Appendix C Noise Modeling

This appendix includes:

- AEDT Nonstandard Modeling Request
- FAA Approval Letter of Nonstandard Aircraft Noise and Performance Data Substitution Request
- TAF Confirmation Memorandum

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HMMH
700 District Avenue, Suite 800
Burlington, MA 01803
781.229.0707

TECHNICAL MEMORANDUM

To:	Bobb A. Beauchamp, Environmental Program Manager, Federal Aviation Administration
From:	Timothy Middleton, C.M., Principal Consultant, HMMH
Date:	September 27, 2021
Subject:	Dane County Regional Airport / Truax Field (MSN) Part 150 Study, Nonstandard Aircraft Noise and Performance Data Substitution Request
Reference:	HMMH Project Number 312360

Harris Miller Miller & Hanson Inc. (HMMH) is assisting Dane County Regional Airport (MSN) with a Noise Exposure Map Update as a component of the Part 150 Noise Compatibility Planning Study that the airport is currently undertaking. Aircraft noise modeling will use the Federal Aviation Administration's (FAA) Aviation Environmental Design Tool (AEDT) Version 3d,[1] combined with modeling with NoiseMAP 7.3 for select military operations.[2] In an initial analysis of flight operations data, HMMH found several aircraft in the flight operations data that are defined in the AEDT database however AEDT does not have representative circuit or touch-and-go profiles (Section 1.0). To accommodate these aircraft, we would perform a nonstandard aircraft noise and performance data substitution in AEDT. This technical memorandum describes the need and requests approval for such a nonstandard aircraft noise and performance data substitution in the model.

HMMH has prepared this technical memorandum in accordance with Section 5 of FAA's document titled "Guidance on Using the Aviation Environmental Design Tool (AEDT) to Conduct Environmental Modeling for FAA Actions Subject to NEPA" dated October 27, 2017.[3] This particular request falls under Section 5.2.2 "Analysis methods/data that require AEE review and approval" items:

- "Aircraft that do not exist in AEDT default data."
- "Alternative models and methodologies besides FAA-required and -preferred models and methodologies (e.g., terrain shielding, adjustments to lateral attenuation, etc.), including modifications to AEDT default methodologies."

HMMH believes that this request should be routed in accordance with Section 5.1 of that document. After review at FAA headquarters, we would expect a document from Office of Environment and Energy (AEE) responding to the methods presented in this memorandum. That AEE response would be included in the NEM's noise technical documentation.

1.0 Non-standard Circuit/Touch-and-go Modeling

MSN aircraft operations include local touch-and-go procedures also known as circuits. However, one of the Aircraft Noise and Performance (ANP) types used in this study does not have circuit or touch-and-go profiles.

[1] AEDT 3d was the most current FAA approved noise model available in April 2022 when model flight track development began.

[2] The military aircraft modeling for the NEM is based on NoiseMap modeling presented in the US Department of Defense "United States Air Force F-35A Operational Beddown Air National Guard Environmental Impact Statement", on file with US Environmental Protection Agency as EIS No. 20200051 and available at https://cdxapps.epa.gov/cdx-enepa-II/public/action/eis/details?eisId=290711 and with a Record of Decision announced in the Federal Register On April 23, 2020 and available at https://www.federalregister.gov/documents/2020/04/23/2020-08597/record-of-decisions-for-the-environmental-impact-statement-united-states-air-force-f-35a-operational. We are updating the EIS modeling specifically for this NEM with coordination with the local Air National Guard and Army National Guard units.

[3] https://aedt.faa.gov/Documents/guidance_aedt_nepa.pdf

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1.1 ANP type PA28

This study includes AEDT operations of ANP type PA28, which does not have circuit or touch-and-go profiles. PA28 is a single engine piston propellor aircraft. Our research indicates that some variants of the Piper 28 are fitted with fixed pitch propellors and others with variable pitch/constant speed propellors. We propose to use AEDT equipment ID 1277/ANP type GASEPV to model the touch-and-go operations that would otherwise be assigned to ANP type PA28. This request would not affect the representation of ANP type PA28 operations within AEDT.

HMMH has prepared a comparison of the noise generated by PA28 and GASEPV arrival-departure cycles as well as the noise produced by a GASEPV circuit operation. Figure 1 below presents the comparison of the PA28 to the GASEPV 75 – 95 dB SEL contours produced by AEDT for an arrival-departure cycle on Runway 18. The PA28 contours are shown in red and the GASEPV contours are shown in black. Figure 2 presents the 75 – 95 dB SEL contours for a GASEPV circuit operation, again on Runway 18.

Figure 1. Comparison of SEL Contours for PA28 and GASEPV Arrival-Departure Cycles

