5. Aviation Forecasts

5.1. INTRODUCTION

This chapter utilizes current and historical Vermont airport data along with national and regional trends to forecast aviation demand during the planning period. It is intended to help guide where the Vermont Agency of Transportation should expect to deploy funding and assets to best align with future aviation demand in the state.

This chapter focuses primarily on operations and based aircraft aspects as they comprise the bulk of the general aviation activity in Vermont. Market-specific activity features such as commercial and military elements are comprehensively analyzed as part of a master plan, with their system wide contributions (i.e. drive time coverage of the state for commercial service) addressed as part of the system plan.

The General Aviation (GA) user base in Vermont is extremely diverse, comprised of private/recreational flying, flight instruction, business travel, emergency medevac operations, agricultural operations, aerial photography and surveying among others. The types of aircraft utilized in GA range from towed motorless gliders to complex business jets employing the most advanced technologies.

This chapter explores historical and current aviation activity on the local, regional and national level to attempt to forecast future aviation activity in the Vermont airport system over the next twenty years. It relies on methodologies and practices accepted in the industry and by the FAA, however it should be noted that as the planning period evolves, events and environmental variables such as socioeconomic and other factors could facilitate unforeseen circumstances at one or more individual airports. As such, not all airports in the Vermont system may realize this forecast activity; however, it is believed that generally, the system as a whole can rely on the information provided and underlying trends identified.

In the process of updating the Vermont State Airport System Plan (VASP), forecasting on the local and state levels plays an important role. An understanding of a forecast of aviation activity will drive decisions on where resources and efforts need to be allocated throughout the planning period to meet projected demand. It is also helpful to examine statewide socioeconomic and demographic trends that will contribute to the health of Vermont's air transportation industry as these important factors will drive aviation demand on all levels. Lastly, it's important to identify strengths or weaknesses that will contribute to, or detract from, a healthy aviation system.

The areas forecast for this system plan update include aircraft operations, based aircraft and enplanements where applicable. While the focus for Burlington International Airport will mostly be on passenger enplanements, most of Vermont's airports are general aviation and as such, most of the focus of this chapter will lie in aircraft operations and based aircraft.

5.2. FORECAST BACKGROUND

In the process of forecasting for this system plan update, historical trends and current activity levels were used to attempt to predict future aviation demand. Two important factors in measuring aviation activity are airport operations and based aircraft. Data was collected from the Vermont Agency of Transportation (VTrans) including historical fuel sales and based aircraft counts and was supplemented with data from the FAA Airport Master Record Forms for each airport. The data was tabulated and used to derive forecast data.

5.2.1. National and Regional Trends

Future aviation activity will be impacted by events at the national, regional and local levels. National events such as the attacks of September 11, 2001 and the 2008 financial crisis have profound negative impacts on U.S. aviation with ripple effects felt worldwide. Similarly, when the price of oil drops below certain levels, GA in particular, sees a boost in activity. At the local level, state demographic shifts and employment growth rates will drive both aircraft operations and based aircraft across the state. The following sections will detail the various tools used to derive forecast data.

FAA Aerospace Forecast

The FAA Aerospace Forecast for the period 2017-2037 indicates that the long-term outlook for GA is stable to optimistic and the general aviation fleet is projected to grow .1% per year, resulting in an increase of approximately 3,400 aircraft.

Utilizing the FAA Aerospace Forecast data to explore the national trends between the calendar years 2010 to 2016, yields the following with respect to active aircraft[1]:

- Fixed wing piston engine aircraft declined 9.9%
- Fixed wing turbines increased 11%
- Rotorcraft increased 6%
- Experimental/light sport aircraft increased 15%
- Total piston engine aircraft declined by 10%
- Total turbine aircraft increased by 12%

These statistics indicate growth in all sectors of GA except single engine piston aircraft which is projected to continue to decline. This is due to many factors, including the aging of the pilot population, the increasing costs of aircraft ownership including maintenance and insurance and other factors.

FAA Terminal Area Forecasts (TAF)

The TAF is FAA's official forecast of aviation activity for U.S. airports. It represents a high-level forecast developed by FAA headquarters using macro-level inputs of national and regional data

[1] The FAA defines an active aircraft as one that has a current registration and was flown at least one hour during the calendar year.

with the airport specific forecast being the result of broad-based forecast applications. While generally understood not to be a detailed reflection of local market demand, the TAF is informed by regional trends and socioeconomic data and used by the FAA as the basis from which a detailed forecast will be measured.

New England Region Airport System Plan – General Aviation (NERASP – GA)

The NERASP - GA was a collaborative plan amongst the six New England state transportation departments with the goals of identifying critical issues that will affect general aviation in new England and working toward strategies for a wisely planned and managed system of airports in New England.

The NERASP - GA study utilized the FAA's General Aviation and Air Taxi Activity (GAATA) Survey, which is an annual survey conducted to help understand the use and utilization of GA aircraft, to derive information about active aircraft in New England. The study found that between 2000 and 2010, the total number of active aircraft in new England varied cyclically from year to year. New England has seen an overall decline in based aircraft since 2007 partly due to older aircraft being retired as result of the economic recession, but also more detailed accountability for seasonal aircraft that are based at more than one airport throughout the year.

Another finding of the study is that in looking at the total number of New England aircraft as a percentage of the total U.S. fleet, New England has closely followed the U.S. trend, however since 2008, New England has seen a slow, steady decline in the number of aircraft in comparison to the remainder of the U.S.

The NERASP – GA study also looked at the numbers of active aircraft per capita and compared New England to the rest of the U.S. The researchers found that the ratio of active aircraft per 100,000 residents, while showing great variability year to year, had the lowest numbers in more urbanized areas in Connecticut, Massachusetts and Rhode Island. New Hampshire seemed to have the highest number of aircraft per capita however the overall trend in New Hampshire was downward. Vermont's aircraft per capita varied greatly over the study period and finished very close to where it started.

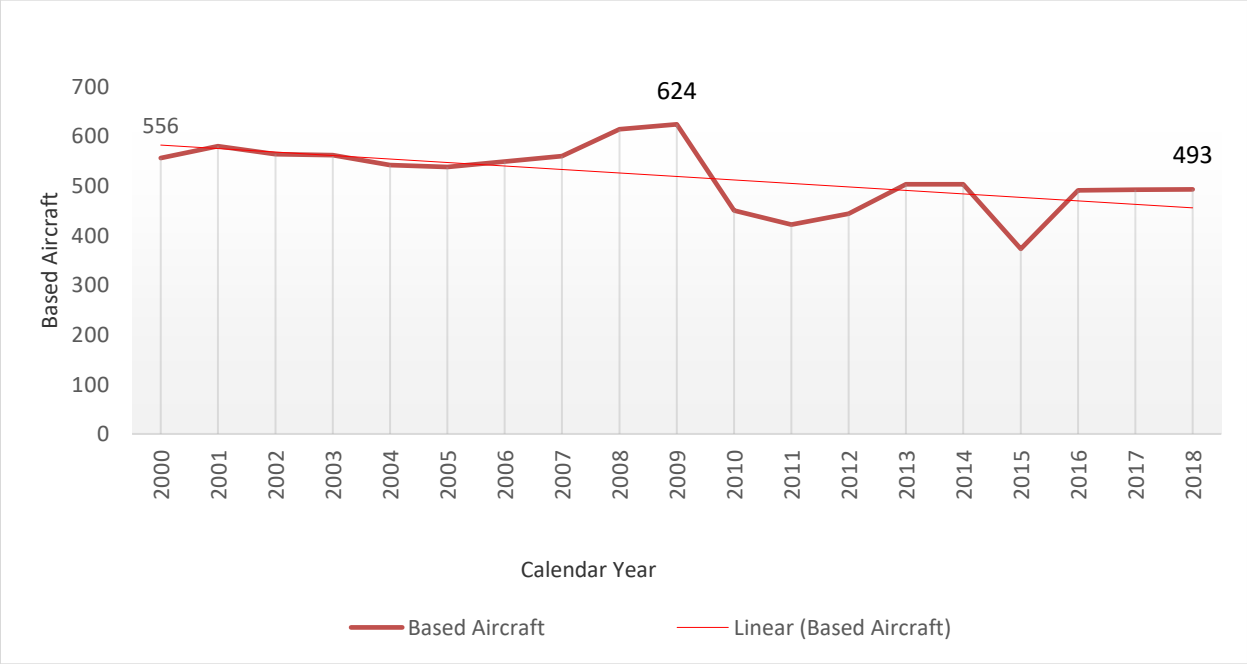
The study examined average hours flown per year by active aircraft. They found some anomalies in the data for Connecticut and Rhode Island which skewed the numbers for those states, but generally, average aircraft utilization in New England showed a decline over the 11-year period. Vermont was on the lower end of this scale and seemed to be hit particularly hard in 2001 and 2008 while showing some recovery in the latter years.

5.2.2.Historical Based Aircraft

Figure 5-1 represents historical based aircraft in Vermont, while Figure 5-2 shows the relationship between historical based aircraft in Vermont versus historical based aircraft in all New England. The range of data is from 2000 to 2018 and is derived from the FAA's TAF which provides historical data on based aircraft as well as future projections. These TAF counts reflect public use airports in the NPIAS only and also include military aircraft. The VASP efforts included a survey effort which builds upon the FAA total counts. These revised totals are reflected later in this chapter.

