



# Green Airport

T.F. Green Airport

Warwick, Rhode Island

Forecasts of Demand

Airport Master Plan

Prepared by C&S Team Member:  
WSP USA

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## Section 1—Introduction

In planning for the future growth of any airport, it is important to understand the context within which potential increases in aviation activity are likely to occur. Several indicators of aviation activity, including local trends, Boston Region trends, and national trends in projected aviation demand, were used to develop the aviation activity forecasts for T.F. Green Airport (PVD or Airport). The Boston Region refers to the combined traffic for Boston Logan International (BOS), PVD, Bradley International, Manchester Boston Regional (MHT), and Worcester Regional (ORH). The forecast period covers a 20-year period from 2017 to 2037 and provides projections for the various forecast elements for the five- (2022) 10- (2027) and 20-year (2037) planning horizons.

The purpose of the aviation demand forecast is to provide one of the parameters for planning future aviation facilities. Aviation forecasting is not an “exact science”, so experienced aviation judgment and practical considerations will influence the level of detail and effort required to establish reasonable forecasts and ultimately airport development decisions. This chapter includes a discussion of the historical aviation demand trends for the U.S., the Boston Region and PVD, as well as projections for aviation demand for the same markets. These trends provide a basis for the projections of aviation activity developed for PVD.

The air traffic activity at the Airport is comprised primarily of air carrier, cargo and general aviation activity. The historical trends and projections are focused specifically to these activities. The forecasts were developed by analysis of recent trends in activity at PVD, the Boston Region, and trends in national aviation activity. Historical growth rates and PVD’s share of historical activity were analyzed and compared to forecasted aviation demand. Trends in the national aviation forecasts developed by the Federal Aviation Administration (FAA) were used to provide the underlying assumptions for the projections of aviation activity and the other elements of the forecast contained herein. The FAA develops its estimates of such trends through analysis and conversations with various segments of the aviation community. Note that except for where otherwise noted, annual data presented for the U.S. and the Boston region is presented for the Federal Fiscal Year (FFY), which ends September 30<sup>th</sup> each year; annual data presented for the Airport is presented on a calendar year (CY) basis.

## Section 2—National Economic & Aviation Trends

This section presents an overview of the national economic, as well as national and local aviation trends. The *FAA Aerospace Forecast, Fiscal Years 2018 – 2038 (FAA Aerospace Forecast)*<sup>1</sup> includes a description of national factors that influence overall aviation demand including economic measures such as U.S. Gross Domestic Product (GDP) and the Consumer Price Index (CPI). In addition to the economic factors, the *FAA Aerospace Forecast* presents aviation trends related to the nation’s enplanement growth, available seat miles, load factors, and aircraft manufacturing and purchases. These activities influence the outlook of aviation activity in the U.S. These factors coupled with local and regional aviation trends are the basis for the PVD forecasts. The following sections provide an overview of the economic and aviation trends, as well as the *FAA Aerospace Forecast’s* projections of aviation demand through 2037, the last year of this study.

### 2.1 National Economic Trends

Table 1 presents the historical and projected gross domestic product (GDP) and consumer price index (CPI) for the U.S. GDP is a measure of overall economic growth and CPI is a measure of economic inflation. As shown in the table, GDP increased at a compound annual growth rate of 1.6 percent from 2008 to 2017. This growth is lower than the projected growth rates, as GDP decreased from 2008 to 2009 because of an economic recession (the Great Recession). It began in December 2007 and ended in June 2009.

Recovery from the Great Recession was much slower than previous recessions. Based on the U.S. Federal Reserve Economic Data (FRED), many key economic indicators did not reach pre-Great Recession levels until late 2012 through mid-2014. For instance, real GDP per capita and non-farm employment did not reach pre-Great Recession levels until the fourth quarter of 2013 and May 2014, respectively. Because of the Great Recession, U.S. aviation activity, which is closely tied to the nation’s economic performance, also did not reach pre-Great Recession levels until the same time frame.

GDP is projected to increase at an average annual growth rate of 2.2 percent from 2017 to 2022. In the near term, year-over-year growth in GDP is forecast to accelerate as the President Trump administration continues to advance its economic stimulus package. GDP is projected to increase at an average annual growth rate of 2.0 percent from 2017 to 2037, with year-over-year increases ranging from 1.8 to 2.0 percent from 2021 to 2037.

Table 1 also presents CPI. CPI increased at an average annual growth rate of 1.3 percent from 2008 to 2017. CPI is projected to increase at an annual compound growth rate of 2.3

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<sup>1</sup> This publication was released in March 2018. Fiscal year refers to the Federal fiscal year, which begins October 1<sup>st</sup> and ends September 30<sup>th</sup> each year.

percent from 2017 to 2022. These projected increases in CPI follow the same pattern as the projected increases in GDP; however, they lag several years with the largest year over year increase (2.5 percent) anticipated to occur from 2019 to 2020 and 2020 to 2021, compared to the largest year-over-year increases occurring in GDP (2.6 percent) from 2017 to 2018 and 2018 to 2019.

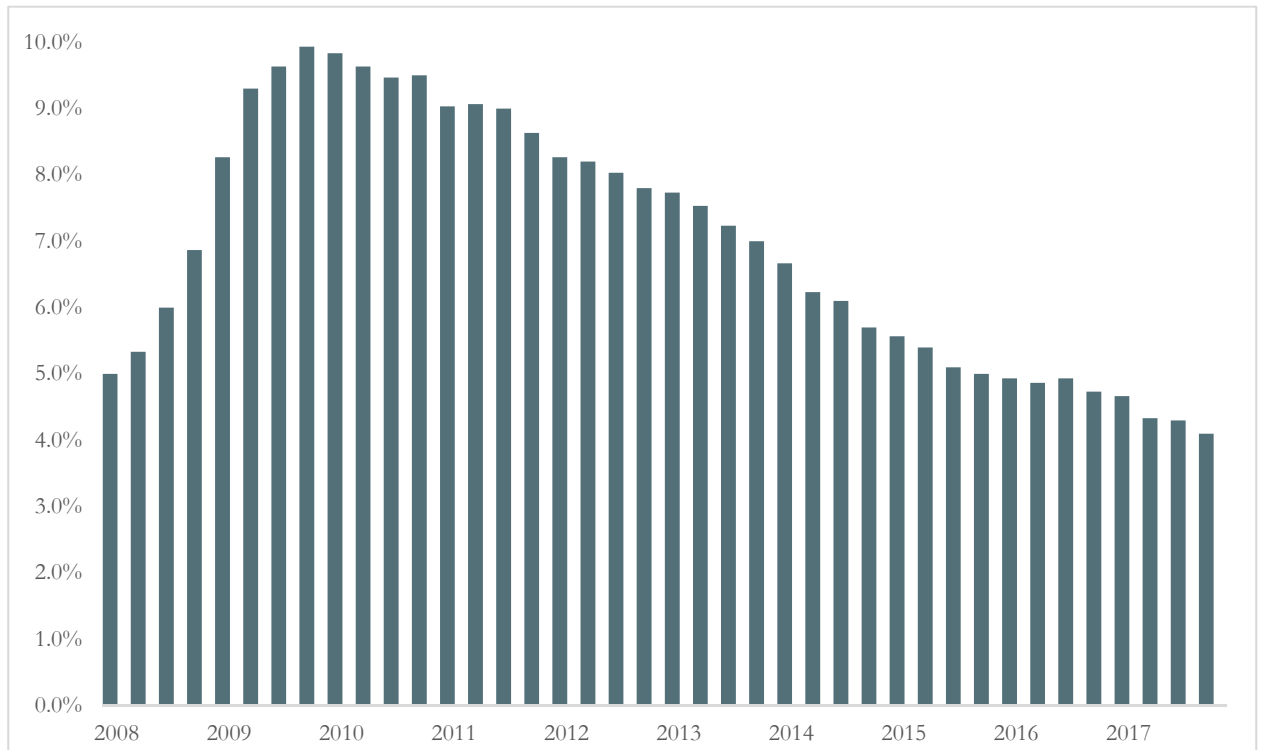
**Table 1 – U.S. Historical and Projected Gross Domestic Product and Consumer Price Index**