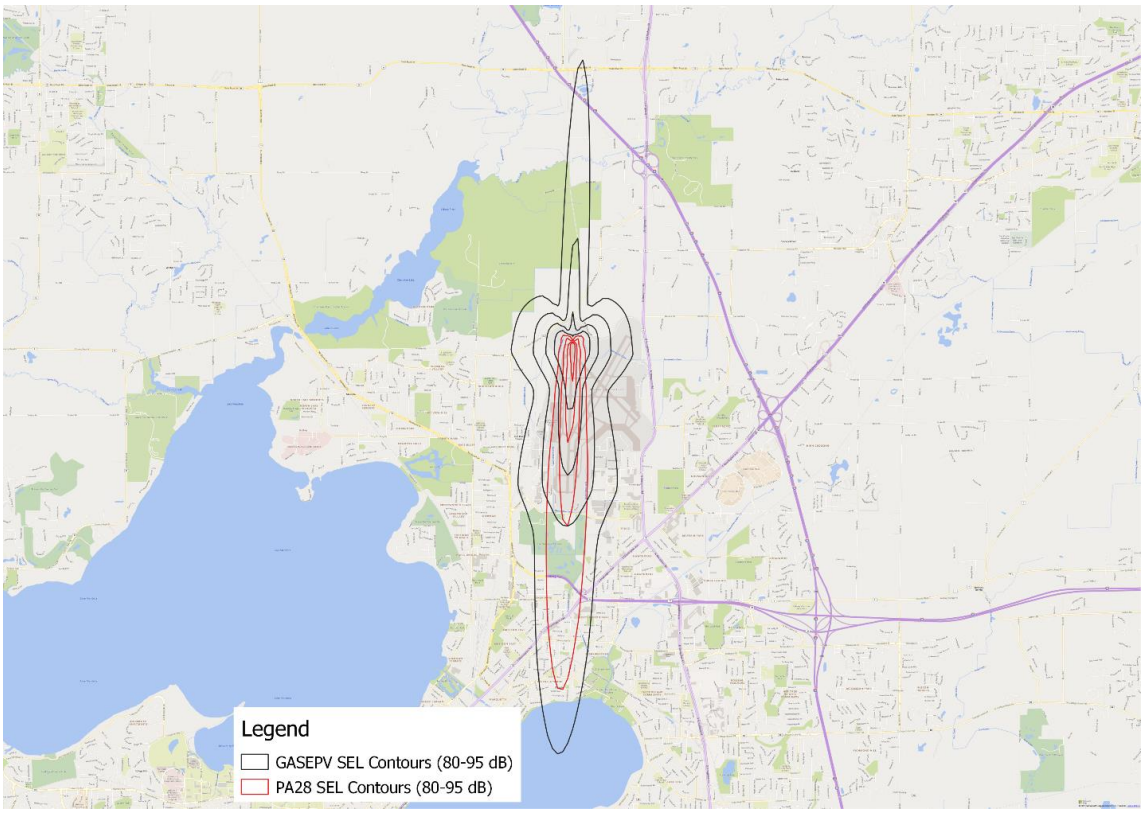

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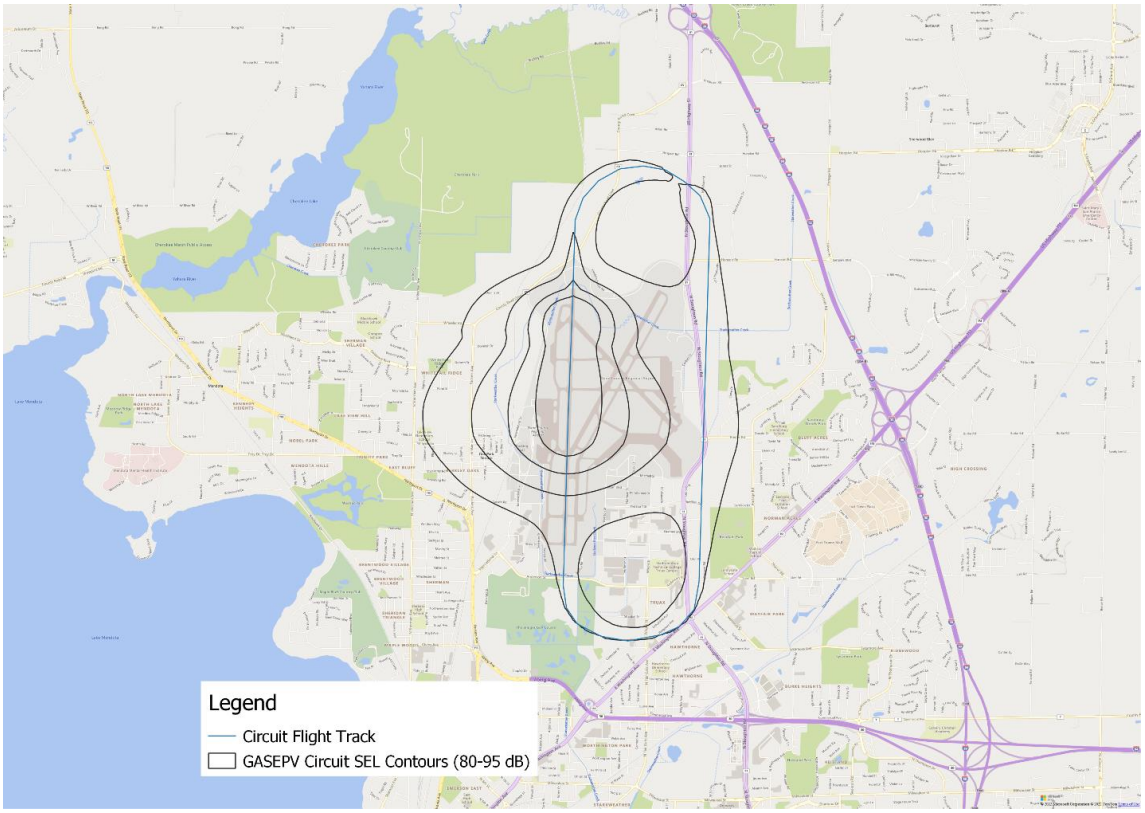
Figure 2. SEL Contours for GASEPV Circuit Operation



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U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of Environment and Energy

800 Independence Ave., S.W.
Washington, D.C. 20591

12/21/2022

Bobb A. Beauchamp
Regional Environmental Protection Specialist
Airports Division
Great Lakes Region
Federal Aviation Administration
2300 E. Devon Ave
Des Plaines, IL 60018

Dear Bobb,

The Office of Environment and Energy (AEE) has received the memo from HMMH on behalf of Dane County dated September 27th, 2022, referencing the Noise Exposure Map (NEM) update as a component of the Part 150 Noise Compatibility Planning Study for the Dane County Regional Airport (KMSN). The memo requests approval for a non-standard AEDT aircraft substitution for modeling circuit/touch-and-go operations at KMSN associated with the AEDT PA28 ANP type in AEDT version 3d.

HMMH identified in the memo that aircraft operations at KMSN include circuit/touch-and-go operations associated with the AEDT PA28 ANP type which does not have circuit/touch-and-go profiles in AEDT. Furthermore, HMMH research indicated operations associated with the AEDT PA28 ANP type at KMSN represent a mix of engine and propeller variants that are fitted with both fixed pitch and variable pitch/constant speed propellers. Based on this information, HMMH recommended substituting the AEDT PA28 ANP type for circuit/touch-and-go operations with the AEDT GASEPV ANP type, which is representative of single engine aircraft equipped with a variable pitch/constant speed propeller and has circuit/touch-and-go profiles available in AEDT.

AEE reviewed the memorandum and requested further clarification on the fleet mix of operations associated with the AEDT PA28 ANP type at KMSN with regards to equipage with fixed pitch versus variable pitch/constant speed propellers. In follow up coordination with Dane County and HMMH on December 19th, AEE's understanding is that operations associated with the AEDT PA28 ANP type at KMSN consist of a mix of PA28 variants that include both fixed pitch and variable pitch/constant speed propellers and that the proposed AEDT GASEPV ANP type is the best AEDT aircraft substitution for representing these circuit/touch-and-go operations while accounting for the proportion of the fleet equipped with variable pitch/constant speed propellers.

AEE has completed its review and approves the proposed AEDT GASEPV ANP substitution for modeling circuit/touch-and-go operations associated with the AEDT PA28 ANP type.

Please understand that this approval is limited to this particular NEM update for KMSN and for use with AEDT 3d only. Further non-standard AEDT inputs for additional projects at this or any other site will require separate approval.