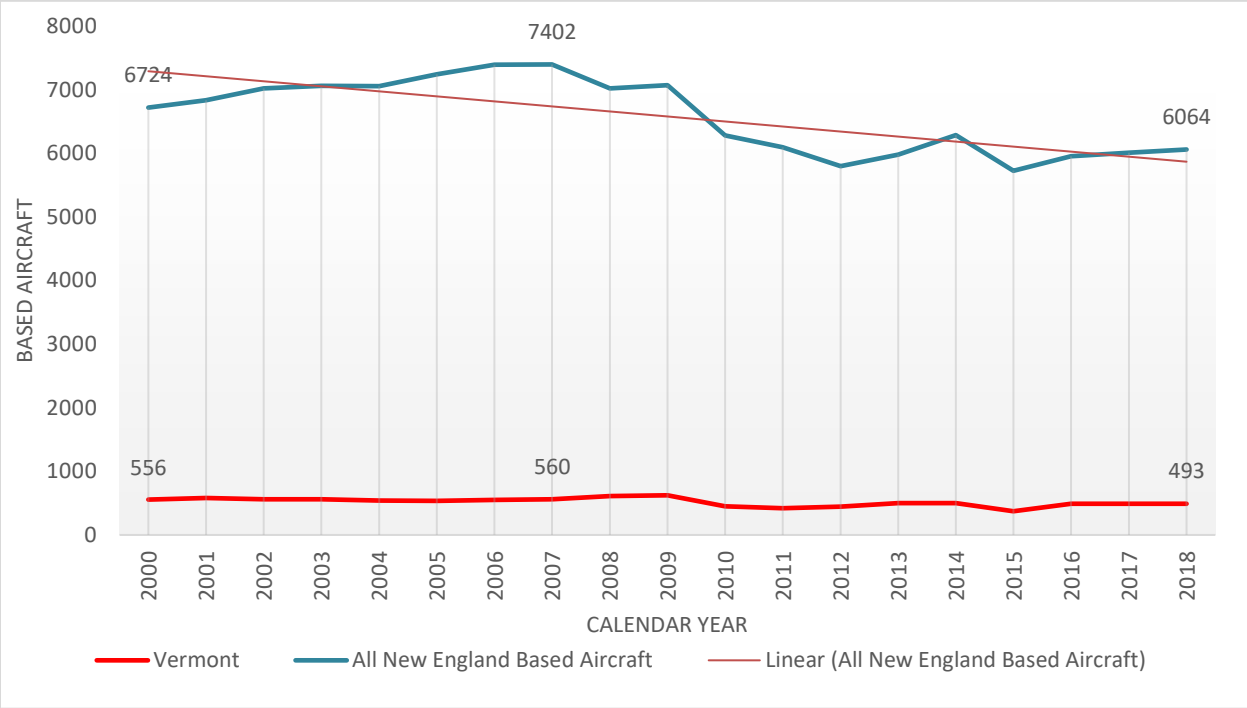
Of significance within the FAA counts however is there appears to be a correlation between Vermont's based aircraft numbers and the rest of the New England Region, though Vermont appears to be seeing a lower rate of decline than the rest of New England. The New England region saw a 13.9% decline in based aircraft over a 16-year period, while Vermont saw a 4.3% decrease over the same timeframe. The main difference between Vermont and the rest of the country is while the U.S. based aircraft inventory is increasing in larger corporate jets and twin-engine class aircraft, Vermont is overwhelmingly single and piston engine aircraft, which has seen slowly and steadily declining both regionally and nationally.

Figure 5-1: Vermont Based Aircraft (2000-2018)



Source: FAA Terminal Area Forecasts

Figure 5-2: Based Aircraft Comparison (2000-2018)



Source: FAA Terminal Area Forecasts

5.2.3. Historical Aircraft Operations

As with based aircraft, historical aircraft operations can be used to produce a reliable forecast trend for the Vermont system of airports. The FAA categorizes an aircraft operation, which is a takeoff or a landing, into varied groups. These categories include commercial operations (air carrier, air taxi and commuter), GA and military activity. For the purposes of this study, GA operations are used which identify operations not classified as air carrier or military. Activity at airports with an air traffic control tower (ATC) facility are systematically recorded and reported, however aircraft operations at airports without an ATC facility are typically an estimate. In Vermont, only Burlington International Airport has an ATC facility, therefore FAA TAF data was used to plot historical Vermont operations.

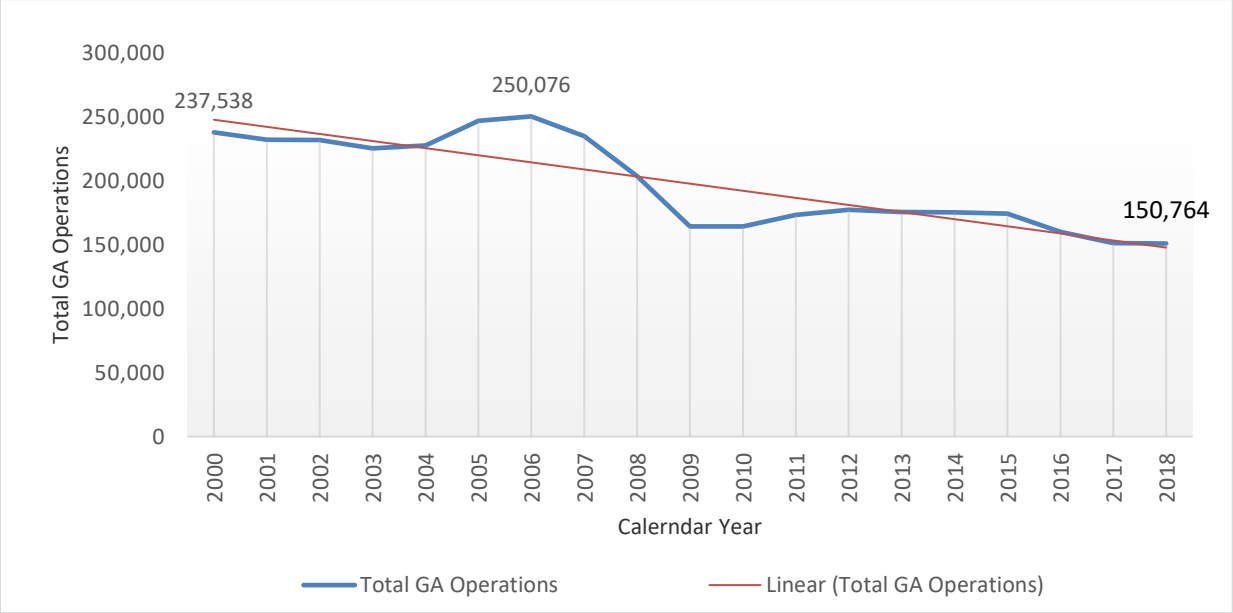
Of the 16 study airports considered for this forecast, historical aircraft operations data was readily available for 12 airports through the FAA Terminal Area Forecast. These airports include:

- Warren-Sugarbush
- Post Mills
- Middlebury State
- Burlington International
- Caledonia County
- William H. Morse
- Newport State
- Franklin County State
- Edward F. Knapp State
- Morrisville-Stowe State

- Rutland – Southern Vermont Regional
- Hartness State

Figure 5-3 shows the historical trend of GA operations in Vermont from 2000 to 2018.

Figure 5-3: Historical Vermont Operations (2000-2018)



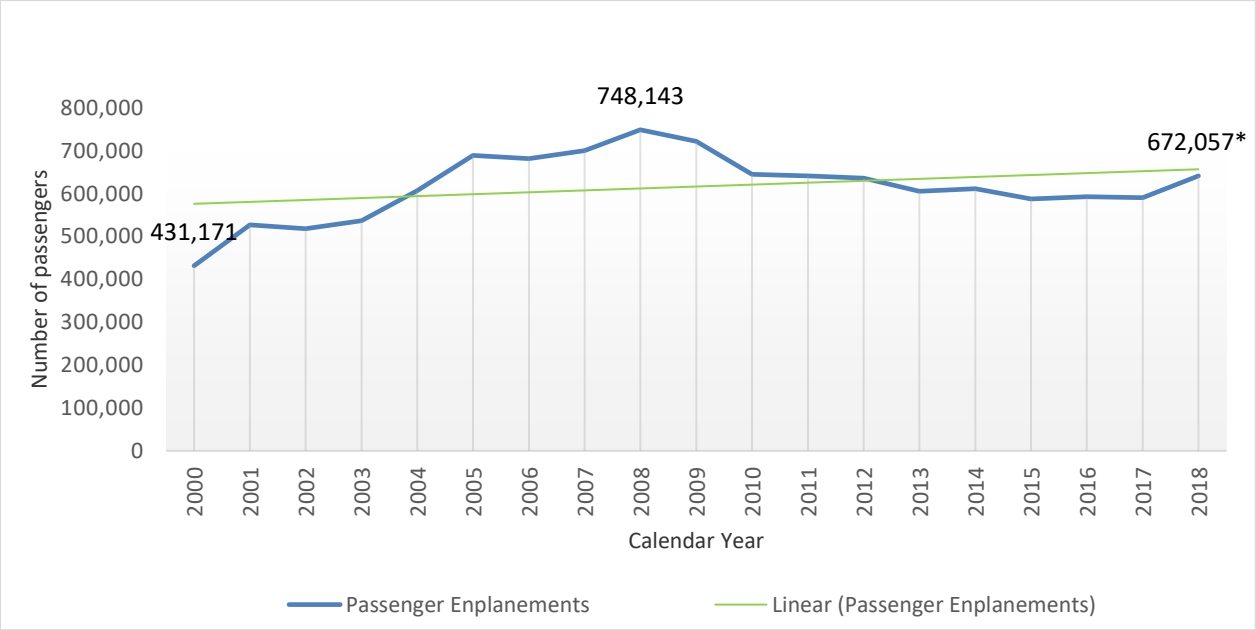
Source: FAA Terminal Area Forecasts

Figure 5-3 indicates Vermont experienced a decline of 36.53% from 2000 to 2018 as operations went from 237,538 to 150,764. In comparison to the national trend which saw a 21.4% decrease over the same period as U.S. GA operations declined to approximately 68 million from approximately 87 million. Vermont's GA operations have seen a greater decline than the national trend.