Federal Fiscal Year	GDP		CPI	
	(Billions 2009 \$)	% Change	(1982-1984=100)	% Change
2008	14,939.0		214.4	
2009	14,426.5	-3.4%	213.8	-0.3%
2010	14,678.8	1.7%	217.4	1.7%
2011	14,957.8	1.9%	223.1	2.6%
2012	15,306.1	2.3%	228.5	2.4%
2013	15,509.8	1.3%	232.2	1.6%
2014	15,906.7	2.6%	236.0	1.6%
2015	16,389.7	3.0%	236.8	0.3%
2016	16,640.2	1.5%	238.9	0.9%
2017	16,987.4	2.1%	243.9	2.1%
2018	17,432.9	2.6%	248.4	1.9%
2019	17,889.2	2.6%	252.6	1.7%
2020	18,280.1	2.2%	259.4	2.7%
2021	18,610.7	1.8%	266.5	2.7%
2022	18,972.0	1.9%	272.9	2.4%
2023	19,343.5	2.0%	279.5	2.4%
2024	19,714.2	1.9%	286.4	2.5%
2025	20,078.9	1.8%	293.5	2.5%
2026	20,443.0	1.8%	300.7	2.5%
2027	20,809.1	1.8%	308.3	2.5%
2028	21,188.4	1.8%	316.0	2.5%
2029	21,598.9	1.9%	324.0	2.6%
2030	22,025.6	2.0%	332.2	2.5%
2031	22,471.4	2.0%	340.4	2.5%
2032	22,920.5	2.0%	348.7	2.4%
2033	23,379.1	2.0%	357.1	2.4%
2034	23,863.7	2.1%	365.8	2.4%
2035	24,334.2	2.0%	374.8	2.4%
2036	24,822.0	2.0%	383.9	2.4%
2037	25,324.5	2.0%	393.3	2.4%
<b>Compound Annual Growth Rate</b>				
2008-2017	1.6%		1.3%	
2017-2022	2.2%		2.3%	
2017-2027	2.0%		2.4%	
2017-2037	2.0%		2.4%	

Source: FAA Aerospace Forecasts; Compiled by WSP.

Since 1960, there have been five economic expansions in the U.S., including the recovery from the Great Recession, that have lasted longer than 48 months. In these prior expansions, the unemployment rate on average has declined about one-third from its highest point by the fourth year. In the last quarter of 2009 the unemployment rate in the U.S. was at its highest rate of 9.9 percent. If prior experience with recovery subsequent to an economic recession held true, the unemployment rate for 2013 should have been around 6.7 percent. However, for the fourth quarter of 2013, the unemployment rate for the nation was 7.0 percent. The unemployment rate did not reach pre-recession levels until the fourth quarter of 2015, approximately eight years after the Great Recession began. This slower recovery of employment is a key contributing factor to the slower than average recovery from the recession. Figure 1 presents the quarterly unemployment rates for the nation from 2008 to 2017.

**Figure 1—U.S. Historical Unemployment Rates by Quarter**



Sources: U.S. Bureau of Labor Statistics; Compiled by WSP

## 2.2 National Aviation Trends

This section presents historical and projected aviation trends for enplanements, available seat miles (ASMs), revenue passenger miles (RPMs), load factor, and aircraft operations for the U.S. The remainder of this section presents elements related to general aviation, and air cargo.

### 2.2.1 Passenger Airline Activity

Air carrier aviation activity trends and projections in the *FAA Aerospace Forecast* are divided in to two categories – mainline carriers and regional carriers. Mainline carriers are defined as those providing service via aircraft with 90 or more seats and regional carriers are carriers that provide service via aircraft with 89 or less seats and whose routes serve mainly as feeders to the mainline carriers. At PVD mainline carriers include Delta Air Lines, United Airlines, American Airlines and Southwest Airlines. Using their regional affiliates, mainline carriers typically cater to business segments such as the short-range air shuttle, low-cost, or premium-service flights that normally would not support the traffic or revenue yield needed for the traditional operation of larger mainline aircraft with over 100 seats between selected city pairs, as well as feed their operations at major hub airports. Most of the commercial aviation activity at PVD is primarily made up of activity on mainline carriers (78 percent in 2017).

Table 2 presents the historical and projected passenger enplanements projected by the FAA from 2008 to 2037. As shown in the table, enplanements have fluctuated in the last decade primarily due to the Great Recession and general uncertainty. The recovery in enplanements in the U.S. is similar to the timing of the recovery from the Great Recession, as enplanements did not reach their 2008 levels until 2015. The *FAA Aerospace Forecasts* indicate that total U.S. enplanements will increase at a compound annual growth rate of 2.0 percent from 2017 to 2037, with the largest year over year increases corresponding with the GDP and CPI increases discussed previously. In the short term (through 2022) U.S. enplanements are projected to increase at a slightly higher annual rate of 2.4 percent. As also shown in the table, international enplanements are projected to increase at an average annual growth rate of 3.6 percent through 2022 and 3.4 percent through 2037, compared to increases in domestic enplanements of 2.3 percent and 1.8 percent during the same time periods, respectively.



