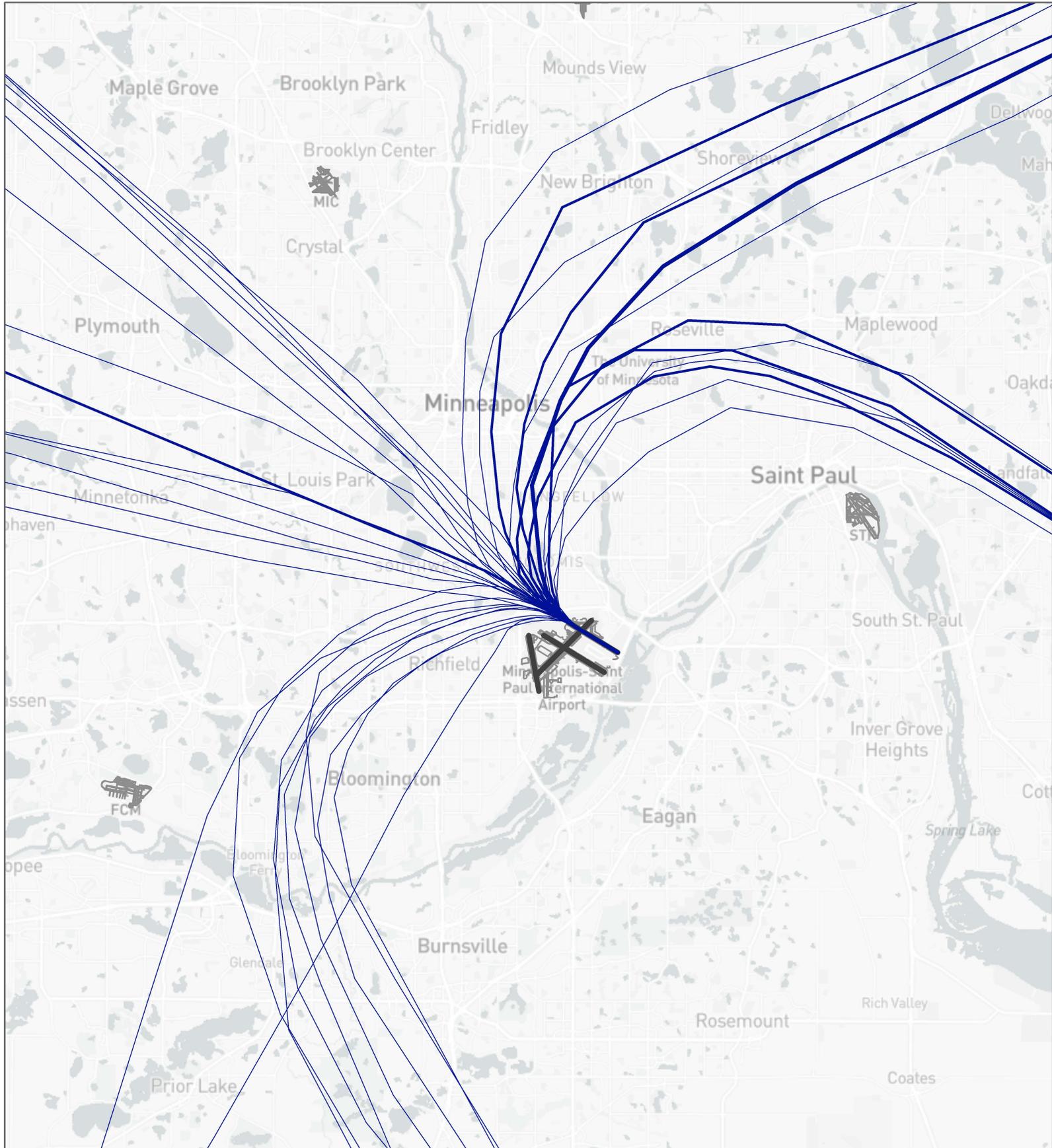
A-25



# 2022 AEDT TRACKS - DEPARTURE RUNWAY 30R

Overall Use Percentage

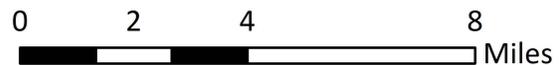
Figure 2.15



## AEDT Track Use Percentage

- < 5%
- 5 - 10%
- 10 - 20%
- 20 - 30%
- 30 - 50%
- > 50%

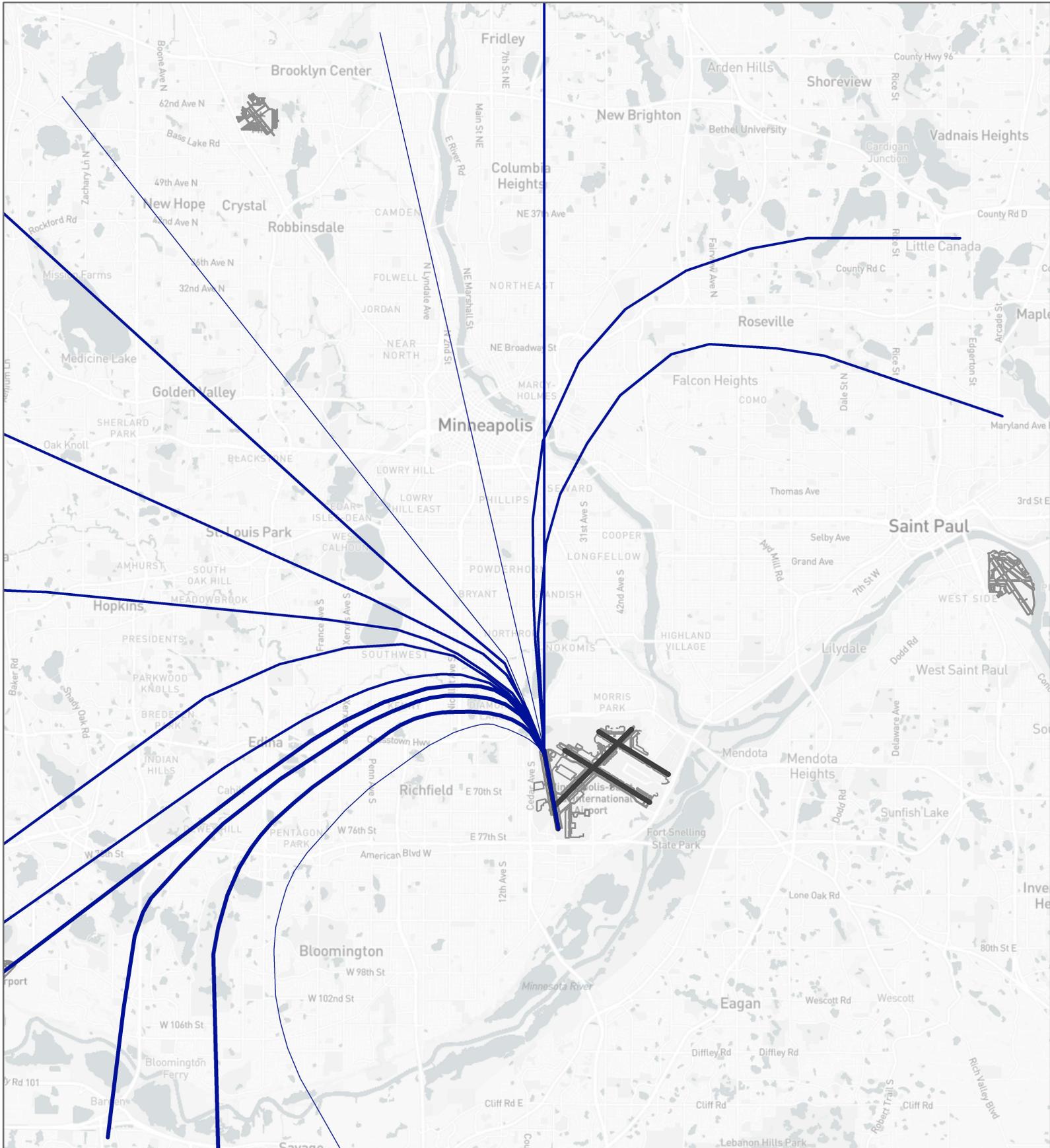
A-26



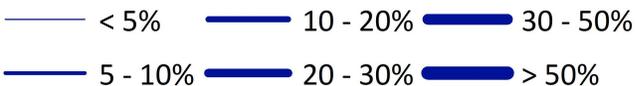
# 2022 AEDT TRACKS - DEPARTURE RUNWAY 35

Overall Use Percentage

Figure 2.16



## AEDT Track Use Percentage



A-27

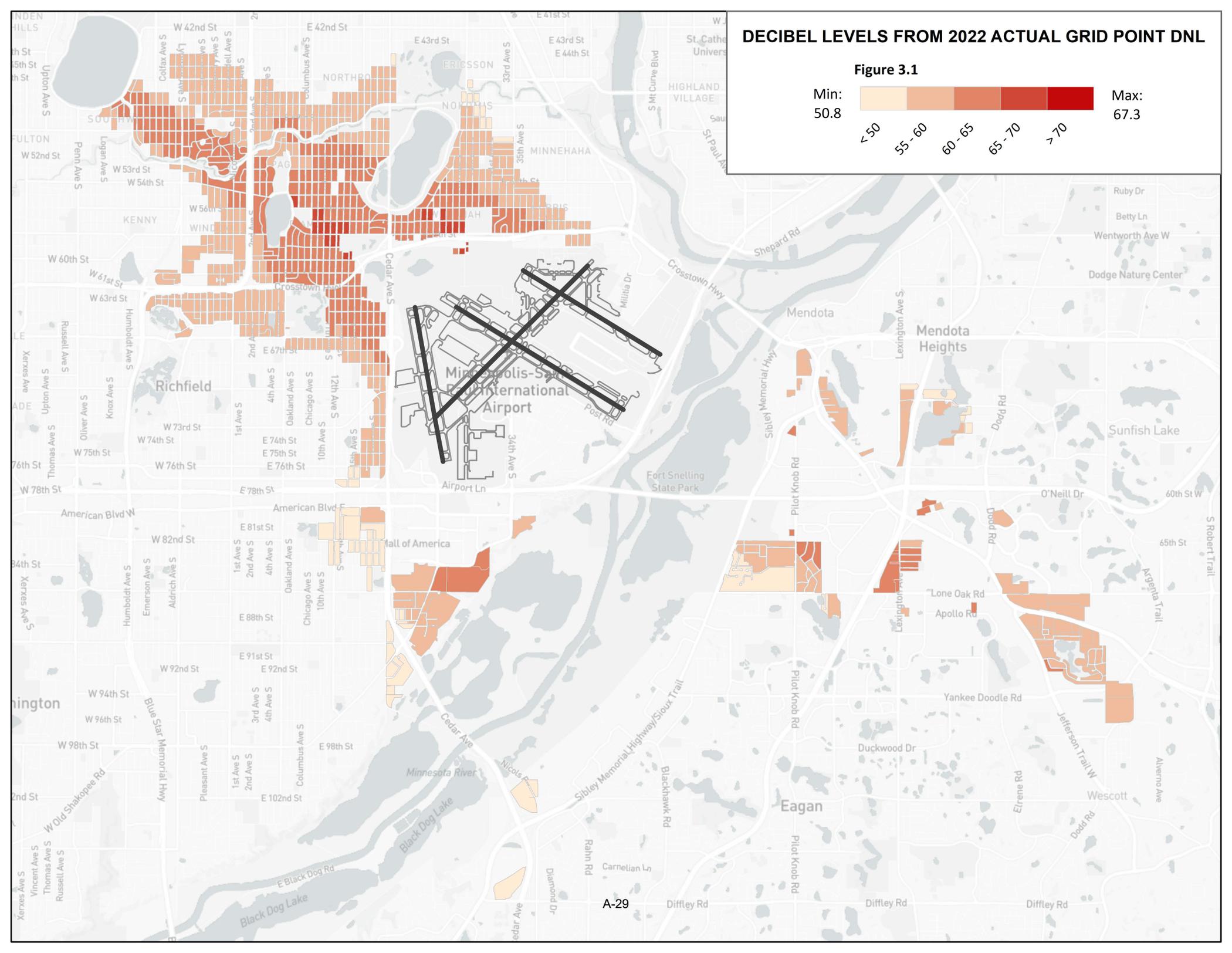
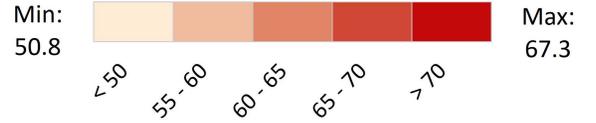


### Appendix 3: Noise Model Grid Point Maps

<b>Figure</b>	<b>Content</b>	<b>Page</b>
<b>Figure 3-1 to Figure 3-5</b>	Decibel Levels from 2022 Actual Grid Point DNLs	A-29
<b>Figure 3-6 to Figure 3-10</b>	Decibel Levels from Base Case Year Grid Point DNLs	A-34
<b>Figure 3-11 to Figure 3-15</b>	Difference in dB Level Between Block Base Case Year and 2022 Actual Grid Point DNLs for Blocks Included in the Noise Mitigation Settlement	A-39