Regarding passenger enplanements, Figure 5-4 depicts passenger enplanements in the state of Vermont. Burlington International Airport, which accounts for over 99% of the State's enplanements, has seen a steady climb in enplanements, followed by a period of decline and stagnation consistent with the recession that occurred during that time. Passenger enplanements at BTV are increasing due in part to larger aircraft replacing smaller regional jets and 2019 is anticipated to have increased passenger traffic with the introduction of Frontier Airlines. Since 2010 Rutland enplanements have fluctuated between 5,200 and 5,900 annually, schedules and capacity are set and fixed as part of the essential air service program and these levels are expected to continue. While Morrisville-Stowe does record some commercial enplanements (200-300 in recent years), these enplanements are not as result of regularly scheduled passenger service. The FAA threshold for a commercial service airport is 2,500 enplanements.

Overall, enplanements in Vermont have fared better than the national average which saw a 16.7% increase from 704 million passengers to 823 million passengers over the same period.

Figure 5-4: Vermont Passenger Enplanements



*Source: FAA Terminal Area Forecasts- * 2018 is estimated*

5.3. AIRPORT ACTIVITY FORECASTS

The FAA conducts an annual forecast of aviation activity to properly plan for the allocation of limited financial resources for the highest return on investments. Similarly, this VASP will present forecast data so VTrans can more effectively predict future activity to meet demand.

GA has long been a lagging indicator of the U.S. economy. As such, it has been slow to recover from the Great Recession. Corporate aviation has suffered recently from high operating costs such as fuel and insurance, coupled with a lack of capital for the purchase of aircraft and equipment and the payroll to support a flight department. Recreational GA is typically accomplished with disposable income which has been in short supply for most average income Americans since 2008. Despite this, GA is starting to make a comeback. The recent downturn has had a negative effect on GA airports, which comprise most of Vermont's system. There are however recent gains being made, particularly in the corporate aviation world as companies are beginning to reengage with turbine engine aircraft acquisitions and leasing.

5.3.1. Forecasting Background

According to the TRB's (Transportation Research Board) Airport Cooperative Research Program (ACRP) *Synthesis 2: Airport Aviation Activity Forecasting,* traditional aviation forecasting methods include the following:

- Market share forecasting-local activity calculated as a share of some larger aggregate forecast.
- Econometric model forecasting-aviation activity tied to other economic measures.
- Time series model forecasting-trend extrapolation of existing activity.
- Simulation-a separate method used to provide a high fidelity "snapshot" estimates of how traffic flows across a network or through an airport.

It is important to emphasize that aviation forecasting is not an exact science, so experienced judgment and practical considerations ultimately influence the level of detail and effort required to establish a reasonable aviation forecast and the development of decisions that result from them.

This forecasting effort is presented in standard 5, 10, and 20-year increments. Historically, the general aviation industry has been highly cyclical, exhibiting strong growth during economic expansions and negative growth during economic uncertainty.

The following sections detail the performance metrics used to derive the projected growth scenarios. They include population by county, fuel sales and based aircraft.

Population

Vermont's population is an important factor in trying to determine causal effects of changes in aviation activity. It can also help to identify airports within the system where resources will likely need to be deployed to meet aviation demand. Population information on each Vermont county was collected from 2007 and 2017 from the U.S. Census Bureau and analyzed to determine the population trend for that county over the ten-year period. The results can be seen in Table 5-1. Most of the population changes were relatively subtle, however they typically correlated closely with other factors used to determine the growth rate scenarios. Counties that have seen population growth have typically also seen growth in based aircraft, operations and fuel sales.

First, a baseline growth rate was established for the state and then each county was compared against that baseline. The Counties that scored more than two times the baseline growth rate were grouped into the High Growth Category and those that saw a decline in population of more than two times the baseline were grouped into the Low Growth Category.

Fuel Sales

Historical fuel sales data was provided to the planning team by the Vermont Agency of Transportation. The data was separated into two groups, a 10-year lookback and a more accurate 4-year lookback. The data for the airports that have sold fuel was compiled into a spreadsheet. Average annual growth rates were established and used as an additional metric to determine those airports' activity levels.

Table 5-1: Vermont Population Changes by County (2007-2017)

Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Addison	36,886	36,905	36,847	36,811	36,861	36,837	36,898	37,009	37,035	36,959	36,776
Bennington	37,077	37,168	37,151	37,077	36,812	36,669	36,692	36,445	36,317	36,191	35,594
Caledonia	31,238	31,167	31,213	31,189	31,130	31,095	31,151	30,981	30,780	30,333	30,164
Chittenden	153,625	154,659	155,793	156,762	157,679	158,641	159,818	160,531	161,382	161,531	162,372
Essex	6,421	6,404	6,331	6,297	6,323	6,216	6,196	6,125	6,163	6,176	6,230
Franklin	47,455	47,462	47,620	47,788	48,175	48,253	48,272	48,642	48,799	48,915	49,025
Grand Isle	7,152	7,211	7,022	6,958	6,983	6,980	6,982	6,994	6,861	6,919	6,998
Lamoille	23,778	23,971	24,193	24,517	24,659	24,905	25,050	25,082	25,235	25,333	25,337
Orange	29,119	29,032	28,965	28,941	29,025	28,933	28,879	28,859	28,899	28,919	28,974
Orleans	27,332	27,269	27,234	27,225	27,162	27,159	27,170	27,082	27,100	26,863	26,841
Rutland	62,618	62,368	61,946	61,573	61,243	60,875	60,545	60,086	59,736	59,310	59,087
Washington	59,275	59,278	59,353	59,550	59,543	59,351	59,221	58,998	58,612	58,504	58,290
Windham	44,444	44,407	44,441	44,503	44,229	43,997	43,808	43,714	43,386	43,145	42,869
Windsor	57,061	56,850	56,708	56,601	56,626	56,227	56,173	56,014	55,737	55,496	55,100

Source: Vermont Population 2000-2014 http://www.healthvermont.gov/health-statistics-vital-records/vital-records-population-data/vermont-population-estimates

Based Aircraft

In the forecasting effort, based aircraft is a critical factor, not only in determining the forecast trend of an airport or a system of airports, but also in determining where to expect growth and a necessary corresponding allocation of resources. The number of based aircraft determines important airport and system needs such as numbers of hangars and tie-downs, amounts of fuel to be sold and airport personnel requirements. Further, understanding the types of aircraft utilizing the airport(s) helps to direct important planning objectives such as determining critical airport design elements like required runway lengths and taxiway widths.

5.3.2. Forecast Methodology

Airport Performance Relative to the VT Airport System - > Airport Growth Categories

VT Airport System Performance Relative to National Trends -> Adjusted Future VT Performance

Adjusted VT Airport System Future Performance + Airport Growth Category -> VASP Growth Rates

Airport Performance

After all the forecast background data was tabulated, trends began to develop respective to airport performance relative to the system. Generally, the counties that have seen growth, also saw growth in airport performance metrics. The compound annual growth rate for Vermont's population for the years 2004 through 2014 is .107%. from that figure, the counties that performed twice as well as the average were grouped into the High Growth Performance Group and those that performed less than twice this number were grouped into the Low Growth Performance Group. The same exercise was conducted for avgas fuel sales, jet-a fuel sales, based aircraft and operations. What was discovered was that Shelburne Airport, Burlington International

Airport, Franklin County Airport, Morrisville-Stowe Airport and Newport State Airport overperformed in most of the performance metrics including population growth. Airports which performed below this level included William H. Morse Airport, Caledonia County Airport, Rutland-Southern Vermont Regional Airport, Warren Sugarbush Airport and Deerfield Valley Airport. The populations of Addison and Orange County and saw near zero population change however the airports located within them, Middlebury State Airport and Post Mills Airport underperformed in based aircraft numbers changes and operations. Conversely, sparsely populated Essex County saw greater than baseline population decline, however John H. Boylan Airport significantly outperformed the baseline for based aircraft numbers. Lastly, Hartness State saw a population decline with an increase in avgas gallons sold.

Airports were assigned a growth category of Low, Average, or High, in regard to their historical performance relative to the system. Airports are not confined to these categories and external economic forces and direct or indirect investment (or lack thereof) could influence an airport's position relative to the system resulting in periods of higher or lower growth over the 20-tear planning horizon. This forecast represents the general growth parameters in which an airports activity is likely to occur over the long run.

Vermont State Performance

National trends are a good general reference for the broader issues and changed that are occurring within the industry, especially for items such as commercial and itinerant general aviation. It is important however to calibrate these national trends to account for the unique features of Vermont. Features from the national aerospace forecast including fuel sales, aircraft mix and operations by aircraft type were calibrated to the activity mix for Vermont. The higher share of single engine piston (100LL) aircraft in Vermont is weighted against the greater projected declines in the national forecast to less of a decline in Vermont as these activity levels are nature. In future updates of the VASP, if the mix remains unchanged in light of continued national decline, a more detailed effort should review in this is a potential liability into the future, however there is nothing to indicate that currently.