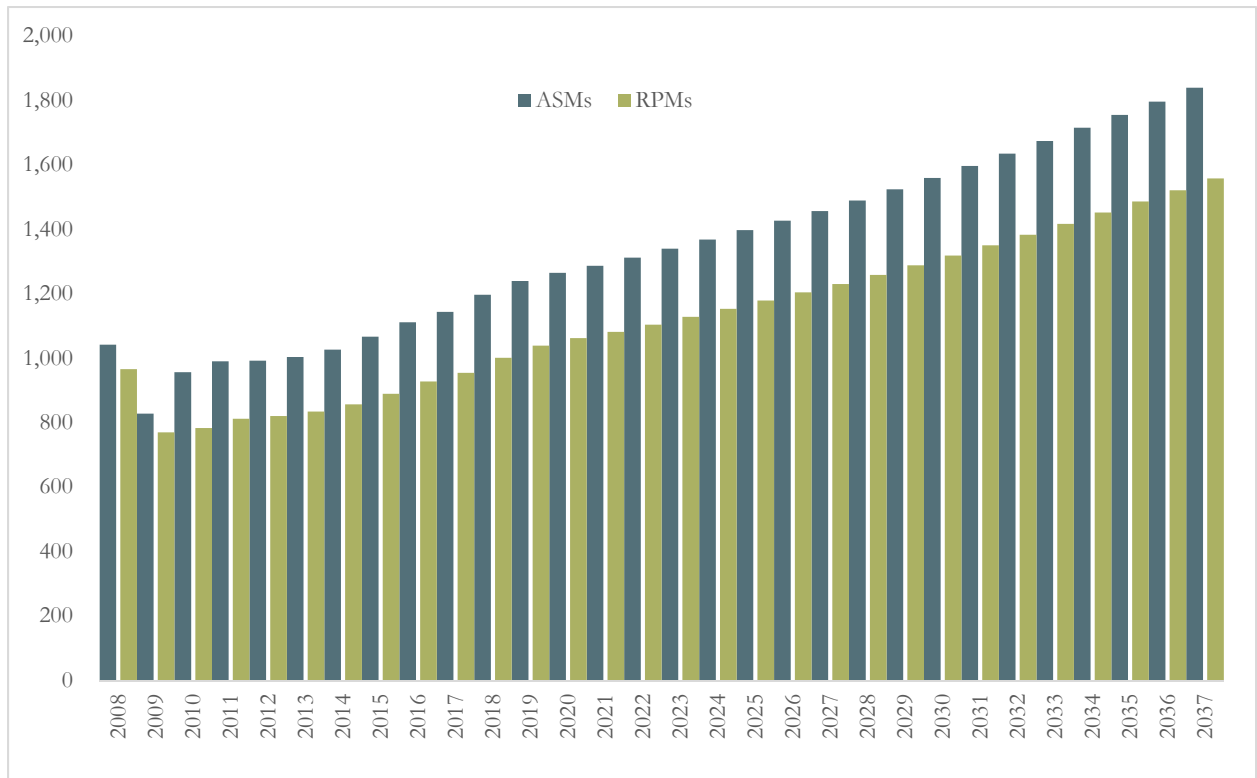
Table 2— U.S. Historical and Projected Enplanements (in millions)

Federal Fiscal Year	Domestic	% Change	International	% Change	Total	% Change
2008	681.0		78.0		759.0	
2009	631.0	-7.3%	74.0	-5.1%	704.0	-7.2%
2010	628.5	-0.4%	77.3	4.5%	705.8	0.3%
2011	644.2	2.5%	81.0	4.8%	725.2	2.7%
2012	649.8	0.9%	82.9	2.3%	732.7	1.0%
2013	654.4	0.7%	85.1	2.6%	739.5	0.9%
2014	668.9	2.2%	88.0	3.5%	756.9	2.4%
2015	696.3	4.1%	90.2	2.5%	786.5	3.9%
2016	726.1	4.3%	93.4	3.6%	819.6	4.2%
2017	743.5	2.4%	96.9	3.7%	840.4	2.5%
2018	778.1	4.7%	101.8	5.0%	879.9	4.7%
2019	803.6	3.3%	105.1	3.2%	908.7	3.3%
2020	814.8	1.4%	108.4	3.2%	923.2	1.6%
2021	822.3	0.9%	111.8	3.1%	934.1	1.2%
2022	832.3	1.2%	115.4	3.2%	947.8	1.5%
2023	844.3	1.4%	119.2	3.3%	963.5	1.7%
2024	856.6	1.5%	123.2	3.4%	979.9	1.7%
2025	869.4	1.5%	127.4	3.4%	996.8	1.7%
2026	882.0	1.5%	131.7	3.4%	1,013.7	1.7%
2027	894.7	1.4%	136.0	3.3%	1,030.7	1.7%
2028	909.1	1.6%	140.4	3.2%	1,049.5	1.8%
2029	925.3	1.8%	145.0	3.3%	1,070.3	2.0%
2030	941.3	1.7%	149.7	3.3%	1,091.0	1.9%
2031	958.6	1.8%	154.5	3.2%	1,113.1	2.0%
2032	976.3	1.8%	159.6	3.2%	1,135.8	2.0%
2033	994.6	1.9%	164.9	3.3%	1,159.4	2.1%
2034	1,013.8	1.9%	170.4	3.3%	1,184.2	2.1%
2035	1,031.8	1.8%	176.0	3.3%	1,207.7	2.0%
2036	1,049.8	1.8%	181.7	3.3%	1,231.6	2.0%
2037	1,069.4	1.9%	187.6	3.3%	1,257.0	2.1%
Compound Annual Growth Rate						
2008-2017	1.9%		2.5%		2.0%	
2017-2022	2.3%		3.6%		2.4%	
2017-2027	1.9%		3.4%		2.1%	
2017-2037	1.8%		3.4%		2.0%	

Source: *FAA Aerospace Forecast*; Compiled by WSP.

Other factors that influence the projections of aviation demand include assumptions related to ASMs, RPMs, and load factors. Figure 2 presents a comparison of historical and projected ASMs and RPMs for the U.S. As shown in the chart ASMs (a measure of capacity or the availability of seats) decreased approximately 20 percent in 2009 from 2008 levels. ASMs increased back to 2008 levels by 2015 and are projected to increase from approximately 1,200 billion in 2018 to approximately 1,840 billion in 2037 representing a compound annual growth rate of 1.7 percent during the same period. RPMs (a measure of demand or the seat miles that were utilized system wide) also decreased by approximately 20 percent in 2009 from 2008 levels; however, it was not until 2017 that they were back to the level experienced in 2008. RPMs are projected to increase from approximately 970 billion in 2017 to 1,560 billion in 2037 representing a compound annual growth rate of 1.7 percent.

Figure 2—U.S. Historical and Projected ASMs and RPMs (in billions)