Sincerely,

Donald Scata
Manager
AEE-100/Noise Division

cc: ARP Contacts (Jean Wolfers-Lawrence, Susan Staehle, APP-400)

Planning Memorandum – MSN TAF Confirmation

Date: October 10, 2022

To: Timothy Middleton, C.M. and Julia Nagy,
HMMH

From: Ryan Hayes and Patricia Song,
Mead & Hunt

Re: MSN Part 150 Study – FAA TAF Confirmation

INTRODUCTION AND BACKGROUND

This memo summarizes past aviation activity at the Dane County Regional Airport (MSN or the Airport) and presents an analysis of the Federal Aviation Administration's (FAA's) 2021 Terminal Area Forecast (TAF) published in March 2022, as well as some additional projections of future aviation activity levels at MSN for comparison purposes. This memo serves as the basis for the MSN existing and forecast aircraft operations assessed in the Airport Noise Compatibility Planning study under Title 14 of the Code of Federal Regulations (CFR) Part 150. Forecasting, by its very nature, is not exact, but it does provide some general indicators of how activity may change in the future. In that manner, this memo serves as a basis for evaluating how aircraft operations may change in the future at MSN. The past conditions serve as the basis for the future fleet mix forecasts described in more detail in the Part 150 study chapters.

In preparing a Part 150 study, one of the key products is the Noise Exposure Maps (NEMs). The NEMs include the existing and future (typically five years into the future) noise exposure contours prepared using the FAA's Aviation Environmental Design Tool (AEDT) noise model. This memo presents estimates of future aircraft operations and will serve as the basis for developing the future noise exposure contour maps.

HISTORICAL DATA

The memo presents the results of two forecasting methods that are later compared to the 2021 FAA TAF: regression analysis and historical trend forecasting methods. Regression analysis forecasts examine the effects of local socioeconomic variables on aviation demand while the latter is based on aviation demand at MSN in the recent past and present future activity levels assuming those trends continue into the future. Both methods account for factors local to the Airport itself or the region that MSN serves.

Base Data

Historical data regarding passenger enplanement and aircraft operations provided by the Airport was assessed and compared against the 2021 FAA TAF. Airport data was recorded monthly and categorized by calendar year. The data was converted to match the FAA fiscal year (FY) of October to September to be comparable to the TAF for this analysis. Thus, the range of historical data used begins in FY 2012 and goes to FY 2021, the most recent full fiscal year of data. **Tables 1 and 2** present the 2021 FAA TAF and

Airport provided data along with a percentage difference or delta (negative percentage implying more enplanements from the Airport data source) for comparison.

Table 1: FY 2012-2021 MSN Passenger ENPLANEMENT Data Comparison – TAF and Airport Records

Fiscal Year	TAF	Airport Data	Delta
2012	779,010	801,674	-2.91%
2013	815,913	834,622	-2.29%
2014	828,052	835,753	-0.93%
2015	827,520	842,419	-1.80%
2016	882,228	906,994	-2.81%
2017	927,071	952,504	-2.74%
2018	1,005,835	1,032,948	-2.70%
2019	1,142,812	1,184,493	-3.65%
2020	633,489	646,222	-2.01%
2021	551,317	560,152	-1.60%
CAGR '12-'21	-3.8%	-3.9%	N/A
Sources: 2021 TAF, Dane County Regional Airport			

Comparing the TAF records and Airport records, there is generally less than 3% difference between the TAF and Airport enplanement records. The largest difference is for 2019 where there is a difference of more 41,681 enplanements with the Airport data showing more enplanements than the TAF.

Table 2: FY 2012-2021 MSN Aircraft OPERATIONS Data Comparison – TAF and Airport Records

Fiscal Year	Total Operations			Itinerant Operations			Local Operations		
	TAF	Airport Data	Delta	TAF	Airport Data	Delta	TAF	Airport Data	Delta
2012	84,853	84,695	0.19%	66,200	66,212	-0.02%	18,653	18,483	0.91%
2013	83,926	83,926	0.00%	66,170	66,170	0.00%	17,756	17,756	0.00%
2014	80,585	80,584	0.00%	65,966	65,965	0.00%	14,619	14,619	0.00%
2015	77,716	77,667	0.06%	63,804	63,839	-0.05%	13,912	13,828	0.60%
2016	80,631	80,631	0.00%	65,265	65,265	0.00%	15,366	15,366	0.00%
2017	83,889	83,874	0.02%	65,643	65,628	0.02%	18,246	18,246	0.00%
2018	85,893	85,902	-0.01%	68,030	68,035	-0.01%	17,863	17,867	-0.02%
2019	82,085	82,261	-0.21%	69,341	69,321	0.03%	12,744	12,940	-1.54%
2020	73,170	73,170	0.00%	57,836	57,836	0.00%	15,334	15,334	0.00%
2021	75,957	76,035	-0.10%	59,246	59,264	-0.03%	16,711	16,771	-0.36%
CAGR '12-'21	-1.2%	-1.2%	N/A	-1.2%	-1.2%	N/A	-1.2%	-1.1%	N/A
Sources: 2021 TAF, Dane County Regional Airport									

Comparing the TAF records and Airport records for itinerant and local aircraft operations, there is generally less than 1% difference between the TAF and Airport records. The exception would be in local

operations in 2019 which can mainly be attributed to the Airport records noting 378 local military operations while the TAF estimates 276, which is a 0.37% difference.

Regional Population and Economic Data

The geographic region analyzed for the forecast is the Madison, WI Metropolitan Area (MSA) which includes Columbia, Dane, Green, and Iowa counties. Socioeconomic variables typically related to aviation demand forecasting were examined and include MSA population, income per capita, gross regional product (GRP), earnings, retail sales, and employment. The socioeconomic variables were utilized in the regression analysis forecast method. **Table 3** shows the 2012-2021 historical socioeconomics of the MSA. Historical growth rates range from approximately 1 to 3 percent.

Table 3: Historical Madison, WI MSA Socioeconomics (2012-2021)

CY	Population	Income/ Capita	Gross Regional Product	Total Earnings	Total Retail Sales	Total Employment
2012	608,979	60,035	48,257	29,428	15,962	462
2013	614,364	60,573	49,829	30,756	16,369	468
2014	619,677	61,819	52,949	31,413	16,845	478
2015	626,171	64,671	56,011	32,990	17,257	489
2016	636,340	65,690	58,005	34,055	17,635	502
2017	642,550	66,903	58,180	34,988	18,107	507
2018	648,478	68,625	59,507	35,803	18,633	514
2019	655,592	70,074	61,372	36,945	19,025	522
2020	661,424	71,241	62,796	37,782	19,665	529
2021	671,135	72,461	64,308	38,672	20,059	537
CAGR '12-'21	1.1%	2.1%	3.2%	3.1%	2.6%	1.7%
Sources: Wisconsin Department of Administration, Woods & Poole Economics, Inc.						