Selected Growth Rates

The final step in the VASP forecast methodology involved taking the adjusted VT airport system growth rates and creating the anticipated ranges of growth to help inform the system planning process. The base VT airport adjustment growth rate was assigned to airports in the "Average" growth category. The base growth rate was doubled for airports in the "high" growth category and halved for airports in the "low" growth category. For based aircraft, the actual compound annual growth rate (CAGR) for the high growth category airports of 0.79% was used for the "high" category.

The growth categories for historical based on historical performance are displayed in Table 5-2.

Table 5-2: Aircraft Operations Compound Annual Growth Rates

Airport	2004	2017	Compound Annual Growth Rate	Historical Growth Category
Basin Harbor	-	-	-	N/A
Burlington International	95,106	67,110	-2.25%	Average
Caledonia County	2,050	7,380	12.35%	High
Deerfield Valley Regional	-	-	-	N/A
Edward F. Knapp	32,000	24,125	-2.54%	Average
Franklin County	21,400	10,095	-6.60%	Low
Hartness State	9,300	6,611	-3.05%	Average
John H. Boylan	-	-	-	N/A
Middlebury State	35,250	10,900	-10.12%	Low
Morrisville-Stowe	18,020	11,976	-3.65%	Average
Northeast Kingdom International	7,140	9,452	2.58%	High
Post Mills	9,510	4,330	-6.90%	Low
Rutland – S. VT Regional	29,376	31,770	0.71%	Average
Shelburne	-	-	-	N/A
Warren-Sugarbush	22,500	17,620	-2.20%	Average
William H. Morse	26,250	14,377	-5.33%	Average
State Total	307,902	215,746	-2.90%	
Average Airports	232,552	173,589	-.62%	
High Growth Airports	9,190	16,832	5.66%	
Low Growth Airports	66,160	25,325	-8.36%	

Source: FAA Terminal Area Forecasts

The Aircraft Operations Growth Rates can be seen in **Table 5-3**.

Table 5-3: Aircraft Operations Growth Rates

Operations	
Average	0.42%
High Growth Rate	0.84%
Low Growth Rate	0.21%

Source: McFarland Johnson 2017

Like aircraft operations, a similar exercise was conducted for historical based aircraft. Based aircraft counts were refreshed during the project so analysis period is for the years 2005-2017. First, the statewide total compound annual growth rate was calculated. Airports that remained positive were conserved as "high", near flat was "average" and below average declines as "low". John H. Boylan was classified as average due to the low sample size. **Table 5-4** lists Vermont's airports and their compound annual growth rates.

Table 5-4: Based Aircraft Growth Rates

Airport	2005	2017	Compound Annual Growth Rate	Historical Growth Category
Basin Harbor	0	0	0.00%	Average
Burlington International (excluding military)	70	86	1.55%	High
Caledonia County	20	18	-0.93%	Low
Deerfield Valley Regional	6	7	1.19%	High
Edward F. Knapp	55	53	-0.31%	Average
Franklin County	71	74	0.34%	High
Hartness State	37	27	-3.09%	Low
John H. Boylan	1	5	5.56%	Average
Middlebury State	45	37	-1.80%	Average
Morrisville-Stowe	26	27	0.31%	High
Newport	19	20	0.42%	High
Post Mills	23	9	-12.96%	Low
Rutland – Southern Vermont Regional	41	30	-3.06%	Low
Shelburne	55	57	0.29%	High
Warren-Sugarbush	65	50	-2.50%	Low
William H. Morse	47	32	-3.91%	Low
Statewide Total	581	532	-0.55%	
Average	24.8	20.4	-1.61%	
High	49.4	57	1.20%	
Low	42	31.4	-2.39%	

Source: FAA Terminal Area Forecast

Again, the High Growth Rate for based aircraft used the actual for the airport growth category grouping whereas the Baseline Growth Rate used the average and the Low Growth Rate is a blend of state performance and national trends as seen in **Table 5-5**. The industry as a whole has been using aviation assets more efficiently which is the primary reason for increased operations with decreased based aircraft. It is important to note that based aircraft counts may fluctuate above and below these numbers on a seasonal basis and that projects at airports or nearby airports could produce short term shifts.

Table 5-5: Based Aircraft Growth Rates

Based Aircraft	
Average	-1.61%
High Growth Rate	1.20%
Low Growth Rate	-2.39%

Source: McFarland Johnson 2017

5.3.3. Airport Forecast Summaries

In the following sections, the calculated growth rates for operations and based aircraft for each of the 16 airports in the Vermont system are calculated and plotted out for the planning period of 2017-2037 at 5-year, 10-year and 20-year increments.

5.3.4. Forecast Operations

Basin Harbor Airport

As demonstrated in the following table and chart, there was no FAA TAF historical or forecast data for Basin Harbor Airport so a simple chart utilizing the number of operations from the airport's 5010 data was utilized. The Low Growth Rate yielded the lowest number of forecast operations, while the High Growth Rate yielded the highest number of forecast operations.

Basin Harbor Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	0	0	0
Average Growth (.42%)	**2,165**	**2,211**	**2,305**
High Growth (.84%)	2,211	2,305	2,506
Low Growth (.21%)	2,142	2,165	2,211

Burlington International Airport

As demonstrated in the following table and chart, the FAA TAF yielded the lowest number of forecast operations throughout the forecast period, despite high historical operations, followed by the Low Growth Rate. The High Growth Rate consistently yielded the highest number of forecast operations.

Burlington International Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	75,781	70,190	73,743
Average Growth (.42%)	**77,658**	**79,303**	**82,697**
High Growth (.84%)	79,296	82,683	89,897
Low Growth (.21%)	76,850	77,660	79,307

Caledonia County Airport

From the following table and graph, we can see an abrupt shift in the number of operations from 2007 to 2009. After 2009, the TAF forecast data falls in the middle of the range with the High Growth Rate projecting the most operations and the Low Growth Rate predicting the least number of operations.

Caledonia County Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	7,380	7,380	7,380
Average Growth (.42%)	**7,536**	**7,696**	**8,025**
High Growth (.84%)	7,695	8,024	8,724
Low Growth (.21%)	7,458	7,536	7,696

Deerfield Valley Regional Airport

As can be seen in the following table and chart, there was no FAA TAF historical or forecast data for Basin Harbor Airport so a simple chart utilizing the number of operations from the airport's 5010 data was utilized. The Low Growth Rate yielded the lowest number of forecast operations, while the High Growth Rate yielded the highest number of forecast operations.

Deerfield Valley Regional Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	0	0	0
Average Growth (.42%)	**3,167**	**3,235**	**3,376**
High Growth (.84%)	3,323	3,370	3,665
Low Growth (.21%)	3,133	3,166	3,233

Edward F. Knapp Airport

The following table and graph shows the historical FAA TAF data dropped sharply from 2008-2009. As is typically the case, the Low Growth Rate yields the lowest number of forecast operations while the High Growth Rate predicts the highest.

Edward F. Knapp Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	24,125	24,125	24,125
Average Growth (.42%)	**24,636**	**25,158**	**26,234**
High Growth (.84%)	25,155	26,230	28,518
Low Growth (.21%)	24,379	24,636	25,159

Franklin County Airport

FAA's historical TAF data shows a steep decline from 2006 to 2007 which could have been some sort of correction. Beyond 2007, the TAF remains flat. The Low Growth Rate produces the lowest

forecast operations numbers while again the High Growth Rate yields the highest forecast operations numbers.

Franklin County Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	10,095	10,095	10,095
Average Growth (.42%)	**10,309**	**10,527**	**10,978**
High Growth (.84%)	10,526	10,976	11,933
Low Growth (.21%)	10,201	10,309	10,528

Hartness State Airport

The FAA TAF historical data varied widely from 1997 to 2016 while in the out years, the High Growth Rate forecasts the greatest number of airport operations and the Low Growth Rate forecasts the least amount.

Hartness State Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	6,611	6,611	6,611
Average Growth (.42%)	**6,751**	**6,894**	**7,189**
High Growth (.84%)	6,893	7,188	7,815
Low Growth (.21%)	6,681	6,751	6,894

John H. Boylan Airport

The FAA TAF historical and forecast date was unavailable so the operations data from the 5010 record was used to plot the forecast operations data. The last complete data available for use was 12 months ending in November 2012.

John H. Boylan Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	0	0	0
Average Growth (.42%)	**420**	**429**	**448**
High Growth (.84%)	438	457	497
Low Growth (.21%)	412	416	425

Middlebury Airport

With the FAA TAF AT Middlebury Airport, there can be seen a precipitous drop in historical operations around 2008.

Middlebury Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	10,900	10,900	10,900
Average Growth (.42%)	**11,131**	**11,367**	**11,853**
High Growth (.84%)	11,366	11,851	12,885
Low Growth (.21%)	11,015	11,131	11,367

Morrisville – Stowe Airport

With Morrisville-Stowe Airport, there is a disparity between the historic and forecast TAF data and the most recent reported 5010 data, of which the last complete year was 2015.

Morrisville – Stowe Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	11,976	11,976	11,976
Average Growth (.42%)	**6,547**	**6,686**	**6,972**
High Growth (.84%)	6,741	7,029	7,643
Low Growth (.21%)	6,452	6,520	6,658

Newport Airport

Contrary to many other Vermont airports, the FAA TAF shows historical data at Newport State increasing at the 2008 mark and then remaining flat throughout the planning period.

Northeast Kingdom International Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	9,452	9,452	9,452
Average Growth (.42%)	**9,652**	**9,857**	**10,278**
High Growth (.84%)	9,856	10,227	11,173
Low Growth (.21%)	9,552	9,652	9,857

Post Mills Airport

The FAA TAF historical data reports a drop off in operations in 2008. The High Growth Rate shows the highest increase in forecast operations while the Low Growth Rate shows a decrease in forecast operations during the planning period.