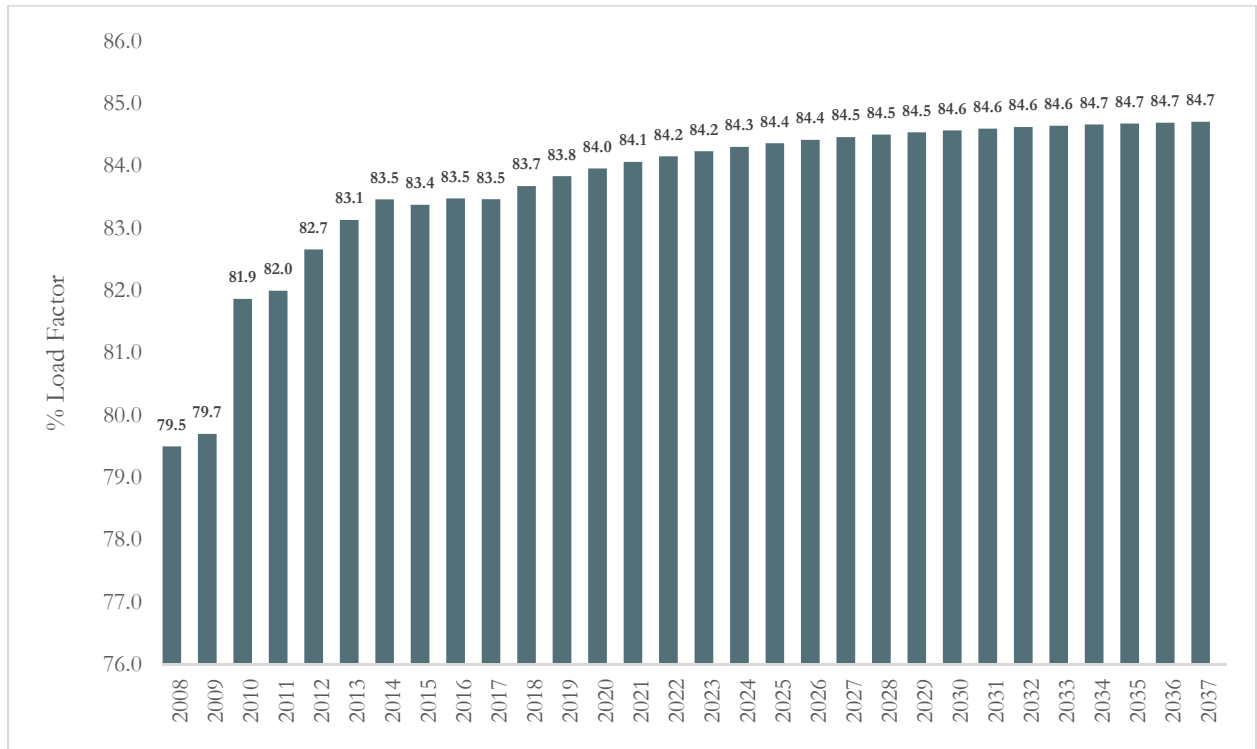


Source: *FAA Aerospace Forecast*; Compiled by WSP.

Another factor that contributes to passenger growth is average load factor. This is a measure of how many seats are filled in an aircraft. Figure 3 presents a historical and projected average load factor from 2008 to 2037. As shown, both load factors increased from 2008 to 2017. In the near term, load factors system wide are projected to increase from 83.5 percent

in 2017 to 84.2 percent in 2022. Projected load factors are expected to increase slowly over the latter part of the forecast period from 84.5 percent in 2027 to 84.7 percent in 2037.

Figure 3—U.S. Historical and Projected Load Factors



Source: *FAA Aerospace Forecast*; Compiled by WSP.

## 2.2.2 Non-Commercial Activity

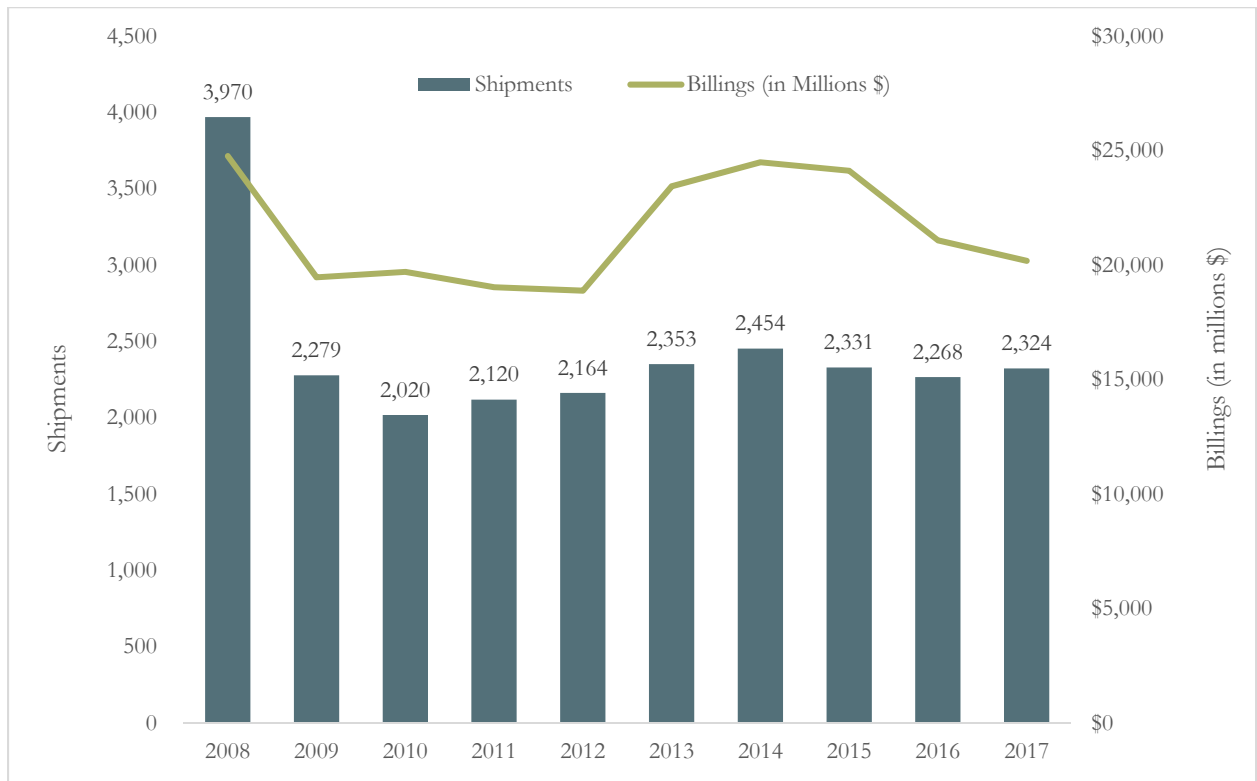
This section presents an overview of historical and projected general aviation activity trends. It includes general aviation and military aircraft operations, as well as, general aviation aircraft shipments and sales.

The Great Recession had a significant effect on the general aviation industry. Figure 4 presents the historical general aviation aircraft shipments from 2008 to 2017, compared to billings for the same time period. According to the General Aviation Manufacturers Association (GAMA), delivery of general aviation aircraft was down nearly 50 percent in 2009 compared to 2008 and was the second year of declining shipments compared to the four previous years, which experienced increases. Since 2009, general aviation aircraft shipments have ranged from a low of 2,020 in 2010 to 2,454 in 2014.

General aviation aircraft billings also reflected decreases in the wake of the Great Recession. General aviation billings remained relatively stable at approximately \$20 billion from 2009 to

2012. However, in the next two years, billings increased to \$24.5 billion in 2014, followed by year over year decreases from 2015 to 2017 to \$20.2 billion.

Figure 4—U.S. Historical General Aviation Shipments and Billings by Calendar Year



Source: *GAMA*; Compiled by WSP.

Table 3 presents the historical and projected non-commercial (general aviation and military) aircraft operations at FAA and “Contract” air traffic control towers. As shown in the table, the number of combined general aviation and military operations has decreased at an average annual rate of 0.4 percent from 2008 to 2017. Combined general aviation and military operations are projected to increase modestly at 0.8 percent from 2017 to 2018 and followed by consistent increases of 0.3 percent each year from 2019 to 2037, with an average annual growth rate of approximately 0.3 percent from 2017 to 2037. Military operations are projected to remain constant during the projection period, while general aviation operations are projected to increase at an average annual growth rate of 0.3 percent between 2017 and 2037.