Future population data was sourced from the Wisconsin Department of Administration's (DOA) annual population estimates. However, the most recent update to population projections was in 2013. Thus, to provide the most recent as possible population forecast, the Woods & Poole Economics, Inc. (W&P) population forecast for the MSA was used to calculate the population growth rate. This growth rate was then applied to DOA base year 2021 data to calculate future MSA population. W&P provides socioeconomic data for gap years in the U.S. Census.

The historical and projected economic data was sourced from W&P data. The economic data was provided in 2012 dollars and have been converted to 2022 dollars using the CPI Inflation Calculator by the U.S. Bureau of Labor Statistics.

Table 4 shows the forecasts for population, income per capita, GRP, earnings, retail sales, and employment. Future growth rates range from approximately one half of a percent to 2 percent.

Table 4: Projected Madison, WI MSA Socioeconomics (2021-2041)

CY	Population	Income/Capita	Gross Regional Product	Total Earnings	Total Retail Sales	Total Employment
2021	671,135	72,461	64,308	38,672	20,059	537
2026	694,664	78,509	71,828	43,096	22,005	572
2031	719,018	84,753	79,775	47,775	23,841	605
2036	739,715	91,385	88,358	52,842	25,702	638
2041	761,008	98,551	97,782	58,425	27,690	672
CAGR	0.6%	1.5%	2.1%	2.1%	1.6%	1.1%
Sources: Wisconsin Department of Administration, Woods & Poole Economics, Inc.						

Mead &Hunt

FORECASTS OF AVIATION ACTIVITY

Regression Analysis Forecast Method

The first forecasting method assessed was based on multi-variable regression analysis. This method links conditions local to the Airport to changes in aviation demand (passenger enplanements and aircraft operations). It examines what effects, if any, local population or economics may have in influencing enplanements and/or operations.

The first step of this method is a correlation analysis of the socioeconomic variables with passenger enplanements and aircraft operations at MSN. Correlation describes how strongly related the rates of change between two variables are to each other. The stronger the correlation, the more linear their relationship is – a positive correlation means two variables increase together while a negative correlation means one variable decreases while the other increases. The stronger the positive correlation, the closer the correlation coefficient approaches the value of 1.0. Strong negative correlations are closer to -1.0 while having no correlation equals a correlation coefficient of 0.

Each of the socioeconomic variables were assessed against total enplanements, itinerant operations, local operations, and total operations using data between 2012 and 2021. Initial assessment resulted in no strong (correlation coefficient greater than 0.8) correlation between any of the socioeconomic variables with total operations. Sales represent the only moderate (greater than 0.7) correlation with total operations. Conversely, historical passenger enplanement strongly correlated with socioeconomic factors. Enplanements rose as population and economic indicators increased over time. **Table 5** shows the correlation coefficients of enplanements and total operations against the socioeconomic variables assessed.

Table 5: 2012-2021 MSN Passenger ENPLANEMENT and Total Aircraft OPERATIONs Correlation Analysis

Correlation Coefficient						
Regression Analysis	**Population**	**Income/Cap**	**GRP**	**Earnings**	**Sales**	**Employment**
Enplanements	0.922	0.906	0.834	0.902	0.921	0.893
Total Operations	0.103	0.040	-0.116	0.031	0.074	0.034

Additional multi-variable analysis was conducted to examine the effects of multiple variables on enplanements and operations. Three multi-variable regression models were tested against historical enplanements and total operations. Multi-variable models allow forecast to account for variables with different scale such as geography (local, county, state) or focus (population, income, employment). In the case of multi-variable regression, the adjusted R^2 is used to decide the level of confidence each model has. Every variable added to a model increases the R^2 and never decreases it, which can lead to an incorrectly high R^2 value. The adjusted R^2 value accounts for this effect and avoids the issue of not knowing if the R^2 value is high due to the model being better or because it has more predictor variables. **Table 6** shows the adjusted R^2 results of the multi-variable analysis.

Table 6: Multi-Variable Regression Analyses for ENPLANEMENTS and OPERATIONS

Multi-variable Analysis - Adjusted R Square	Enplanements	Total Operations
Population, Income/Capita, GRP, Earnings, Sales, Employment	0.932	0.773
Population, Income/Capita, GRP	0.958	0.696
Population, GRP	0.910	0.052
Population, Sales	0.833	0.460

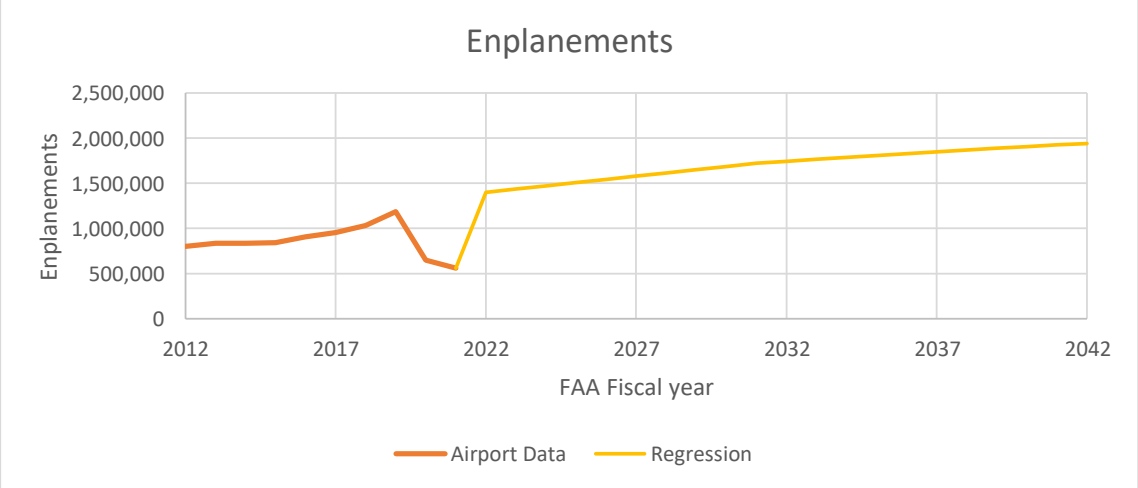
Regression Analysis Forecast of Passenger Enplanements

Due to the strong adjusted R^2 of the passenger enplanement multivariable analysis, a regression forecast using a two-variable model with population and GRP was used to project future enplanements. A forecast for total operations was not completed as the strongest adjusted R^2 is from the five-variable model using all the socioeconomic variables assessed. This is likely due to the result of the use of multiple variables which, as explained previously, naturally increases the R^2 that even the adjusted R^2 does not fully mitigate. Additionally, most of the socioeconomic variables have no correlation to historical total operations rules out regression-based projections for total operations at MSN as a forecasting method. **Table 7** and **Figure 1** show the enplanement forecast results using the population and GRP two-variable forecast method.