Post Mills Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area	4,330	4,330	4,330
Average Growth (.42%)	**4,422**	**4,515**	**4,709**
High Growth (.84%)	4,515	4,708	5,119
Low Growth (.21%)	4,376	4,422	4,516

Rutland – Southern Vermont Regional Airport

Again, there seems to be a disparity between the forecast operations numbers in the FAA TAF for Rutland – Southern Vermont Regional Airport. The TAF forecasts over 31,000 operations per year throughout the planning period and for comparison, the graph below shows forecast data based off the most recent operations numbers in the Airport 5010 record.

Rutland-Southern Vermont Regional Airport			
Operations Forecast			
	5 year	10 year	20 year
FAA Terminal Area Forecast	13,091	13,091	13,091
Average Growth (.42%)	**12,614**	**12,881**	**13,432**
High Growth (.84%)	12,880	13,430	14,601
Low Growth (.21%)	12,482	12,614	12,881

Shelburne Airport

Since there was no historical or forecast FAA TAF data for Shelburne Airport, the most recent 5010 data were used as a basis for the projections throughout the planning period.

Shelburne Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	N/A	N/A	N/A
Average Growth (.42%)	**4,326**	**4,417**	**4,606**
High Growth (.84%)	4,417	4,606	5,007
Low Growth (.21%)	4,281	4,326	4,418

Warren-Sugarbush Airport

There was no FAA TAF data prior to 2000 and the data between the years 2000 to 2011 shows wild fluctuations. After 2012, the TAF forecast levels out to 17,620 each subsequent year. The forecast growth rates are shown in the table and line chart below.

Warren-Sugarbush Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	17,620	17,620	17,620
Average Growth (.42%)	**17,993**	**18,374**	**19,161**
High Growth (.84%)	18,373	19,157	20,829
Low Growth (.21%)	17,806	17,994	18,375

William H. Morse State Airport

The FAA TAF data shows great variation on the historical side of the line graph below, while the forecast operations projections are highest in the High Growth Rate, and lowest in the Low Growth Rates.

William H. Morse State Airport			
Operations Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	14,377	14,377	14,377
Average Growth (.42%)	**14,554**	**14,862**	**15,498**
High Growth (.84%)	14,861	15,495	16,847
Low Growth (.21%)	14,402	14,554	14,863

5.3.5. Forecast Based Aircraft

Basin Harbor Airport

The FAA TAF had no historical or forecast information regarding Basin Harbor Airport. Also, the Airport's 5010 record shows there are no based aircraft.

Basin Harbor Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	N/A	N/A	N/A
Average Growth (-1.61%)	**0**	**0**	**0**
High Growth (1.20%)	0	0	0
Low Growth (-2.39%)	0	0	0

Burlington International Airport

As demonstrated in the following table and chart, Burlington International Airport will see the highest growth rate with the FAA TAF, while the Low Growth Scenario would yield the lowest growth rate. In 2017, BTV reported 86 based aircraft which is slightly higher than the reported TAF number which explains the disconnect at 2017 between forecast calculations and the TAF forecast.

Burlington International Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	90	99	119
Average Growth (-1.61%)	**79**	**73**	**62**
High Growth (1.20%)	91	97	109
Low Growth (-2.39%)	76	68	53

Caledonia County Airport

As can be seen in the following table and graph, the Airport is expected to remain around 18 based aircraft throughout the planning period.

Caledonia County Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	18	18	18
Average Growth (-1.61%)	**17**	**15**	**13**
High Growth (1.20%)	19	20	23
Low Growth (-2.39%)	16	14	11

Deerfield Valley Regional Airport

Absent any TAF data, there is no readily available historical information about based aircraft at the airport so the following table and graph plot only future based aircraft. Utilizing the most recent 5010 data of 7 based aircraft, the forecast based aircraft projections remain flat throughout the planning period.

Deerfield Valley Regional Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	7	7	7
Average Growth (-1.61%)	**7**	**7**	**7**
High Growth (1.20%)	7	7	7
Low Growth (-2.39%)	7	7	7

Edward F. Knapp State Airport

The FAA TAF showed wild variability from year to year with respect to historical based aircraft at Edward F. Knapp State Airport. It also shows a flatline growth in based aircraft from 2015 through the end of the planning period.

Edward F. Knapp Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	54	54	54
Average Growth (-1.61%)	**49**	**45**	**38**
High Growth (1.20%)	56	60	67
Low Growth (-2.39%)	47	42	33

Franklin County Airport

Like other Vermont Airports, the FAA TAF shows variability in the historical numbers of based aircraft, and then a flatline in the latter half of the planning period.

Franklin County Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	69	69	69
Average Growth (-1.61%)	**81**	**75**	**64**
High Growth (1.20%)	93	99	112
Low Growth (-2.39%)	78	69	54

Hartness State Airport

The based aircraft at Hartness Airport according to the FAA TAF has been varied prior to 2015 and the flat from 2015 through the end of the planning period.

Hartness State Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	21	21	21
Average Growth (-1.61%)	**25**	**23**	**20**
High Growth (1.20%)	29	30	34
Low Growth (-2.39%)	24	21	17

John H. Boylan Airport

As with other smaller airports, there is no FAA TAF date for John H. Boylan Airport. The most recent based aircraft data readily available from the airport's 5010 record was used to plot the forecast based aircraft. The results are shown below in the graph and table.

John H. Boylan Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	N/A	N/A	N/A
Average Growth (-1.61%)	**5**	**4**	**4**
High Growth (1.20%)	5	6	6
Low Growth (-2.39%)	4	4	3

Middlebury Airport

The TAF for Middlebury State Airport varied wildly from 1990 through 2015 and then flattened out for the remaining years. The Low Growth Scenario shoes a decline throughout the forecast period.

Middlebury Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	36	36	36
Average Growth (-1.61%)	**34**	**31**	**27**
High Growth (1.20%)	39	42	47
Low Growth (-2.39%)	33	29	23

Morrisville – Stowe Airport

At Morrisville – Stowe Airport, the 5010 record shows 19 fixed-wing aircraft, 6 gliders and 2 ultra-light aircraft which is the basis for the FAA TAF data. For the purposes of this forecast, the gliders and ultralights were included in the table and graph below which explains the discrepancy.

Morrisville – Stowe Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	19	19	19
Average Growth (-1.61%)	**25**	**23**	**20**
High Growth (1.20%)	29	30	34
Low Growth (-2.39%)	24	21	17

Newport Airport

At Newport Airport, the historical TAF was relatively stable. The forecast based aircraft for the High Growth Scenario shows a slight increase in based aircraft.

Newport Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	21	21	21
Average Growth (-1.61%)	**18**	**17**	**14**
High Growth (1.20%)	21	23	25
Low Growth (-2.39%)	18	16	12

Post Mills Airport

The FAA TAF data for Post Mills Airport forecasts zero based aircraft after 2015, while the Low Growth Scenario projects a slight decline from 9 based aircraft down to 7 throughout the planning period.

Post Mills Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	N/A	N/A	N/A
Average Growth (-1.61%)	**8**	**8**	**7**
High Growth (1.20%)	10	10	11
Low Growth (-2.39%)	8	8	6

Rutland – Southern Vermont Regional Airport

Rutland – Southern Vermont Regional Airport has historically shown great variability in based aircraft according to the FAA TAF. Throughout the planning period, it appears the number of based aircraft are forecast to decline to 23 aircraft.

Rutland-Southern Vermont Regional Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	29	29	29
Average Growth (-1.61%)	**28**	**26**	**22**
High Growth (1.20%)	32	34	38
Low Growth (-2.39%)	27	24	18

Shelburne Airport

There was no historical or forecast FAA TAF data so the most recently 5010 data for the airport's based aircraft was utilized to plot the Baseline Growth scenario, the High Growth scenario and the Low Growth Scenario. The results can be seen in the following table and graph.

Shelburne Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	N/A	N/A	N/A
Average Growth (-1.61%)	**53**	**48**	**41**
High Growth (1.20%)	61	64	72
Low Growth (-2.39%)	51	45	35

Warren-Sugarbush Airport

The forecast TAF data from 2012 through the planning period indicates there will be zero based aircraft so the airport 5010 data showing 50 based aircraft was utilized for the forecast period. The results can be seen in the following table and graph.

Warren-Sugarbush Airport			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	N/A	N/A	N/A
Average Growth (-1.61%)	**46**	**43**	**36**
High Growth (1.20%)	53	56	63
Low Growth (-2.39%)	44	39	31

William H. Morse State Airport

As with other airports, the FAA TAF has forecast a set number of aircraft throughout the latter half of the planning period. The Baseline Growth Rate, High Growth Rate and Low Growth Rates were all based on currently available 5010 data which deviates from FAA's TAF forecast somewhat. The results can be seen in the following table and graph.