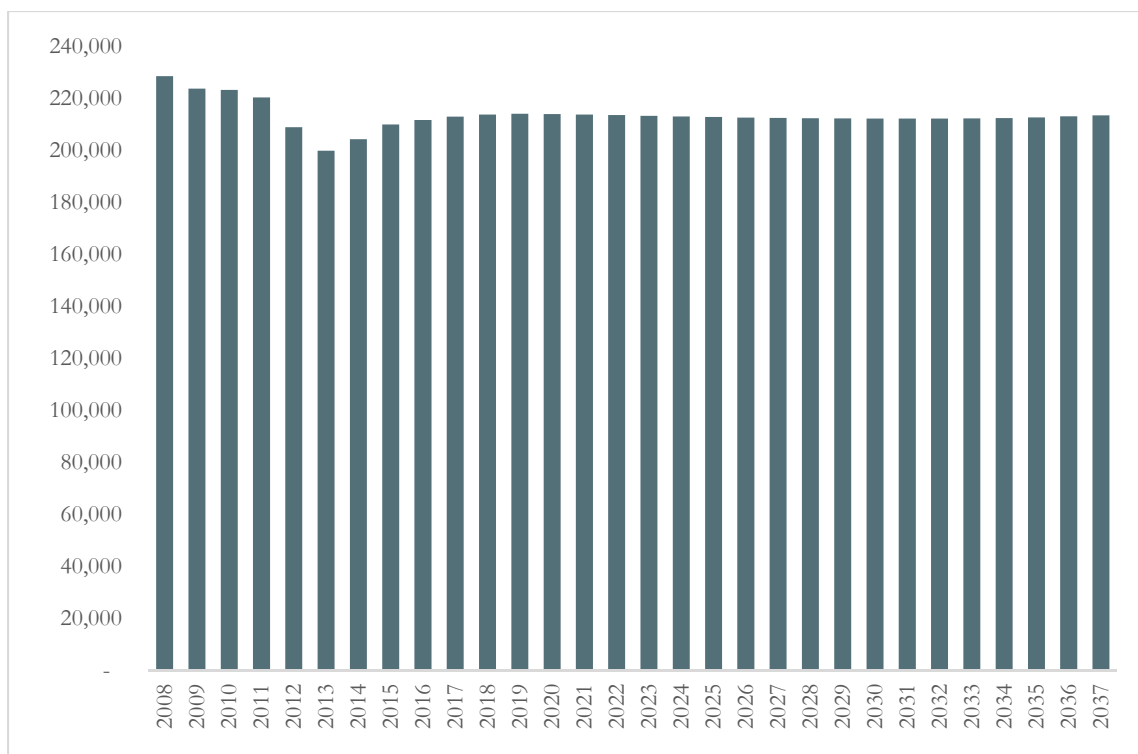
Table 3— U.S. Historical and Projected Non-Commercial Aircraft Operations (in thousands)

Federal Fiscal Year	General Aviation	% Change	Military	% Change	Total	% Change
2008	31,573.8		2,530.6		34,104.4	
2009	28,019.0	-11.3%	2,585.5	2.2%	30,604.5	-10.3%
2010	26,580.1	-5.1%	2,606.9	0.8%	29,187.0	-4.6%
2011	25,964.9	-2.3%	2,630.3	0.9%	28,595.3	-2.0%
2012	26,130.0	0.6%	2,578.8	-2.0%	28,708.7	0.4%
2013	25,805.7	-1.2%	2,551.6	-1.1%	28,357.3	-1.2%
2014	25,654.0	-0.6%	2,515.2	-1.4%	28,169.3	-0.7%
2015	25,578.0	-0.3%	2,494.6	-0.8%	28,072.6	-0.3%
2016	25,536.5	-0.2%	2,461.8	-1.3%	27,998.3	-0.3%
2017	25,569.6	0.1%	2,526.2	2.6%	28,095.9	0.3%
2018	25,806.9	0.9%	2,526.2	0.0%	28,333.2	0.8%
2019	25,879.8	0.3%	2,526.2	0.0%	28,406.0	0.3%
2020	25,953.1	0.3%	2,526.2	0.0%	28,479.3	0.3%
2021	26,026.8	0.3%	2,526.2	0.0%	28,553.0	0.3%
2022	26,100.9	0.3%	2,526.2	0.0%	28,627.1	0.3%
2023	26,175.5	0.3%	2,526.2	0.0%	28,701.8	0.3%
2024	26,250.6	0.3%	2,526.2	0.0%	28,776.8	0.3%
2025	26,326.1	0.3%	2,526.2	0.0%	28,852.3	0.3%
2026	26,402.0	0.3%	2,526.2	0.0%	28,928.3	0.3%
2027	26,478.4	0.3%	2,526.2	0.0%	29,004.7	0.3%
2028	26,555.3	0.3%	2,526.2	0.0%	29,081.5	0.3%
2029	26,632.7	0.3%	2,526.2	0.0%	29,158.9	0.3%
2030	26,710.5	0.3%	2,526.2	0.0%	29,236.7	0.3%
2031	26,788.8	0.3%	2,526.2	0.0%	29,315.0	0.3%
2032	26,867.6	0.3%	2,526.2	0.0%	29,393.8	0.3%
2033	26,946.9	0.3%	2,526.2	0.0%	29,473.1	0.3%
2034	27,026.7	0.3%	2,526.2	0.0%	29,552.9	0.3%
2035	27,107.0	0.3%	2,526.2	0.0%	29,633.2	0.3%
2036	27,187.8	0.3%	2,526.2	0.0%	29,714.1	0.3%
2037	27,269.2	0.3%	2,526.2	0.0%	29,795.4	0.3%
Compound Annual Growth Rate						
2008-2017	-0.4%		-0.3%		-0.4%	
2017-2022	0.4%		0.0%		0.4%	
2017-2027	0.3%		0.0%		0.3%	
2017-2037	0.3%		0.0%		0.3%	

Source: FAA Aerospace Forecast; Compiled by WSP.

Figure 5 presents the historical and projected general aviation fleet mix for the U.S. from 2008 to 2037. As shown, the general aviation fleet mix was approximately 230,000 in 2008 decreasing to approximately 213,000 in 2017. The general aviation fleet mix is projected to remain steady through 2037; however, the mix of aircraft is projected to change with less piston aircraft and more turbine and jet aircraft in the fleet. According to the FAA Aerospace Forecast, piston aircraft is projected to decrease at an average annual rate of approximately 1.0 percent from 2017 to 2038, while turbine aircraft is projected to increase at a compound annual growth rate of approximately 2.0 percent during the same time period.