Table 7: Two-Variable Regression – Passenger ENPLANEMENT Forecast

FY	Enplanements
2019	1,184,493
2021	560,152
2027	1,576,918
2032	1,742,176
2037	1,847,539
2042	1,940,355
CAGR '21-'42	6.09%

Figure 1: Two-Variable Regression - Passenger ENPLANEMENT Forecast



Historical Trend Forecast Method

The historical trend forecast method is based on using the annual growth rate of the historical period (CAGR) to determine the future growth rate. **Table 8** shows the historical trends for enplanements and each operation category based on Airport provided data. The 2012 to 2019 CAGR was used for the historical trend forecast growth rate as it excludes the 2020 and 2021 COVID-19 related impacts years.

Table 8: 2012-2021 MSN Passenger ENPLANEMENT and Aircraft OPERATIONS Historical Trends

FY	Enplane-ments	ITINERANT					LOCAL			Total Opera-tions
		AC	AT	GA	MI	Total	Civil	Military	Total	
2012	801,674	11,738	19,670	29,940	4,864	66,212	17,542	941	18,483	84,695
2013	834,622	15,256	18,261	27,861	4,792	66,170	17,103	653	17,756	83,926
2014	835,753	15,022	18,014	28,741	4,188	65,965	14,274	345	14,619	80,584
2015	842,419	16,335	14,432	28,944	4,128	63,839	13,438	390	13,828	77,667
2016	906,994	18,530	11,086	30,559	5,090	65,265	14,916	450	15,366	80,631
2017	952,504	18,755	11,700	31,306	3,867	65,628	18,004	242	18,246	83,874
2018	1,032,948	21,912	10,899	30,704	4,520	68,035	17,581	286	17,867	85,902
2019	1,184,493	24,286	11,612	28,665	4,758	69,321	12,562	378	12,940	82,261
2020	646,222	20,069	6,168	27,058	4,541	57,836	15,065	269	15,334	73,170
2021	560,152	17,730	6,747	29,931	4,856	59,264	16,587	184	16,771	76,035
CAGR										
'12-'21	-3.9%	4.7%	-11.2%	0.0%	0.0%	-1.2%	-0.6%	-16.6%	-1.1%	-1.2%
'12-'19	5.7%	10.9%	-7.3%	-0.6%	-0.3%	0.7%	-4.7%	-12.2%	-5.0%	-0.4%
'19-'20	-45.4%	-17.4%	-46.9%	-5.6%	-4.6%	-16.6%	19.9%	-28.8%	18.5%	-11.1%
'20-'21	-13.3%	-11.7%	9.4%	10.6%	6.9%	2.5%	10.1%	-31.6%	9.4%	3.9%
'19-'21	-31.2%	-14.6%	-23.8%	2.2%	1.0%	-7.5%	14.9%	-30.2%	13.8%	-3.9%
Source: Dane County Regional Airport										

The historical trend method assumes past growth rates (positive or negative) to carry into the future. Thus, factors that have grown or declined in the historical period would continue to grow or decline through the forecast period. In this case, enplanements at MSN between 2012 and 2019 grew at an average annual rate of 5.7%. Based on the trend forecasting method, this growth would be carried into the future with total enplanements reaching over 1.7 million enplanements. Similarly, itinerant air carrier operations will continue to increase at an average annual rate of 10.9%, recovering to 2019 levels by 2025 and then growing to over 100,000 operations by 2042. In contrast, air taxi operations would decrease at an average annual rate of 7.3% and be reduced to less than 2,000 operations during the same period.

Table 9 shows the forecasted passenger enplanements and aircraft operations at MSN using the historical trend method.

Table 9: Historical Trend Method Forecast for MSN Passenger ENPLANEMENTS and Aircraft OPERATIONS

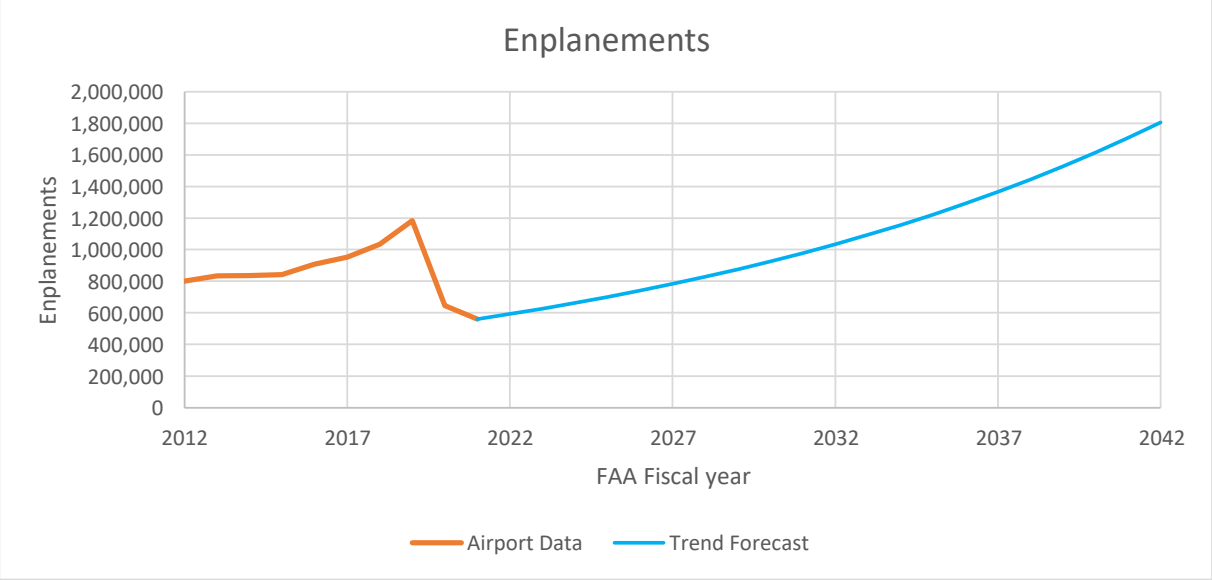
FY	Enplane-ments	ITINERANT					LOCAL			Total Opera-tions
		AC	AT	GA	MI	Total	Civil	Military	Total	
2019	1,184,493	24,286	11,612	28,665	4,758	69,321	12,562	378	12,940	82,261
2021	560,152	17,730	6,747	29,931	4,856	59,264	16,587	184	16,771	76,035
2026	740,290	29,803	4,630	29,015	4,780	61,239	13,067	96	13,001	74,468
2031	978,359	50,095	3,178	28,127	4,706	63,279	10,294	50	10,078	72,933
2036	1,292,988	84,206	2,181	27,266	4,632	65,387	8,110	26	7,812	71,429
2041	1,708,798	141,542	1,497	26,431	4,560	67,566	6,389	14	6,056	69,957
CAGR										
'21-'41	5.74%	10.95%	-7.25%	-0.62%	-0.31%	0.66%	-4.66%	-12.22%	-4.97%	-0.42%
Source: Dane County Regional Airport										