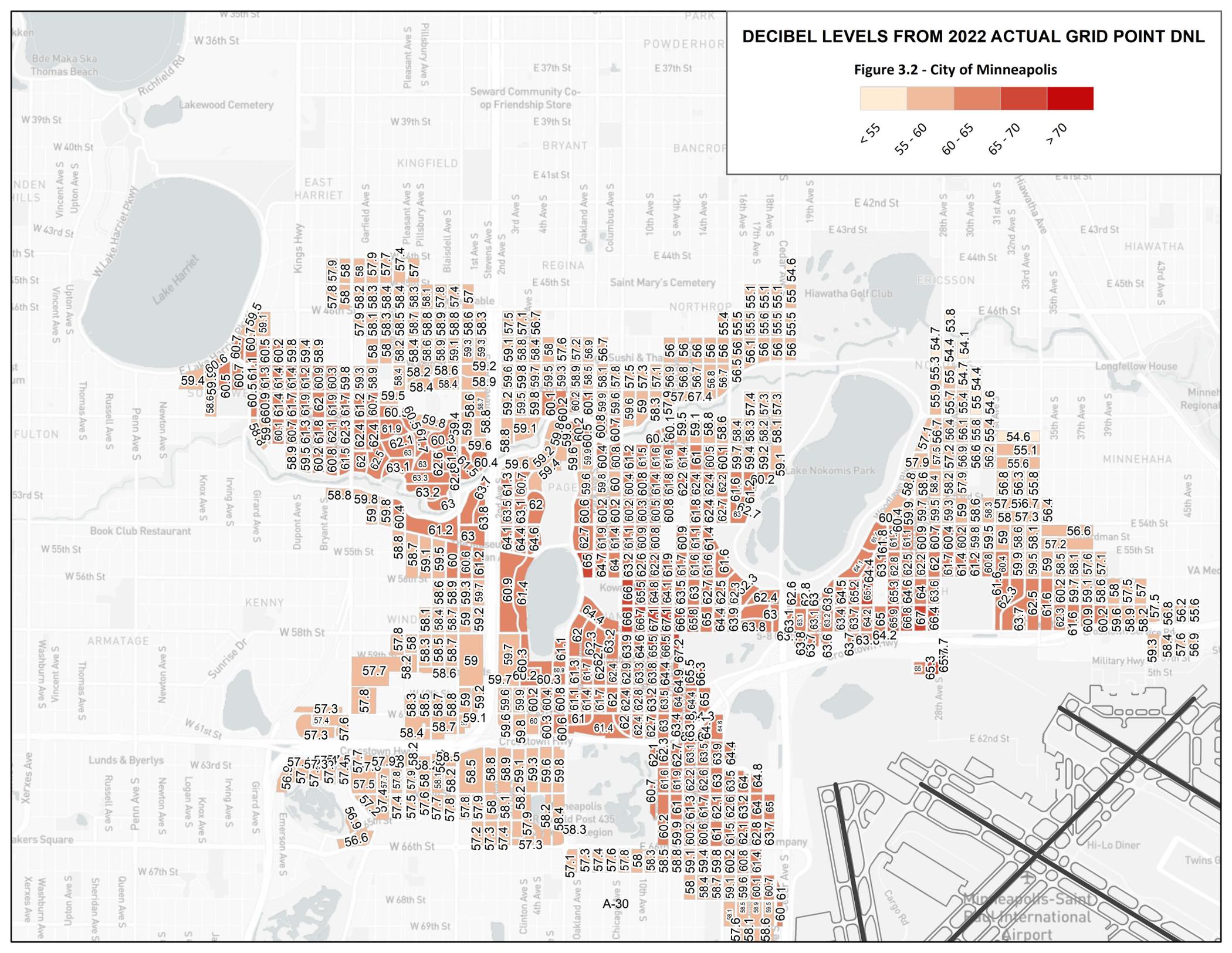
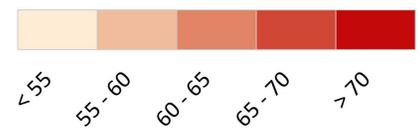
# DECIBEL LEVELS FROM 2022 ACTUAL GRID POINT DNL