Figure 5—U.S. Historical and Projected General Aviation Fleet Mix



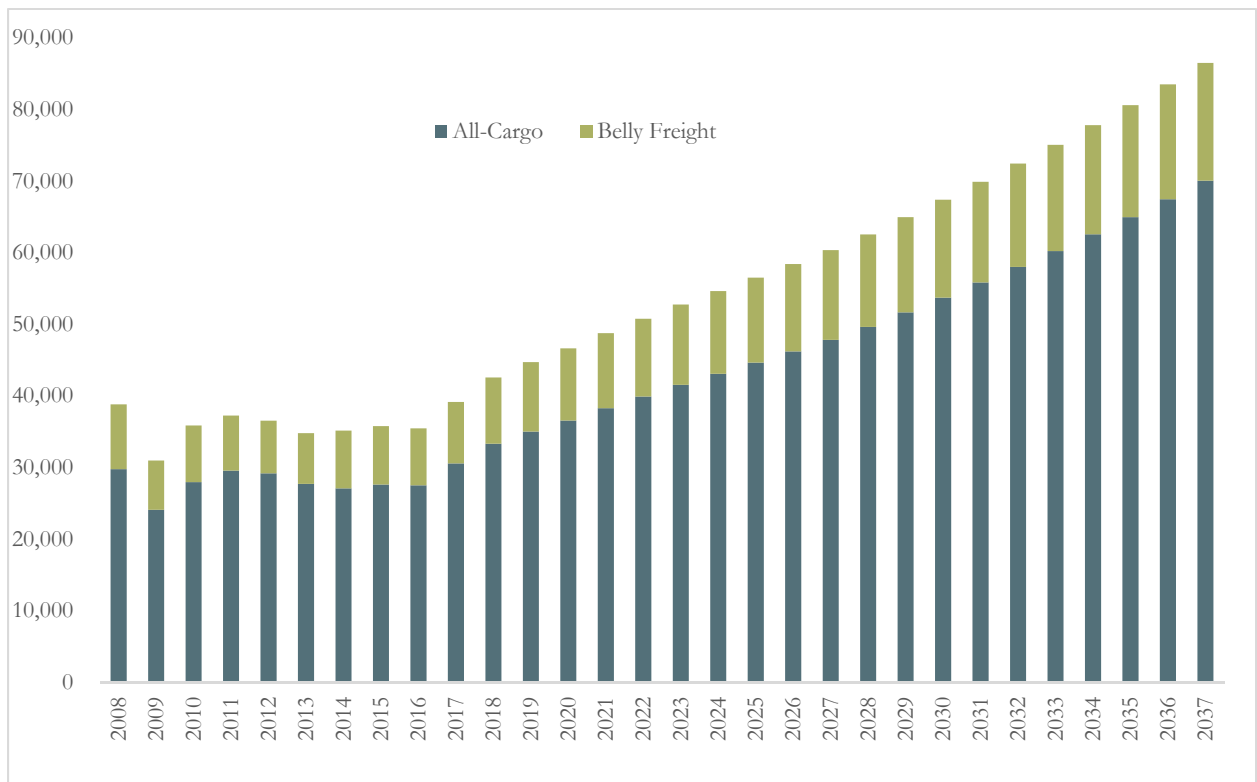
Source: *FAA Aerospace Forecast*; Compiled by WSP.

### 2.2.3 Air Cargo Activity

Air cargo traffic includes both freight/express and belly freight. Freight/express cargo is carried by all-cargo carriers and moves on dedicated cargo aircraft by carriers such as UPS, FedEx and DHL. Belly freight is cargo that is carried in the belly of passenger aircraft and typically contains mail. Figure 6 presents the FAA’s historical and projected cargo revenue ton miles (RTMs) for U.S. carriers. As shown, total cargo remained relatively flat from 2008 to 2017 increasing from approximately 38.8 billion in 2008 to 39.2 billion in 2017, reflecting a compound annual growth rate of 0.1 percent during that time period. Total cargo RTMs

are projected to increase from 30.2 billion in 2017 to 86.5 billion in 2037, reflecting an average annual growth rate of 4.0 percent. All-cargo is projected to increase at a slightly higher rate than belly freight, with compound annual growth rates of 4.2 percent and 3.3 percent, respectively from 2017 to 2037. Cargo is expected to increase the most during the near-term, reflecting strong economic growth during the period from 2017 to 2022 and carrying forward the double-digit percentage growth (10 percent) experienced from 2016 to 2017.

Figure 6—U.S. Historical and Projected RTMs (in billions)



Source: *FAA Aerospace Forecast*; Compiled by WSP.

### 2.2.4 Commercial Aviation Fleet Mix

Commercial aviation includes activity by mainline carriers, regional carriers, and all-cargo carriers. The *FAA Aerospace Forecast* includes fleet mix projections for aircraft in the U.S. including mainline (including low cost), international, and regional aircraft operations, as well all-cargo aircraft. The fleet mix for mainline and cargo carriers is delineated by narrow and wide body aircraft and the regional carrier fleet mix is divided into categories for non-jet and jet aircraft. Table 4 below presents a summary of representative aircraft for each category.

Table 4— U.S. Representative Aircraft by Category

Aircraft Category	Representative Aircraft
Wide Body	Boeing 747, Boeing 767, Boeing 777, Boeing 787, Airbus 340, Airbus 350, Airbus 380
Narrow Body	Boeing 727, Boeing 737, Boeing 757, Airbus 320, MD 88
Regional Jet > 50 Seats	Canadair Regional Jet 700, Canadair Regional Jet 900, Canadair Regional Jet 1000
Regional Jet < 50 Seats	Canadair Regional Jet 200, Embraer 135, Embraer 145
Regional Non-Jet	Bombardier Q400, Saab 340,

Source: Compiled by WSP.

Table 5 presents historical and projected fleet mixes for mainline regional and cargo carriers. From 2008 to 2017 there was an increase in mainline carrier aircraft and a decrease in regional aircraft and cargo aircraft. Wide body aircraft for both mainline and cargo carriers are projected to increase through 2037, at compound annual growth rates of 2.3 percent and 2.0 percent, respectively. The growth in widebody aircraft is the highest compound annual growth rates of any aircraft category. From 2017 to 2037 regional jets with greater than 50 seats (mainline carriers) are projected to decrease at an average rate of 1.1 percent annually. Regional jets with less than 50 seats are projected to increase at a compound annual growth rate of 0.6 percent.



Table 5 — U.S. Historical and Projected Fleet Mix

Federal Fiscal Year	Mainline Aircraft > 50 Seats				Regional Aircraft < 50 Seats			Cargo Aircraft		
	Narrow Body	Wide Body	Regional Jet	Total Mainline	Non-Jet	Jet	Total Regional	Narrow Body	Wide Body	Total Cargo
2008	3,383	536	63	3,982	1,033	1,747	2,780	399	571	970
2009	3,181	524	79	3,784	927	1,755	2,682	308	563	871
2010	3,129	522	71	3,722	857	1,756	2,613	288	562	850
2011	3,135	519	76	3,730	857	1,710	2,567	291	580	871
2012	3,130	523	82	3,735	758	1,582	2,340	266	573	839
2013	3,164	522	93	3,779	571	1,642	2,213	213	535	748
2014	3,226	512	98	3,836	555	1,602	2,157	235	533	768
2015	3,321	523	99	3,943	516	1,628	2,144	252	537	789
2016	3,459	517	97	4,073	519	1,637	2,156	256	554	810
2017	3,540	517	98	4,155	487	1,644	2,131	261	594	855
2018	3,617	526	98	4,241	429	1,651	2,080	263	595	858
2019	3,653	539	90	4,282	410	1,641	2,051	264	588	852
2020	3,673	550	80	4,303	397	1,646	2,043	265	593	858
2021	3,687	573	80	4,340	378	1,668	2,046	265	597	862
2022	3,701	586	80	4,367	367	1,688	2,055	267	604	871
2023	3,711	601	80	4,392	351	1,716	2,067	267	621	888
2024	3,735	598	80	4,413	332	1,741	2,073	268	628	896
2025	3,759	605	80	4,444	312	1,733	2,045	269	635	904
2026	3,787	611	80	4,478	296	1,717	2,013	268	645	913
2027	3,821	615	80	4,516	277	1,690	1,967	267	661	928
2028	3,844	619	79	4,542	266	1,663	1,929	267	677	944
2029	3,876	634	78	4,588	249	1,661	1,910	267	700	967
2030	3,909	642	78	4,629	234	1,664	1,898	268	720	988
2031	3,939	667	78	4,684	214	1,681	1,895	269	741	1,010
2032	3,977	692	78	4,747	199	1,708	1,907	270	761	1,031
2033	4,012	718	78	4,808	187	1,756	1,943	270	787	1,057
2034	4,060	741	78	4,879	167	1,785	1,952	271	805	1,076
2035	4,104	763	78	4,945	152	1,802	1,954	272	829	1,101
2036	4,143	786	78	5,007	136	1,834	1,970	272	854	1,126
2037	4,166	809	78	5,053	121	1,869	1,990	272	880	1,152
Compound Annual Growth Rate										
2008-2017	0.5%	-0.4%	5.0%	0.5%	-8.0%	-0.7%	-2.9%	-4.6%	0.4%	-1.4%
2017-2022	0.9%	2.5%	-4.0%	1.0%	-5.5%	0.5%	-0.7%	0.5%	0.3%	0.4%
2017-2027	0.8%	1.8%	-2.0%	0.8%	-5.5%	0.3%	-0.8%	0.2%	1.1%	0.8%
2017-2037	0.8%	2.3%	-1.1%	1.0%	-6.7%	0.6%	-0.3%	0.2%	2.0%	1.5%

Source: FAA Aerospace Forecast; Compiled by WSP.