William H. Morse State Airport Based Aircraft			
Based Aircraft Forecast			
	5 Year	10 Year	20 Year
FAA Terminal Area Forecast	32	32	32
Average Growth (-1.61%)	**30**	**27**	**23**
High Growth (1.20%)	34	36	41
Low Growth (-2.39%)	28	25	20

5.3.6. Aircraft Fleet Mix Forecast

The FAA Aerospace Forecast utilizes a methodology that considers numerous industry factors as well as economic conditions to attempt to predict future U.S. aviation demand. The following summarizes the most recent average growth rates for the general aviation fleet nationally and are applicable for this effort:

Table 5-6: FAA Aerospace Fleet Mix Forecast

Forecast Active GA and Air Taxi Aircraft Growth Rates 2016-2037	
Single Engine Piston	-0.9%
Multi Engine Piston	-0.5%
Turbo-Prop	1.4%
Turbo-Jet	2.3%
Rotorcraft	1.6%
Experimental	1.0%
Sport Aircraft	4.1%
Total GA Fleet	0.1%

Source: FAA Aerospace Forecast

Considering these FAA national forecast growth rates, the FAA rates were applied to the 2016 based aircraft numbers and projected out to 2037. A fleet mix breakdown was performed using the most recent available 5010 data. The following are percentage of total based aircraft that can reasonably be estimated for each category:

- Piston-powered Fleet (78%)
- Turbo-Jet Fleet (3%)
- Rotorcraft Fleet (1%)

- All Others (18%)

The FAA growth rates applied to the Vermont based aircraft fleet yield the following results for the 5, 10, and 20-year periods. As can be seen in **Table 5-7** the majority of Vermont's fleet is comprised of piston engine aircraft will decline significantly. If the FAA Aerospace Forecast holds up, much of the decline in single engine piston aircraft will be made up for in experimental and light sport aircraft throughout the planning period, with a slight increase in turbine engine aircraft.

Table 5-7: Forecast Vermont Aircraft Fleet Mix

	2016	2022	2027	2037
Piston	396	378	360	325
Multiengine Piston	21	20	19	17
Turbo-Jet	17	19	21	25
Rotorcraft	4	4	5	5
All Others (gliders, ultralights and light sport)	94	118	142	190
Totals	532	539	547	562

Source: McFarland Johnson 2017

5.3.7. Passenger and Cargo Activity

Scheduled Passenger Service

Burlington International Airport began a Master Plan Update in 2018, including a forecast of aviation demand. The forecast reviewed historical data, FAA activity estimates, aviation industry trends, and socioeconomic data to estimate future aviation activity at the airport. Additional insight was provided by airport and airline management on potential route and airframe changes, which factored into the assumptions and methodologies for projecting demand. The forecasts projected future passenger enplanements, operations, and based aircraft. Enplanements at Burlington International Airport are expected to increase at an annual average growth rate (AAGR) of 0.8 percent from 2018 to 2038, reaching 695,171 enplanements by 2023 and 787,012 by 2038. This growth is associated with an expected increase in air carrier operations and average seats per departure of 0.3 percent each with load factors forecasted to increase by 0.2 percent over the 20-year. Total operations are forecasted to increase at an AAGR of 0.5 percent from 71,722 in 2018 to 78,748 in 2038. A summary of the Master Plan Update approved aviation forecast is shown in the table below.

Table 5-8: Burlington International Airport Activity Forecast

Year	Based Aircraft	Enplanements	Operations				
			Air Carrier	GA	Cargo	Military	Total
2018	93	667,004	24,082	39,005	535	8,099	71,722
2023	97	695,171	24,480	40,864	588	5,486	71,418
2028	102	724,528	24,899	42,743	646	5,486	73,773
2038	111	787,012	25,804	46,679	779	5,486	78,748
AAGR	0.9%	0.8%	0.3%	0.9%	1.9%	-1.9%	0.5%

Note: AAGR = annual average growth rate; GA = general aviation.
Source: Airport Master Record (Form 5010), FAA TAF, FAA Aerospace Forecast (FY 2018-2038), Boeing World Air Cargo Forecast (2016-2017), Airbus Global Market Forecast (FY 2018-2037), Burlington Airport Commission, CHA, 2018.

Scheduled passenger service at the Rutland Southern Vermont Regional Airport is provided as part of the Essential Air Service (EAS) program consisting of three daily flights to Boston Logan International Airport. Service is currently provided by Cape Air in twin-engine piston Cessna 402 aircraft, which are unpressurized. Since service levels are set as part of the EAS program and decided by the US Department of Transportation, incremental demand-based capacity increases are difficult to discern. Enplanements have varied between 5,196 and 5,997 since 2010. It is anticipated that enplanements will remain within this range at an average of 5,500 annual enplanements until there are changes to the EAS program.

Charter Passenger Service

In addition to the daily, scheduled service that exists at both Burlington and Rutland, Morrisville/Stowe is served by seasonal scheduled charter flights on select days with various frequencies based on demand. A total of 265 enplanements were recorded in 2016.

These flights are a function of specialty demand between two points as these flights do not connect with other airlines or destinations. Much of the basis for these flights is the connection to a nearby ski resort (Stowe Mountain Resort). With the infancy and varied nature of the charter service, a specific forecast for the MVL passenger service is not developed as part of this statewide system plan. Additional destinations and similar service to other airports is possible and should be evaluated on an airport specific basis either through a master plan forecast or a specialized air service study.

Air Cargo Activity

Air cargo activity is not reported or accounted, with the same degree of clarity as passenger enplanements. A more in-depth review of air cargo activity in Vermont was conducted as part of this system plan and is included in Appendix X of this report.

Appendix X Air Cargo Review

AIR CARGO BUSINESS MODELS

The air cargo industry is comprised of four basic types of carriers. The dominant carriers of U.S. domestic cargo are integrated carriers (integrators) like FedEx and UPS, which operate scheduled air service and proprietary trucking that both substitutes and complements its air operation. With this roadway capacity, integrators offer door-to-door service for businesses and consumers. The integrators also operate as freight forwarders, buying capacity from other air carriers. Previously both DHL and its acquisition, the former Airborne Express, operated as integrators in the U.S. domestic market but DHL now limits its U.S. activities to international shipments with a U.S. domestic feeder network only to feed its international operations.

Other all-cargo airlines, such as international carriers Cargolux and Nippon Cargo Airlines (NCA), provide only airport-to-airport transport, while off-airport surface transportation is likely to be provided by common commercial trucking companies. While the referenced carriers operate their own scheduled service, ACMI (aircraft, crew, maintenance, and insurance) carriers such as Atlas Air operate chartered and scheduled freighter aircraft on a leased basis on behalf of carriers that may not require scheduled service year-round, or which may be prohibited (like DHL, as a foreign corporation) from owning a U.S. airline. However, ACMI carriers are also critical to small feeder markets where FedEx and UPS contract with Ameriflight and Wiggins Airways (acquired by Ameriflight in 2014), as well as Air Cargo Carriers (ACC).

Combination carriers operate both passenger and all-cargo flights on which cargo is carried. Among U.S. passenger carriers, only Alaska Airlines operates still operates freighters, as well as "combi" aircraft that carry both passengers and main deck freight on the same flight with the passengers in the front of the aircraft. Combination carriers offer shippers network advantages by pairing the dedicated capacity of freighters plus additional destinations and frequencies justified only by passenger demand. Combination carriers gain efficiencies from having passenger and all-cargo flights leverage the same facilities, equipment and labor.

Apart from Alaska Airlines, U.S. passenger airlines are belly carriers that provide cargo capacity only on passenger flights. While most U.S. legacy carriers previously had their own stations and cargo sales staff in all major markets, the sales function has often been outsourced to freight forwarders and general sales agents (GSA's) while the warehouse operations were outsourced to third party cargo handling companies and to other airlines, particularly alliance partners. While belly carriers have lost considerable domestic market share to integrators and trucking companies, they are still the main carriers of mail and provide essential capacity on transcontinental routes, especially to destinations lacking adequate demand to justify freighters.

Cargo handling companies Alliance Ground International (AGI), Consolidated Aviation Services (CAS), Integrated Airline Services (IAS), Menzies, Mercury, Swissport, Total Airport Services (TAS) and Worldwide Flight Services (WFS) do not operate aircraft but allow many carriers to maintain a cargo presence that otherwise might be unprofitable if the carrier had to maintain its own

warehouse and labor for daily (or less) service. Depending on the terms of its contracts with individual carrier customers, handling companies may provide loading and unloading of aircraft, tug transport to/from the ramp, warehouse functions such as the breakdown and buildup of pallets and containers, as well as the handling of documents on international shipments. By leveraging its warehouse space, labor and ground service equipment, third party cargo handlers maximize utilization of cargo facilities well beyond what was possible when each carrier had its own cargo operation. Nonetheless, where enough tonnage justifies it, carriers will keep their cargo operations in-house.

Freight forwarders account for the routing of about 70% of international but only 10% of domestic shipments (excluding domestic segments of international shipments). Depending on the needs of their shipper customers, forwarders may provide a variety of services but most commonly they profit from the spread between the rate they pay carriers for capacity based on volume purchasing discounts and what they charge shippers for that same capacity. Forwarders support international gateways but can also be the agents of diversions to other gateways. To serve the critical needs of shippers, forwarders must depend upon the frequencies, destinations and capacity types (belly and freighter) provided by air carriers which typically are more diverse and plentiful at the largest gateways, such as JFK. Forwarders prefer the control afforded by local gateways where interaction with regulators and airline managers can be beneficial but will still mostly truck to/from larger gateways.

Federal agencies are essential to the functioning of an international gateway. U.S. Customs and Border Protection (CBP) is critical at all international cargo gateways, while specific commodities escalate the roles of the Department of Agriculture and the U.S. Fish & Wildlife Service. Ideally, these regulators are in a centralized facility with easy access to one another and to dependent commercial operators but in some cases, agencies may be located at or nearer the major seaports.

RECENT AIR CARGO INDUSTRY EXPERIENCE

Since late 2000, the U.S. air cargo industry has experienced a dramatic decline as several all-cargo carriers ceased operations, domestic passenger carriers decreased belly capacity available for cargo[1], and partially as a result, trucking companies gained market share for domestic time-sensitive routings of shipments.