Figure 3.1

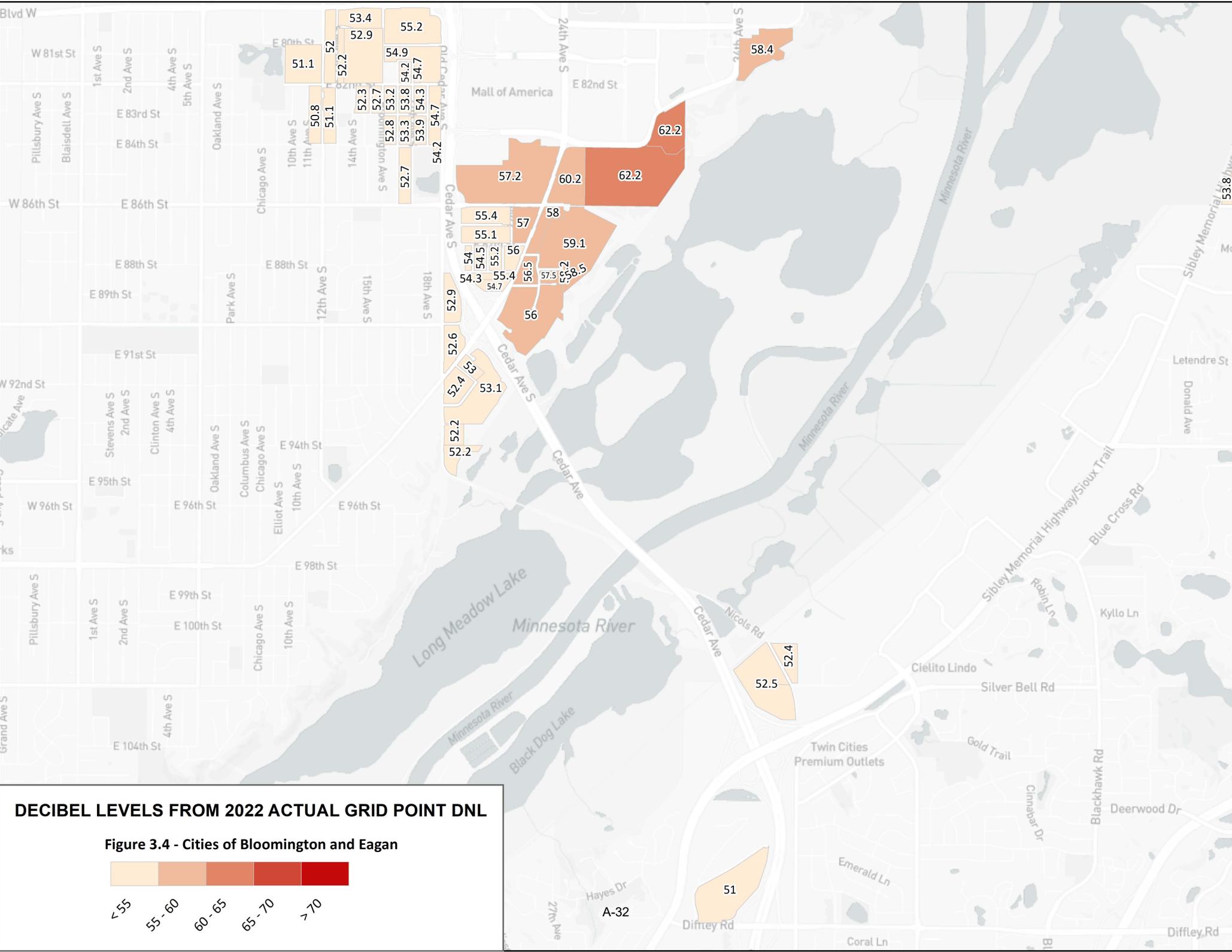


# DECIBEL LEVELS FROM 2022 ACTUAL GRID POINT DNL

## Figure 3.2 - City of Minneapolis



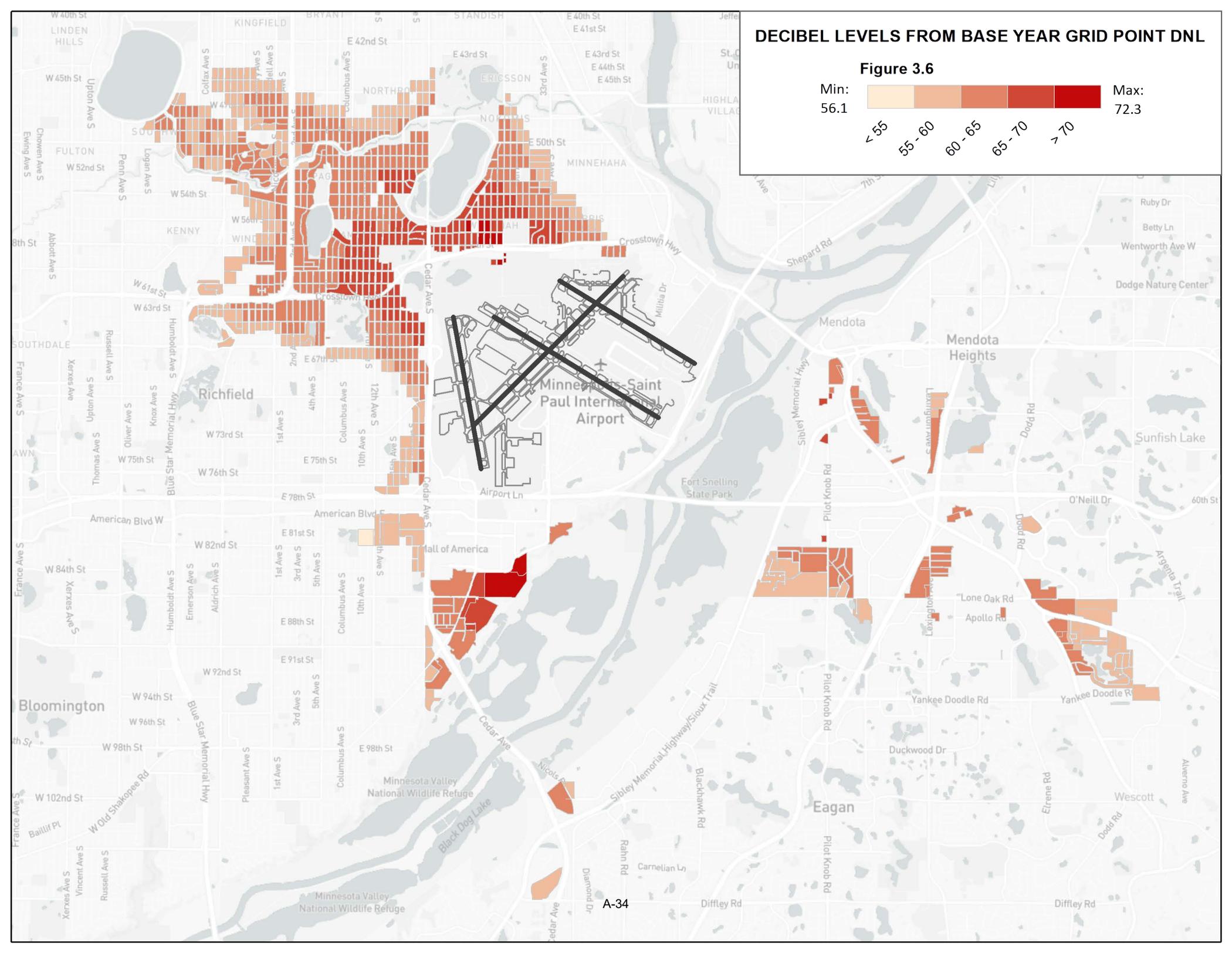
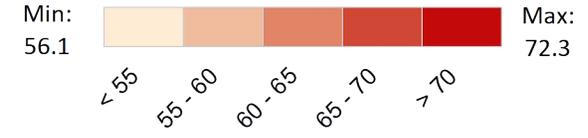






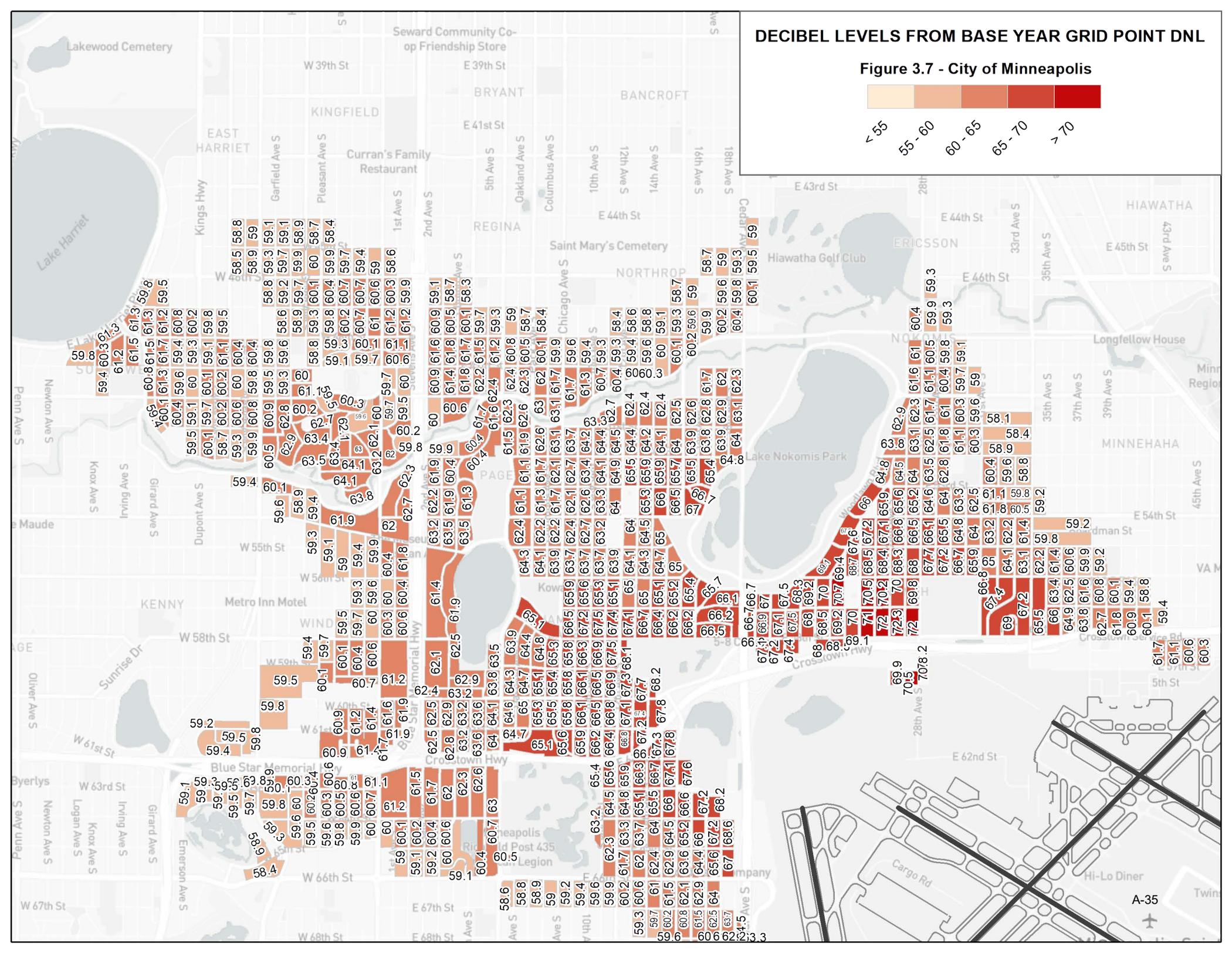
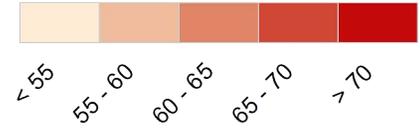
# DECIBEL LEVELS FROM BASE YEAR GRID POINT DNL