## Section 3—Local Aviation Trends

This section presents aviation trends at PVD. It includes air carrier, general aviation, and air cargo activity trends.

### 3.1 Passenger Airline Activity

This section presents a historical review of passenger airline activity at PVD compared to the Boston Region and U.S.

#### 3.1.1 Enplanements

PVD is the only primary commercial service airport in Rhode Island. However, because of the proximity of air service at airports in the Boston Region, activity at these airports has an impact on air service at PVD. The largest impact is from BOS because of their large overlapping service area. In addition, the geographic relationship between BOS, MHT and PVD, as well as their combined service area creates a “regional” airport system with BOS having the largest share.

Table 6 presents a comparison of total enplanements at PVD to that of the Boston Region airports and the U.S. As shown, PVD’s share of both the total enplanements at nearby airports (which includes PVD) and the U.S. has steadily decreased over the last 10 years. This is primarily due to an increase in traffic at BOS, whose share of the Boston Region’s enplanements increased from approximately 65 percent in 2008 to 75 percent in 2017.

PVD’s overall share of the airports in the Boston Region market declined from 11.5 percent (2008) to 8.0 percent (2017). MHT’s decline over the same period was more severe, as declined from 9.2 percent (2008) to 3.9 percent (2017). Conversely, BOS’s share of the Boston Region airports increased from 64 percent to 75 percent. Data for the nearby airports was compiled using the most recent FAA Terminal Area Forecast released in March 2018.

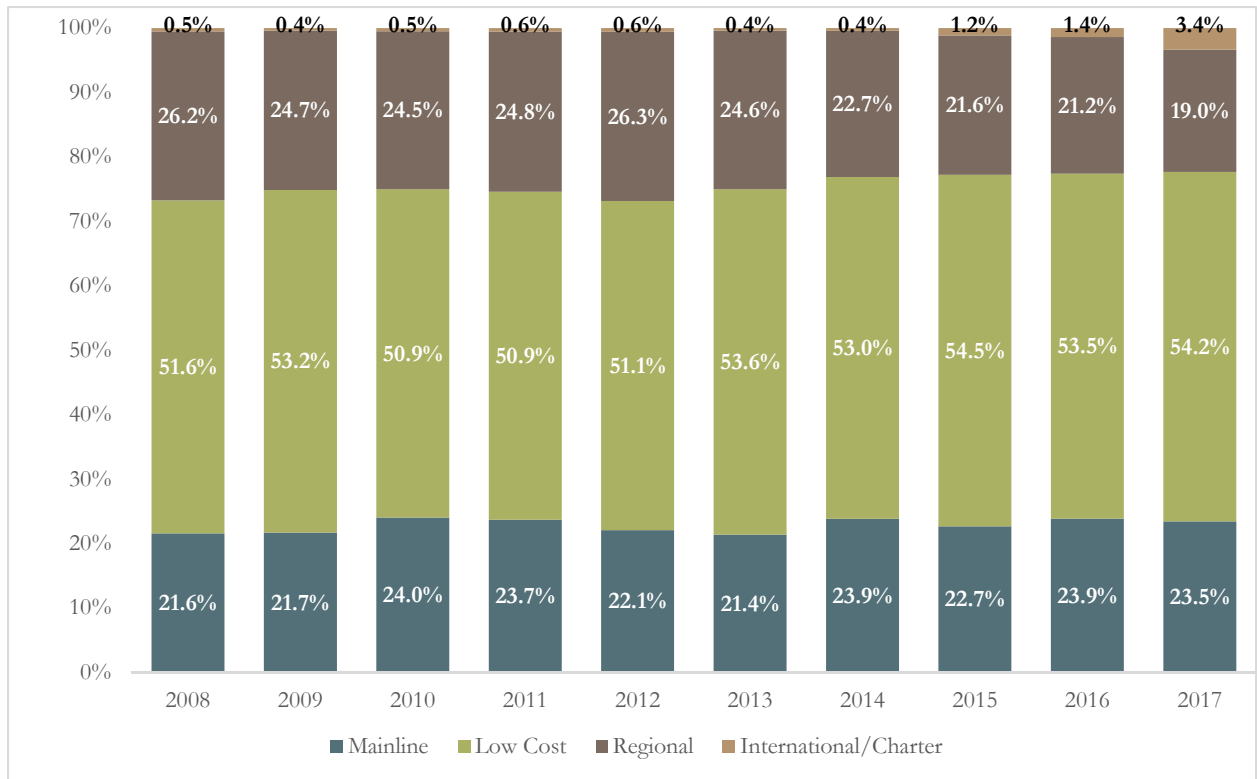
Table 6—PVD, Boston Region, and U.S. Historical Enplanements

Sources: RIAC Records, FAA Terminal Area Forecast, and FAA Aerospace Forecast; Compiled by WSP

Calendar Year	PVD Enplanements	PVD % Change	BOS Enplanements	BOS % Change	Boston Region Enplanements	Boston Region % Change	U.S. Enplanements (in millions)	U.S. % Change	PVD % Share Boston Region	BOS % Share Boston Region	PVD % Share of U.S.
2008	2,353,715		13,157,454		20,500,764		759.0		11.5%	64.2%	0.310%
2009	2,168,146	-7.9%	12,371,847	-6.0%	18,886,996	-7.9%	704.0	-7.2%	11.5%	65.5%	0.308%
2010	1,967,507	-9.3%	13,240,041	7.0%	19,192,867	1.6%	705.8	0.3%	10.3%	69.0%	0.279%
2011	1,945,979	-1.1%	14,127,938	6.7%	20,280,873	5.7%	725.2	2.7%	9.6%	69.7%	0.268%
2012	1,830,602	-5.9%	14,325,928	1.4%	20,092,085	-0.9%	732.7	1.0%	9.1%	71.3%	0.250%
2013	1,908,497	4.3%	14,598,002	1.9%	20,317,345	1.1%	739.5	0.9%	9.4%	71.8%	0.258%
2014	1,789,083	-6.3%	15,301,281	4.8%	21,099,699	3.9%	756.9	2.4%	8.5%	72.5%	0.236%
2015	1,786,599	-0.1%	16,079,273	5.1%	21,866,262	3.6%	786.5	3.9%	8.2%	73.5%	0.227%
2016	1,826,949	2.3%	17,392,255	8.2%	23,240,350	6.3%	819.6	4.2%	7.9%	74.8%	0.223%
2017	1,969,966	7.8%	18,521,638	6.5%	24,636,809	6.0%	840.4	2.5%	8.0%	75.2%	0.234%
<b>Compound Annual Growth Rate</b>											
2008-2017	-2.0%		3.9%		2.1%		1.1%				
2013-2017	0.8%		6.1%		4.9%		3.3%				