Following decades of air cargo growth through the late 1990's, the airport industry commonly perceived cargo as an attractive prospect for business development. In 2000, many medium- and large-market airports had at least six all-cargo carriers, specifically Airborne Express, BAX Global, DHL, Emery Worldwide, FedEx and UPS. To varying degrees, each of these six carriers qualified as integrated carriers with dedicated proprietary networks of air and trucking service.

Between 2000 and 2010 (inclusive), Airborne Express would be largely acquired by DHL, which later withdrew from the U.S. domestic integrator business in favor of concentrating on

[1] Total cargo generally refers to the total of freight (including express) and mail. The term freight excludes mail.

international shipments exclusively through major gateways with only nominal feeder service. BAX Global was acquired by a German forwarder and converted into DB Schenker with the dedicated air service terminated in late 2010. Emery Worldwide had its fleet grounded by the FAA and later had its forwarder division acquired by UPS, which never resurrected Emery's former fleet, but collapsed its former air network into UPS's own network. Together, the preceding events caused what had been a reliable mix of six all-cargo integrated carriers to dwindle to at most two at small- and medium-sized US markets.

Other U.S. all-cargo carriers traditionally focused on only the airport-to-airport transportation of cargo while relying on common carrier trucking companies to provide surface transportation to/from the airports. In this operational sense, these carriers were more like cargo-carrying passenger airlines. In the late 1990's, two of the largest domestic all-cargo airlines - American International Airways, Inc. (AIA) and Kitty Hawk Airlines - merged but the combined carrier ceased operations in 2008. Meanwhile, passenger carriers greatly reduced the amount of capacity offered for cargo, as domestic passenger airlines down-gauged aircraft size and trimmed networks and frequencies. Moreover, the requirement for 100% screening of enplaned domestic belly cargo on passenger flights added motivation to truck time-sensitive freight on domestic routes, as well as on the domestic segments of international routings (between feeder markets and international gateways). Worse still for domestic cargo tonnages, the U.S. Postal Service emphasized cheaper trucking as much as possible, even as demand for first class mail service was already being greatly reduced by electronic messaging, billing and payment.

All of the preceding developments contributed to a massive redistribution of cargo market shares in favor of the two remaining integrators, FedEx and UPS. Further eroding air cargo tonnages, these two carriers invested most heavily in their trucking networks to accommodate U.S. growth, while increasingly dedicating new air freighters to higher growth international markets. Within the U.S. market, the consistently fastest growing sector for both carriers was the deferred delivery service - 3rd and 4th day deliveries - easily accommodated by pure trucking operations. Apart from international gateways, the two carriers most responsible for growth of on-airport cargo facilities at U.S. airports have increasingly moved their most labor-intensive sorting facilities off-airports, except for specifically overnight shipments.

At the airport level, the result of this industry realignment is that the top 100 U.S. airports experienced a collective net decrease in total air cargo tonnage of 4% between calendar year 2000 and 2016 (inclusive). If the top four U.S. airports (FedEx hub Memphis, UPS hub Louisville, trans-Pacific tech stop Anchorage and Latin American gateway Miami) are excluded, the remainder of the top 100 U.S. airports incurred a 19% decrease in cargo over the same period – a collective decrease of almost 5 million metric tonnes.

Table 1
Top Twenty U.S. Cargo Airports (ranked by 2016 Total Annual Metric Tonnes)

ACI rank		2000	2016	Change %	Function
1	Memphis (MEM)	2,489,078	4,322,071	74%	FedEx Hub
2	Anchorage (ANC)	1,804,221	2,542,526	41%	Tech Stop
3	Louisville (SDF)	1,519,528	2,437,010	60%	UPS Hub
4	Miami (MIA)	1,642,744	2,014,205	23%	Gateway
5	Los Angeles (LAX)	2,038,784	1,993,308	-2%	Gateway
6	Chicago (ORD)	1,468,553	1,528,136	4%	Gateway
7	New York (JFK)	1,818,838	1,278,707	-30%	Gateway
8	Indianapolis (IND)	1,165,431	1,065,114	-9%	FedEx Hub
9	Dallas/Ft. Worth (DFW)	903,141	752,073	-17%	UPS Hub
10	Cincinnati (CVG)	390,820	742,407	90%	DHL Hub
11	Newark (EWR)	1,082,407	719,006	-34%	FedEx Hub
12	Atlanta (ATL)	868,286	648,595	-25%	Gateway
13	Ontario (ONT)	464,164	519,474	12%	UPS Hub
14	Oakland (OAK)	685,425	511,780	-25%	FedEx Hub
15	San Francisco (SFO)	872,252	483,223	-45%	Gateway
16	Honolulu (HNL)	441,163	460,921	4%	Gateway
17	Houston (IAH)	368,498	431,908	17%	Gateway
18	Philadelphia (PHL)	559,340	404,430	-28%	UPS Hub
19	Seattle (SEA)	456,920	366,429	-20%	Gateway
20	Phoenix (PHX)	375,250	321,964	-14%	Gateway

Source: Airports Council International – North America (for data) with analysis by Webber Air Cargo, Inc.

As can be observed in Table 1, regional hubs for integrated carriers FedEx and UPS fared no better than the U.S. average, excluding the Memphis and Louisville national hubs. Principal northeastern regional hubs, Newark (for FedEx) and Philadelphia (for UPS) experienced decreases of 34% and 28%, respectively.

THE U.S. NORTHEASTERN AIR CARGO MARKET

The U.S. northeastern region has three airports ranked among the U.S. top twenty in total annual air cargo (ranked by 2016 totals). The dominant international gateway is New York's JFK International Airport with almost 1.3 million metric tonnes, while the principal integrated carrier hubs are Newark (EWR) and Philadelphia (PHL). In addition to the northeastern regional hubs for the integrated carriers, EWR and PHL are also significant international passenger gateways from which forwarders can buy belly cargo capacity from hub carriers United and American, respectively. While JFK offers substantial freighter and belly capacity to both Europe and Asia, Boston (BOS) and Washington Dulles (IAD) offer only belly capacity – mostly to Europe.

Most of the remainder of the northeastern airports ranking in the top 100 are predominantly (more likely, entirely) origin & destination airports with air cargo operations suitable to serve only the demand of local industry. As Table 2 indicates, this region's air cargo totals performed even worse than the national average for the period between peak year 2000 and 2016 (inclusive). For

the northeastern airports ranking in the top 100, total cargo decreased about 32% - representing a loss of more than 1.6 million metric tonnes. Only three northeastern airports in the top 100 managed any growth for the period, led by Allentown's Lehigh Valley International Airport (ABE), which added a substantial Amazon air cargo operation to an existing FedEx presence.

Table 2:
Northeastern Cargo Airports ranked in the U.S. Top 100 (by 2016 Total Annual Metric Tonnes)

ACI rank	Airport (Code)	2000	2016	Change %
7	New York (JFK)	1,818,838	1,278,707	-30%
11	Newark (EWR)	1,082,407	719,006	-34%
18	Philadelphia (PHL)	559,340	387,626	-31%
21	Boston (BOS)	474,943	279,836	-41%
22	Washington DC (IAD)	383,852	265,818	-31%
33	Baltimore (BAL)	236,043	118,074	-50%
35	Hartford (BDL)	171,451	107,248	-37%
42	Pittsburgh (PIT)	147,014	83,116	-43%
45	Manchester (MHT)	76,203	77,603	2%
59	Allentown (ABE)	23,416	57,121	144%
62	Harrisburg (MDT)	49,664	52,807	6%
68	Rochester (ROC)	49,341	41,644	-16%
74	Buffalo (BUF)	52,081	36,358	-30%
94	Syracuse (SYR)	26,598	18,533	-30%
95	Albany (ALB)	21,783	17,275	-21%
96	Stewart, NY (SWF)	32,437	17,181	-47%
	GROUP	**5,205,411**	**3,557,953**	**-32%**

Source: Airports Council International – North America (for data) with analysis by Webber Air Cargo, Inc.

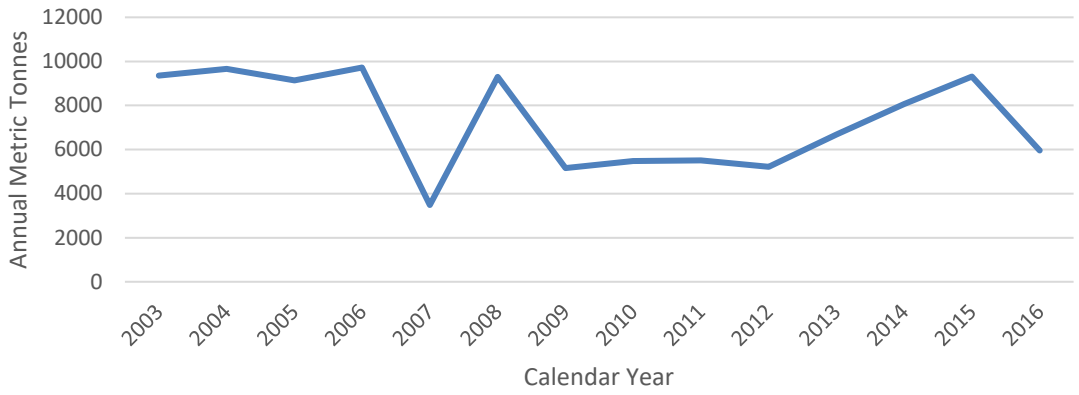
THE VERMONT AIR CARGO MARKET

Vermont does not have an airport ranked among the U.S. top 100. The largest airport in the state, Burlington International Airport (BTV) ended 2016 with slightly less than 6,000 metric tonnes of annual air cargo – about one-third of the smallest total recorded by any northeastern airport (Stewart, NY at #96) in the top 100.