Figure 3.6



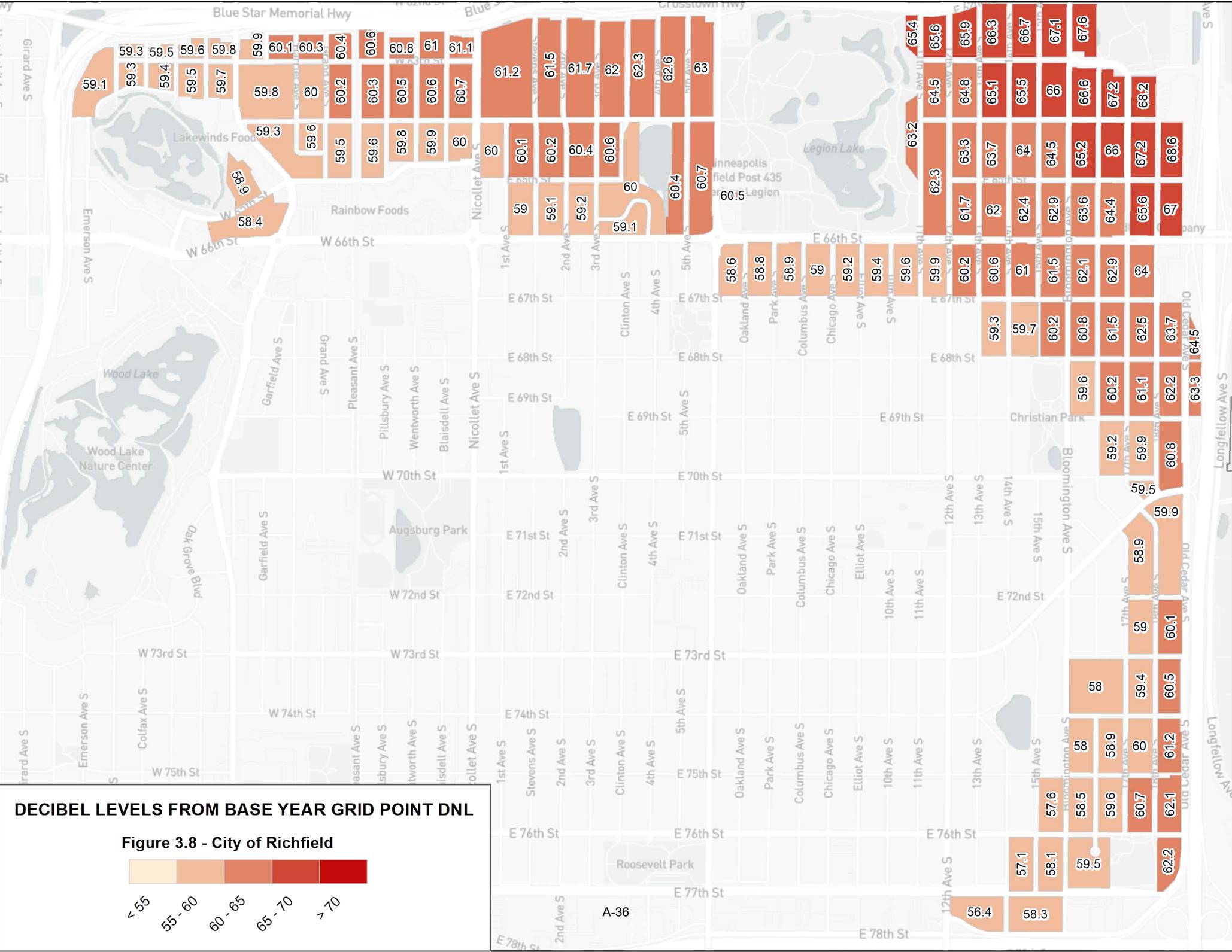
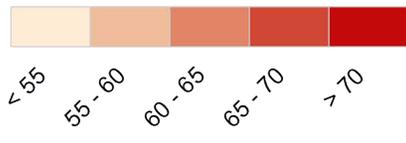
# DECIBEL LEVELS FROM BASE YEAR GRID POINT DNL