The historical trend forecast method is not a preferred forecast method due its prediction of declining total operations at MSN. This method does not account for factors such as market maturation in terms of enplanements or factors such as different airlines having different rates of aircraft adoption or retirement, airline route planning, or potential changes in the general aviation industry that might increase activity at MSN.

Historical Trend Forecast of Passenger Enplanements

Figure 2 illustrates the enplanement forecast results historical trend method.

Figure 2: ENPLANEMENT Forecast Comparison – 2021 TAF and Historical Trend Methods



Historical Trend Forecast of Aircraft Operations

Figure 3 through **Figure 5** focus on future aircraft operations. The trend forecast for local operations is steadily declining throughout the planning period while itinerant operations are forecast to slightly increase.

The total operation forecasts in **Figure 5** are the sum of the local and itinerant operations and thus combine the characteristics of the two forecasts. The historical trend forecast estimates overall operations will very gradually decline throughout the planning period.

Figure 3: Local Aircraft OPERATIONS Historical Trend Forecast

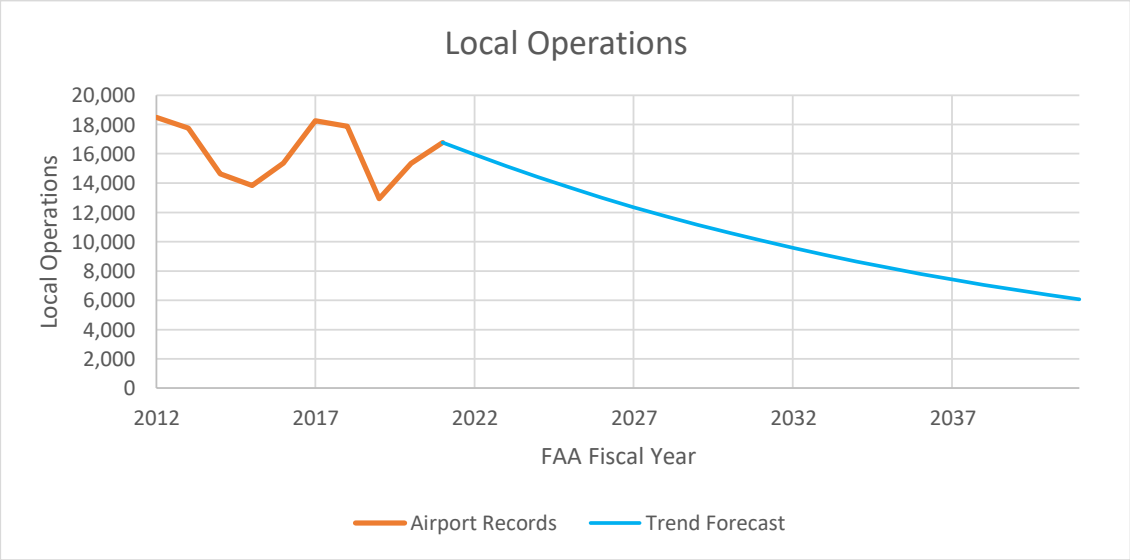


Figure 4: Itinerant Aircraft OPERATIONS Historical Trend Forecast

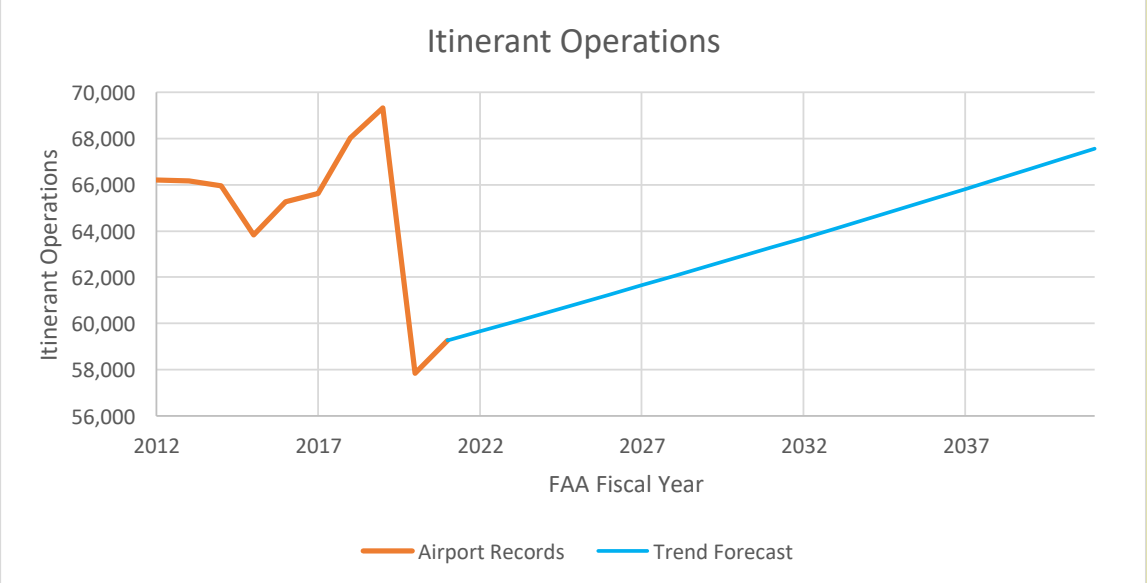


Figure 5: Total Aircraft OPERATIONS Historical Trend Forecast

2021 FAA TAF Comparison

The 2021 FAA TAF projects all passenger enplanements and aircraft operations except for military operations to grow within the forecast period. Military operations are held constant through the forecast period because the Department of Defense typically does not disclose its future plans to utilize civilian airports. Compared to the historical trend forecast, operation types that declined with the trend method are instead growing or projected to be relatively constant.