10-Year Historical Air Cargo Tonnage

Comparable data sets were not available for BTV that would allow comparison for a similar timeframe (2000 through 2017) as the top 100 airports but according to ACI-NA data, total cargo at BTV decreased by 36% from 9,363 annual metric tonnes in 2003 to only 5,953 metric tonnes in 2016. ACI-NA data will not be available for the full calendar year 2017 for several more months but according to the Federal Aviation Administration's T-100 data, total cargo at BTV had decreased another 13% year-on-year for the 9-month period through September 2017.

Exhibit One:
Burlington International Airport, Annual Metric Tonnes: Calendar Years 2003 - 2016



Source: Airports Council International – North America (for data) with analysis by Webber Air Cargo, Inc.

Unfortunately, no other Vermont airport reports comparable data to Airports Council International – North America. The principal alternative to ACI-NA historical data, the Bureau of Transportation Statistics (BTS) Air Carrier Statistics database (T-100 data bank) contains domestic and international airline market and segment data. Unfortunately, too, the T-100 data set has deep flaws as a resource to compile a historical record for Vermont's air cargo because the U.S. Department of Transportation routinely waives reporting requirements for commercial operations resulting in revenues below certain plateaus. For major cargo airports, such exclusions would amount to little more than a mathematical rounding error but for smaller Vermont airports (including even BTV but particularly even smaller airports) the exclusions include all outbound cargo at Rutland-Southern Vermont Regional Airport (RUT) and all cargo (inbound and outbound) at E.F. Knapp Airport (MPV) in Montpellier. Consequently, T-100 data for BTV is at least partially representative but deeply compromised for RUT and non-existent for MPV. Consequently, building a credible 10-year historical cargo record for Vermont airports other than Burlington would require data provided directly by either the carriers or from them through the airports. Multiple requests for this specific data were made to both the carrier (Wiggins Airways) and airports but were ignored.

Forecast of Total Statewide Air Cargo:

Typically, a variety of forecasting approaches is in consideration to project airports' total cargo. However, a standard trend analysis using ten years of historical data requires confidence that the past is prologue. Given the remarkably negative developments – multiple bankruptcies of formerly major all-cargo carriers – it is unlikely (and highly undesirable) that the forecasted period would follow the losses incurred since the air cargo industry's peak year (2000). Were Vermont's cargo flagship airport (BTV) to repeat the -36% decrease, eventually Vermont's total cargo would approach zero. Similarly, the negative trajectory of total cargo would divert from a regression analysis, unless gross domestic product (GDP) had proportionally decreased for the period. Moreover, as has already been established, credible historical data to support the trend analysis has not been made available.

Table 3
Total 20-Year Cargo Forecasts for Vermont Airports (Base year 2016)

HIGH	2016	2021	2026	2036
BTV	13,124,115	14,994,163	17,130,674	22,143,592
RUT	646,052	738,108	843,280	1,090,048
MPV	378,804	432,780	494,446	639,135
Total	14,148,971	16,165,051	18,468,401	23,872,774
BASE	**2016**	**2021**	**2026**	**2036**
BTV	13,124,115	14,704,430	16,475,035	20,480,253
RUT	646,052	723,845	811,006	1,008,168
MPV	378,804	424,417	475,522	591,126
Total	14,148,971	15,852,692	17,761,563	22,079,546
LOW	**2016**	**2021**	**2026**	**2036**
BTV	13,124,115	14,278,243	15,533,866	18,206,088
RUT	646,052	702,866	764,675	896,219
MPV	378,804	412,116	448,357	525,486
Total	14,148,971	15,393,225	16,746,898	19,627,792

Source: Webber Air Cargo, Inc.

Consequently, the most credible approach remaining for this forecast is to use the Boeing World Air Cargo Forecast 2016-2017 to establish High (2.7%), Base (2.3%) and Low (1.7%) case growth rates. While modest, these positive growth rates are substantially better than the negative decreases actually experienced in recent years. Although the scope of work specifies that the forecasts be in tonnage, the relatively modest cargo numbers for RUT and MPV suggest computations in pounds.

As revealed in Table 3, the High Case growth rates result in forecasted total statewide cargo of roughly 23.9 million pounds at the end of Calendar Year 2036. The Base Case growth rates result in just over 22 million pounds. The Low Case growth rates result in about 19.6 million pounds.

Breakout of Feeder Carriers Using Airports Outside of Burlington (BTV)

BTV is served by FedEx scheduled service, as well as FedEx's contract carrier Wiggins Airways. The largest scheduled freighter aircraft operating in Vermont is FedEx's B757-200 operating between BTV and Syracuse, NY (SYR) five days weekly. That freighter schedule is supplemented by Embraer EMB-110 aircraft connecting BTV with Manchester, NH (MHT) on at least ten weekly roundtrips, as well as a single weekly (Thursday) flight continuing from Rutland.

Table 4

Feeder Aircraft Operating at Vermont Airports

Burlington	Revenue Payload	Annual Departures	Annual One-Way Payload
B757-200 (FedEx)	79,200	260	20,592,000
Embraer EMB-110	3,300	572	1,887,600
Rutland			
Cessna 208 Caravan (C208)	3,000	208	624,000
Embraer EMB-110	3,300	104	343,200
Raytheon Beech B99	2,200	312	686,400
E.F. Knapp/Montpelier			
Raytheon Beech B99	2,200	208	457,600

Source: Webber Air Cargo, Inc.

RUT is served only by contract carrier Wiggins Airways with a relatively diverse schedule and fleet, compared even to much larger BTV. Using flight tower reports for the full week beginning, Monday 4/2/2018, RUT is served by Embraer EMB-110 aircraft linking RUT and Albany (ALB) on two days each week, Cessna 208 Caravans (C208) on four days each week mostly linking ALB but also MHT, and Raytheon Beech B99 aircraft on six days each week, linking BTV and MHT. In terms of capacity planning, schedules indicate that Wiggins Airways may occasionally adjust schedules according to daily load demands.

The final Vermont airport with scheduled all-cargo service is E.F. Knapp Airport (MPV) in Montpellier which is served on four weekly roundtrips using Beech B99 aircraft connecting MHT. Significantly, MHT is Wiggins Airways' hub where Wiggins can build larger consolidations before transferring cargo to one or more of the FedEx hubs. Routes serving non-hub markets – such as Syracuse and Albany – suggest that additional markets are required to achieve satisfactory payloads with Vermont's airports splitting the service. This interpretation is further validated by the multiples of demand from 2016 base year that could be accommodated without increasing weekly frequencies and/or aircraft gauge.

Aircraft Operational Fleet Mixes

Comparing the air cargo forecasts (Table Three) with available revenue payloads in **Table 4**, it appears that adequate capacity already exists to accommodate forecasted growth for the period through 2036. In this context, the determination to add frequencies or expand aircraft gauge would likely be driven not by local demand but by carrier decisions pursuant to how much payload should be dedicated to Vermont markets versus adding capacity to satisfy linked markets outside of hub routes.

Due to aircraft retirements, FedEx made the decision to convert its BTV operations from Boeing 727-200 aircraft to B757-200, beginning in 2013. FedEx has recently (November 2017) announced it will begin adding Cessna SkyCourier 408 aircraft with a substantially larger (6,000 lbs.) maximum payload that nearly doubles that of current similar feeder aircraft. At least for now, it is believed

that aircraft will more likely be used on longer, thin (in terms of demand) routes in the MidWest and West, rather than the shorter routes typical of service from Vermont's airports.

For RUT and MPV, it is unlikely that any change in aircraft gauge would be demand-driven in the near planning horizon, so only currently unanticipated fleet retirements would suggest changes in fleets. Wiggins Airways has been acquired by Ameriflight LLC, which has a larger and more diverse all-cargo fleet that could potentially be rotated through Vermont's airports.

AIR CARGO RECOMMENDED ACTIONS & POLICY DEVELOPMENT

As has already been indicated, the current combinations of aircraft capacity and frequencies already operating on schedules at BTV, RUT and MPV would theoretically suffice for forecasted tonnages through the twenty-year forecast.

Of the three airports with scheduled all-cargo service, only BTV could potentially require more than Fixed Base Operation (FBO) services and facilities to accommodate forecasted demand. The provision of new cargo facilities is unlikely to encourage growth of cargo tonnage, operations or aircraft gauge. The modest cargo operations at Vermont's airports are not a function of air cargo facilities but rather of perceived demand in the form of area manufacturing and distribution.

Given the willingness of FedEx and its contract carrier Wiggins Airways to serve three Vermont airports with so little demand, it is likely that FedEx is responding to national accounts that have Vermont locations. Given the excess of freighter capacity to demand, runway length is not the determining limitation on types of aircraft used at Vermont's airports.

The most likely means by which Vermont's airports are likely to dramatically stimulate air cargo growth would be by attraction of demand-drivers, such as e-Commerce distribution. In contrast to the 32% average decrease for the northeastern region, Allentown's Lehigh Valley International Airport (ABE) experienced 144% growth between 2000 and 2016 due to ABE's use by Amazon.com

Going forward, the Vermont Agency of Transportation could facilitate richer analysis of its airports' cargo operations by requiring cargo operators to report monthly activity (tons, operations and aircraft gauge) and continuously building a database for each of its airports. This would fill gaps left by exemptions described in the federal T-100 databases.