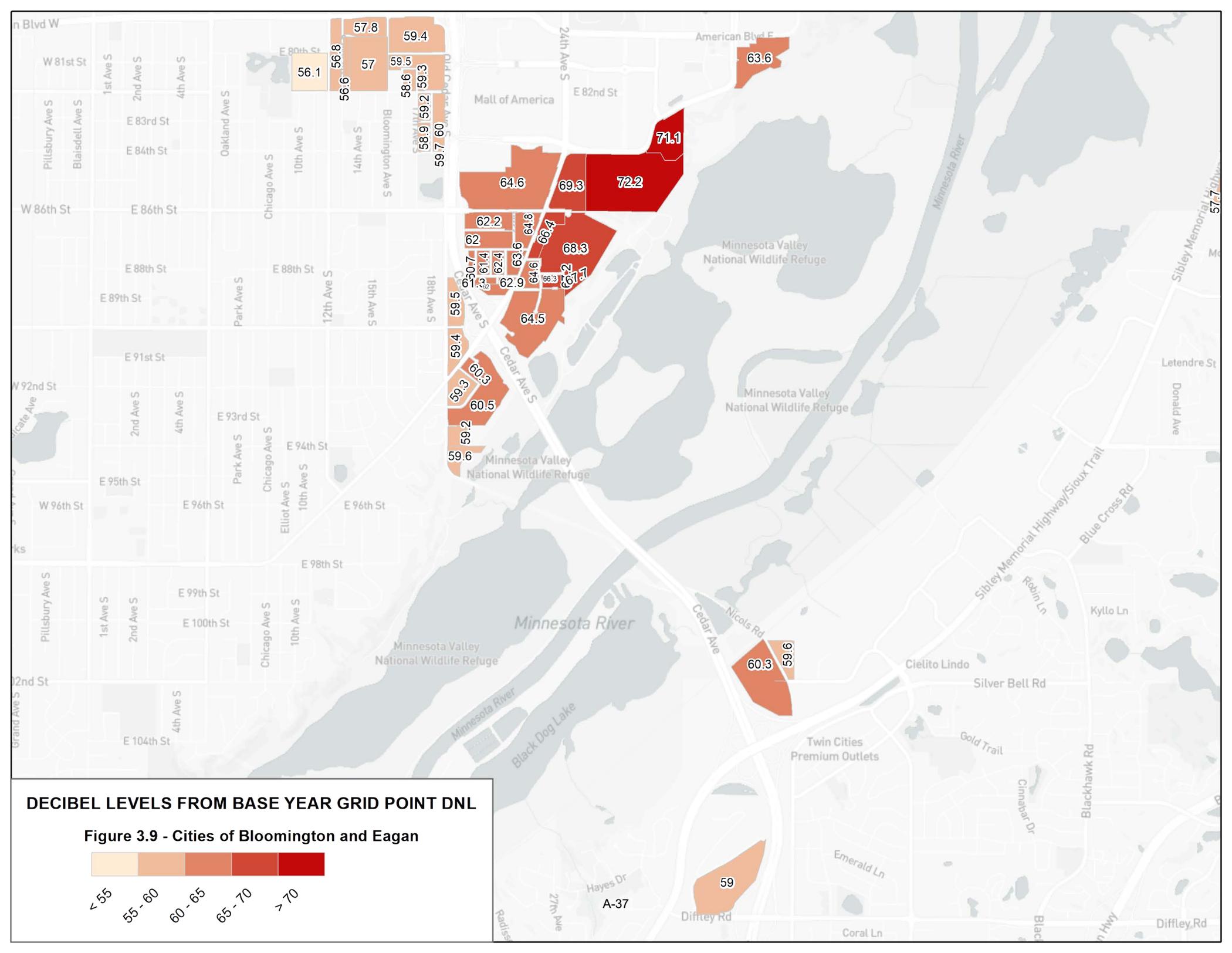
## Figure 3.7 - City of Minneapolis



**DECIBEL LEVELS FROM BASE YEAR GRID POINT DNL**

**Figure 3.8 - City of Richfield**

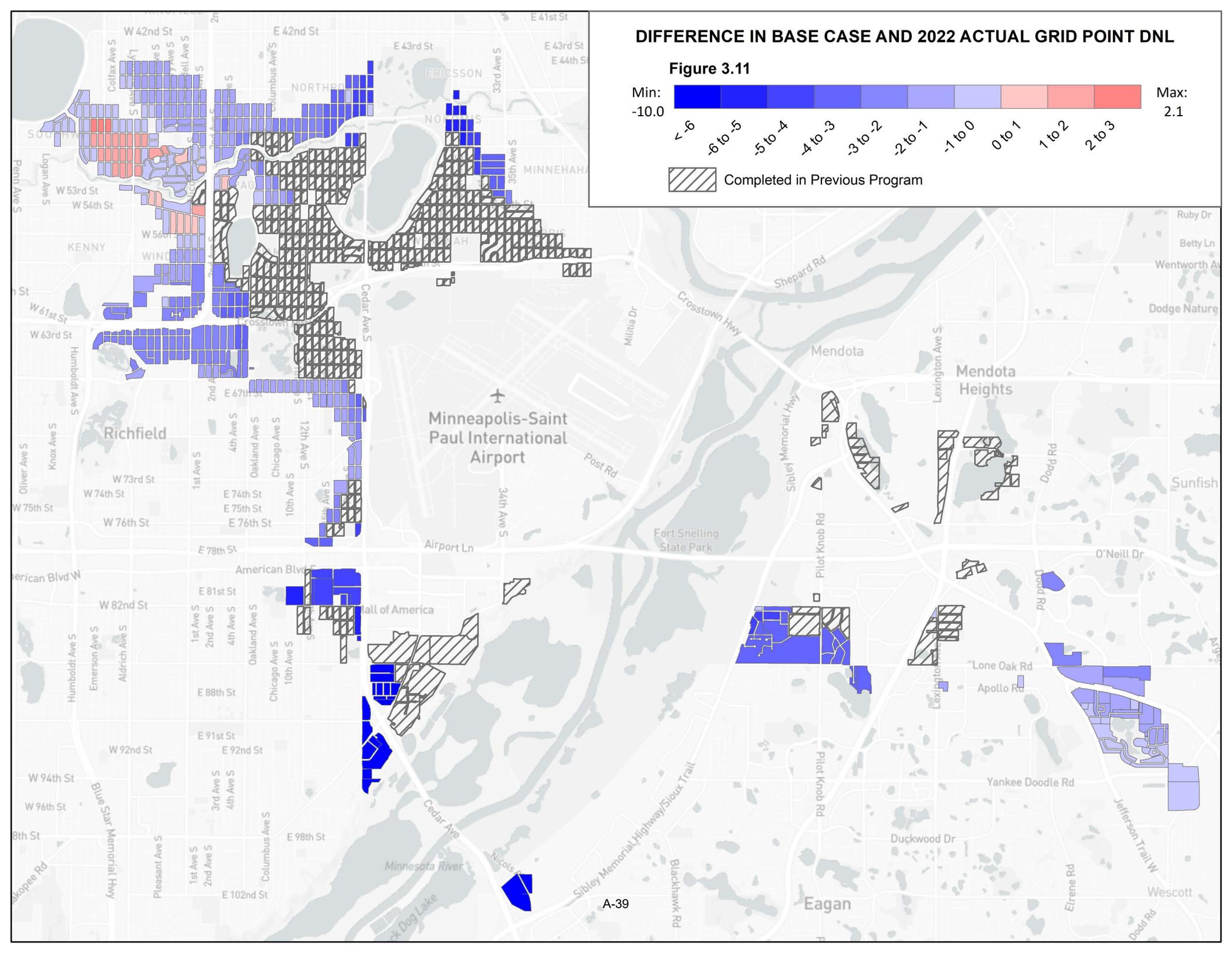
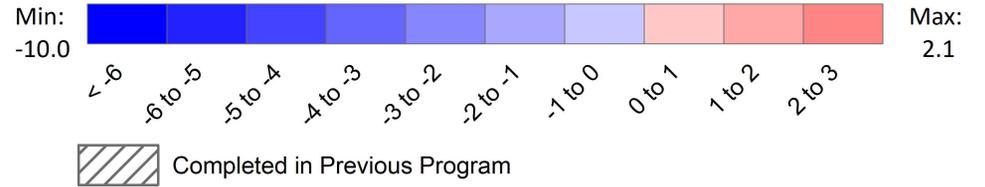