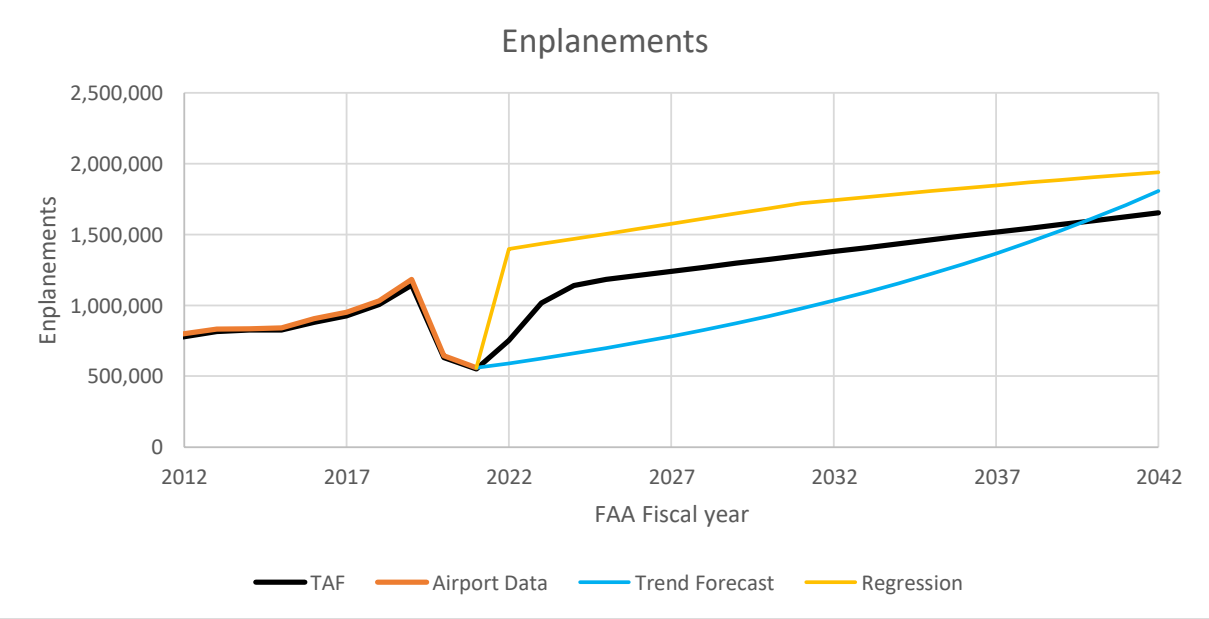
Table 10: 2021 FAA Terminal Area Forecast for MSN for ENPLANEMENTS and OPERATIONS

FY	Enplane-ments	ITINERANT					LOCAL			Total Opera-tions
		AC	AT	GA	MI	Total	Civil	Military	Total	
2019	1,142,812	24,284	11,655	28,689	4,713	69,341	12,468	276	12,744	82,085
2021	551,317	17,728	6,747	29,916	4,855	59,246	16,541	170	16,711	75,957
2027	1,240,424	34,654	6,606	31,990	4,855	78,105	16,025	170	16,195	94,300
2032	1,380,356	37,751	7,024	32,971	4,855	82,601	16,267	170	16,437	99,038
2037	1,518,024	40,618	7,446	33,983	4,855	86,902	16,514	170	16,684	103,586
2042	1,654,384	44,434	7,867	35,025	4,855	92,181	16,764	170	16,934	109,115
CAGR										
'21-'42	5.56%	4.64%	0.72%	0.76%	0.00%	2.19%	0.05%	0.00%	0.05%	1.79%
Source: 2021 FAA Terminal Area Forecast										

Enplanements Comparison

Figure 6 compares the enplanement forecast results of the 2021 TAF to the regression method and the historical trend method. While the enplanement projections in 2042 are relatively similar, the 2021 TAF forecast projects a COVID-19 recovery period of 13% CAGR where enplanements recover to 2019 levels by 2025 before growth tapers to 2% CAGR for the rest of the forecast period. This contrasts with the historical trend method which does not include a post-COVID-19 recovery period and instead projects a constant increase in enplanements for the forecast period, surpassing the 2021 TAF enplanement projections by 2040. As shown in **Figure 6**, the FAA TAF is considered a reasonable, middle of the road forecast for future passenger enplanements at MSN for the purposes of this study as its slightly less optimistic than the regression forecast and slightly more optimistic than the trend forecast.

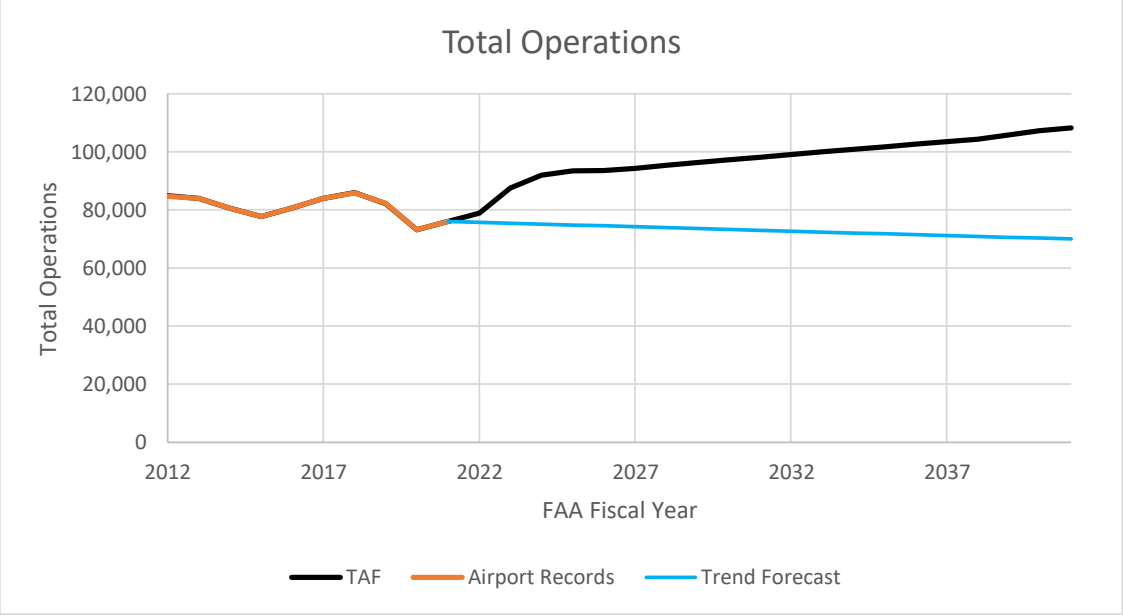
Figure 6: ENPLANEMENT Forecast Methods Comparison



Operations Comparison

The total operation forecasts in **Figure 7** are the sum of the local and itinerant operations and thus combine the characteristics of the forecasts. The historical trend forecast estimates overall operations will very gradually decline throughout the planning period. while the 2021 TAF projects a modest increase in total operations at MSN from 75,957 operations in 2021 to 109,115 operations by 2042.