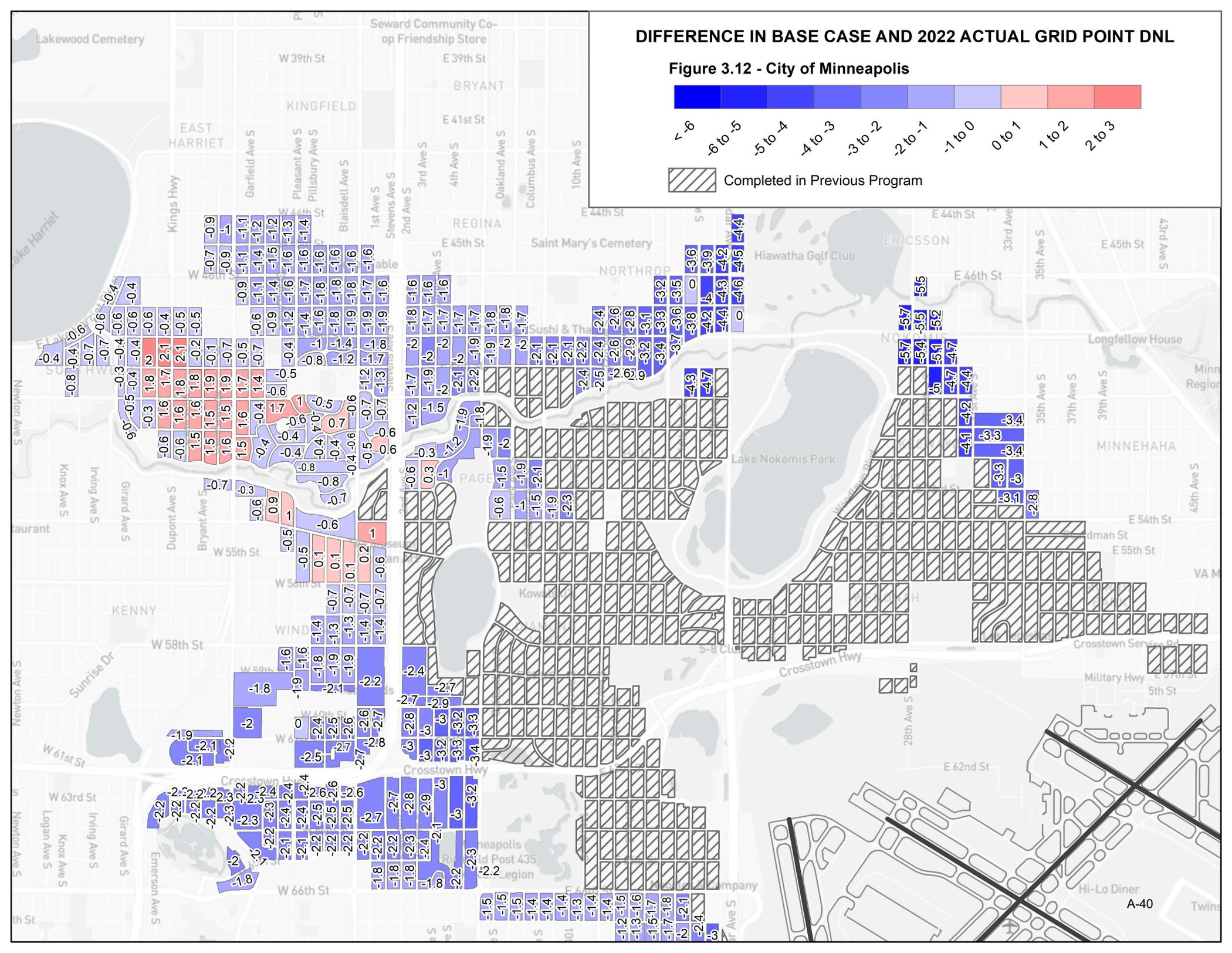
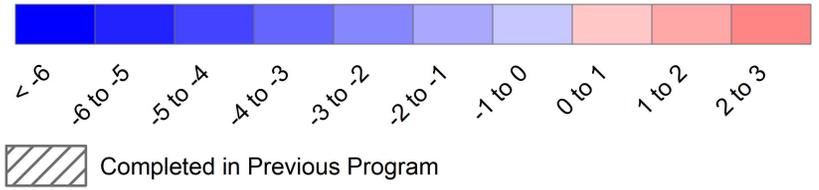
# DIFFERENCE IN BASE CASE AND 2022 ACTUAL GRID POINT DNL

Figure 3.11

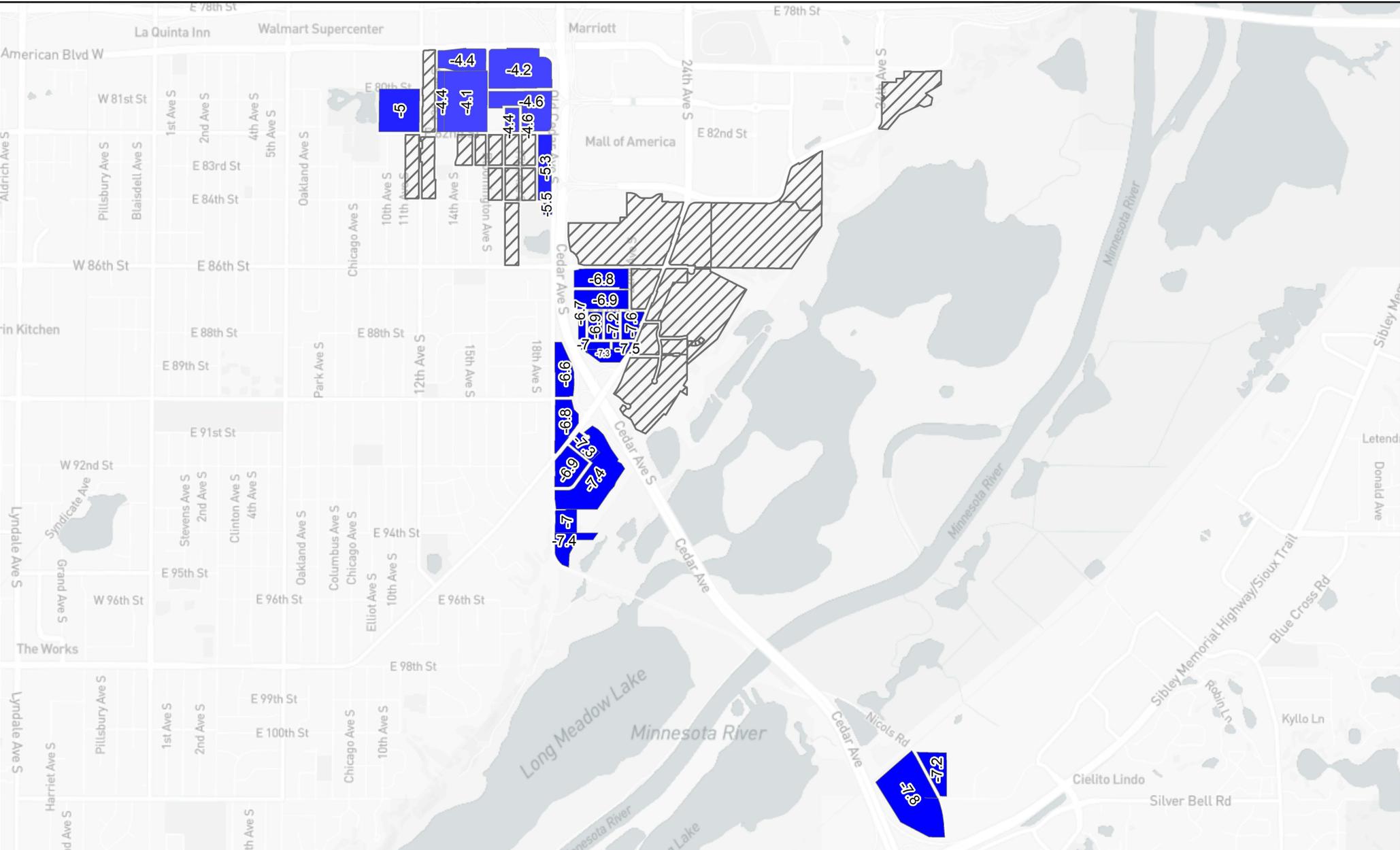


# DIFFERENCE IN BASE CASE AND 2022 ACTUAL GRID POINT DNL

## Figure 3.12 - City of Minneapolis

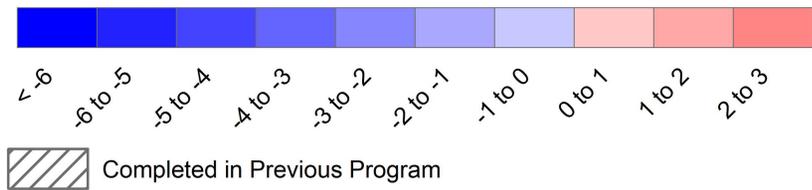


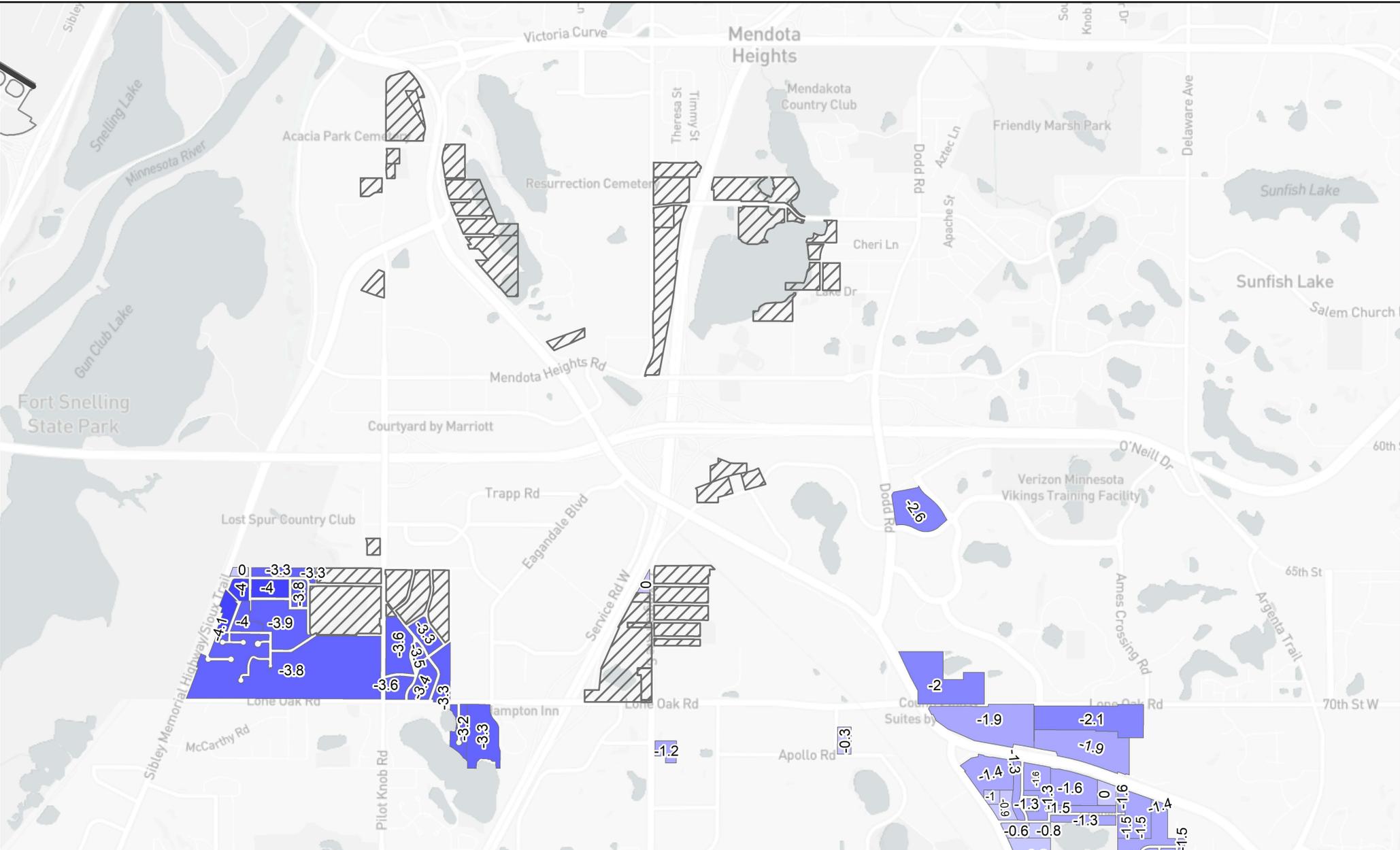




**DIFFERENCE IN BASE CASE AND 2022 ACTUAL GRID POINT DNL**

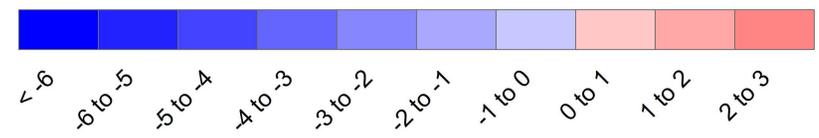
**Figure 3.14 - Cities of Bloomington and Eagan**





**DIFFERENCE IN BASE CASE AND 2022 ACTUAL GRID POINT DNL**

**Figure 3.15 - Cities of Eagan, Mendota Heights and Inver Grove Heights**



 Completed in Previous Program