Figure 7: Total Aircraft OPERATIONS Forecast Comparison – 2021 TAF and Historical Trend Method



Forecast Summary and Recommended Part 150 Forecasts

Analysis of the three forecast methods (regression, trend and FAA TAF) results in the 2021 TAF being the preferred forecast as it most accurately accounts for COVID-19 impacts and likely recovery scenarios. The lack of correlation between regional socioeconomics results in regression-based forecasts not being considered as reliable while historical trends forecasting methods are hindered by their inability to account for how COVID-19 impacts. The historical trend method also does not include a means to which adjust for market maturation in the airline industry or current positive growth trends in general aviation, particularly business aviation. One recommended adjustment to the 2021 FAA TAF is to include military operations as projected by the local Air National Guard and the Army National Guard units at MSN/Truax Field. Both units provided current and detailed operations statistics and aircraft fleet management information to the MSN Part 150 Study team for their respective military operations during the Part 150 forecast period.

Part 150 Forecast of Aircraft Operations by Category

As shown in **Table 11**, the most recent full year of normal operations (2019), existing year, also known as year of submission (2022) and study forecast year (2027) are depicted. The baseline year is the last full year of activity prior to the impacts of the pandemic. The existing/year of submission of 2022 is still pandemic impacted, but less so than 2020 and 2021, and the future year of 2027 assumes MSN has fully recovered from the pandemic and is again experiencing positive growth in both commercial aircraft

operations and general aviation aircraft operations. According to the 2021 FAA TAF, total operations at MSN are forecast to increase at a Compound Annual Growth Rate (CAGR) of 3.7% percent through 2027.

Because FAA TAF historical numbers are based on ATCT counts (FAA OPSNET) and the ATCT at Dane County Regional Airport is closed from 11 pm to 6 am local time, the FAA TAF projections for 2022 and 2027 were adjusted to account for the nighttime closure and capture these operations based on 2021 data. Projections for military operations in 2022 and 2027 were also adjusted based on input from the Air National Guard and Army National Guard.

These forecasts are shown in **Table 12** and again depict the most recent full year of normal operations (2019 base year), existing year (2022) and study forecast year (2027). As previously described the 2027 forecast of operations by aircraft type will be used to develop the future noise contours for the purposes of this study. **Table 13** includes the 2022 and 2027 TAF Adjusted forecast operations by aircraft type.

Table 11: Summary of Aircraft OPERATIONS Forecast by Aircraft Category

Aircraft Operation Category	2019 Baseline Year	2022 Existing Year/ Year of Submission	2027 Forecast Year
Air Carrier	24,284	19,702	34,654
Air Taxi	11,655	7,231	6,606
General Aviation	41,157	46,917	48,015
Military	4,989	5,025	5,025
Total Operations	82,085	78,875	94,300
2019 Source: Dane County Regional Airport 2022 and 2027 Source: FAA TAF Note: CY operations were used for 2021 as they are the most recent 12 months of available data.			

Table 12: Summary of Aircraft OPERATIONS Forecast by Aircraft Category – TAF Adjusted

Aircraft Operation Category	2019 Baseline Year	2022 Existing Year/ Year of Submission	2027 Forecast Year
Air Carrier	24,284	20,306	35,714
Air Taxi	11,655	7,395	6,757
General Aviation	41,157	47,735	48,825
Military	4,989	6,047	7,470
Total Operations	82,085	81,483	98,793
2019 Source: Dane County Regional Airport 2022 and 2027 Source: FAA TAF with Mead & Hunt/HMMH adjustments			

Table 13: Summary of Aircraft OPERATIONS Forecast by Aircraft Type – TAF Adjusted, 2022 and 2027

Aircraft Category	Aircraft Noise Performance (ANP) ID	Aircraft Type	2022 Operations	2027 Operations
AC	A300-622R	Jet	795	1,441
AC	757PW	Jet	250	453
AC	757RR	Jet	240	435
AC	A320-271N	Jet	343	1,198
AC	A319-131	Jet	1,932	6,748
AC	A320-211	Jet	341	1,191
AC	717200	Jet	1,473	-
AC	737800	Jet	879	3,070
AC	CRJ9-ER	Jet	10,609	10,934
AC	EMB170	Jet	725	747
AC	EMB175	Jet	2,719	9,497
AT	EC130	Helicopter	17	25
AT	CNA182	Piston	692	1,009
AT	CNA208	Turboprop	904	1,317
AT	FAL20	Jet	36	52
AT	BEC58P	Piston	11	16
AT	SD330	Turboprop	513	748
AT	CNA680	Jet	938	1,367
AT	CL600	Jet	1,906	825
AT	CNA55B	Jet	959	1,398
AT	EMB14L	Jet	1,419	-
GA	A109	Helicopter	473	484
GA	MU3001	Jet	408	418
GA	CNA525C	Jet	1,847	1,890
GA	CNA55B	Jet	628	643
GA	CNA560U	Jet	808	827
GA	CNA560XL	Jet	576	589
GA	CNA680	Jet	813	832
GA	CL600	Jet	664	680
GA	CL601	Jet	424	434
GA	EMB145	Jet	605	619
GA	CNA750	Jet	667	683
GA	FAL900EX	Jet	523	535
GA	GIV	Jet	557	570
GA	LEAR35	Jet	1,714	1,754
GA	GASEPV	Piston	4,935	5,051
GA	GASEPF	Piston	5,666	5,799
GA	CNA172	Piston	9,574	9,798
GA	CNA182	Piston	1,635	1,673
GA	BEC58P	Piston	2,657	2,719
GA	PA28	Piston	7,873	8,057
GA	COMSEP	Piston	1,258	1,287
GA	DHC6	Turboprop	1,739	1,780
GA	CNA441	Turboprop	692	708
GA	CNA208	Turboprop	999	1,022
MIL	F35A	Jet	0	4,304
MIL	F16C	Jet	3,081	0
MIL	RC26	Turboprop	120	0
MIL	C26	Turboprop	342	342
MIL	UH60A	Helicopter	2,132	2,452
MIL	F18	Jet	142	142
MIL	C130	Turboprop	74	74
MIL	C17	Jet	16	16
MIL	KC135R	Jet	22	22
MIL	T38	Jet	118	118
TOTALS			81,483	98,793

Sources: M&H, HMMH, Air National Guard, Army National Guard