PVD is served by a number of air carriers, representing several segments of the aviation market. These types of carriers include mainline carriers (Delta, United, and American), regional carriers (mainly affiliates of the mainline carriers such as Pinnacle, Express Jet, and Skywest); low cost carriers (jetBlue, Southwest, and Frontier); and international/charter carriers (Norwegian Air International and SATA International). Figure 7 presents the share of enplanements by type of carrier from 2008 to 2017. As shown, since 2008, the share of regional carrier enplanements has decreased from 26.2 percent to 19.0 percent. This shift occurred as low cost carriers have initiated service at PVD and as mainline carriers consolidated operations through bankruptcy and acquisition, as well as the increased utilization of larger regional jets rather than aircraft with 50 seats or less. Further, there has been an increase in the share of enplanements on international and charter carriers as airlines such as Norwegian Air International have initiated service at PVD, serving European markets in the summer and the Caribbean and Mexico in the winter.

Figure 7—PVD Historical Enplanements by Carrier Type



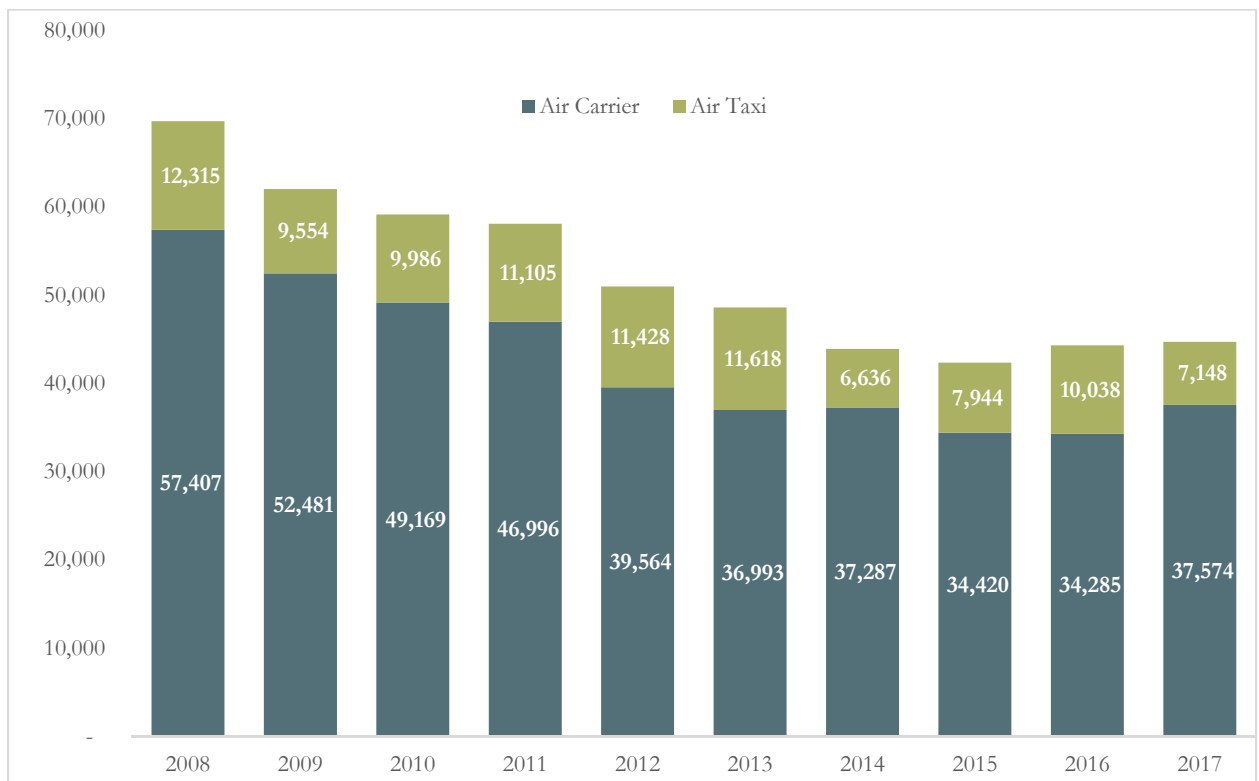
Source: RIAC Records; Compiled by WSP.

### 3.1.2 Aircraft Operations

Passenger airline aircraft operations are captured in the FAA Terminal Area Forecast under the FAA classifications of air carrier and air taxi operations, which also include air cargo aircraft operations. Additional aircraft operation data is available from the FAA’s Traffic Flow Management System Counts (TFMISC) data. This database categorizes aircraft operations among air carrier, air taxi, and freight operations. TFMISC data reports only those aircraft operations that used instrument flight rules (IFR) for landings or take offs, while PVD and FAA Terminal Area Forecast data includes aircraft operations that use visual flight rules (VFR). Therefore, TFMISC data and FAA Terminal Area Forecast data may differ slightly as the total of VFR and IFR aircraft operations make up total aircraft operations. The TFMISC data aircraft operations allocation between air carrier, air taxi, and freight was applied to PVD’s aircraft operation data for air carrier and air taxi to estimate passenger airline aircraft operations versus all-cargo/freight aircraft operations. Further the Official Airline Guide (OAG) provides data related to the scheduled aircraft operations, which are also included in air carrier and air taxi aircraft operations.

Figure 8 presents the air carrier and air taxi aircraft operations from 2008 to 2017 for PVD. As shown, air carrier and air taxi aircraft operations have decreased from approximately 70,000 in 2008 to approximately 45,000 in 2017. The average annual decrease during this time period was 4.6 percent for air carrier aircraft operations and 4.1 percent for air taxi aircraft operations. These decreases compare to an average annual increase of 2.3 percent and an average annual decrease of 5.7 for air carrier aircraft operations and air taxi aircraft operations for New England, respectively.

Figure 8—PVD Historical Air Carrier and Air Taxi Aircraft Operations



Source: RIAC Records; TFMSC Data; Compiled by WSP.

Figure 9 presents the average seats per scheduled departure at PVD from 2008 to 2017. As shown, the average number of seats per departure at PVD has increased from 91.9 in 2007 to 117.9 in 2017. This is primarily due to the increase in the utilization of larger regional jets (greater than 50 seats). The number of departures on regional aircraft (jets with less than 50 seats and turbo prop aircraft) decreased from approximately 12,000 in 2008 to approximately 2,600 in 2017. This type of air service has been replacing scheduled service that was provided on larger regional jet aircraft ranging from 70 seats to 100 seats. Schedule information from the OAG was compared to enplanements to calculate the average load factor from 2008 to 2017.

Figure 9—PVD Seats per Scheduled Departure



Source: Official Airline Guide; Compiled by WSP.

Figure 10 presents the average load factor at PVD compared to the load factor for the U.S. from 2008 to 2017. The average load factor at PVD increased from 76.7 percent in 2008 to 81.1 percent in 2017. This compared to load factors of 79.5 and 83.5 for the U.S. for the same years. In 2010 and 2011, the average load factor at PVD was approximately 10 percentage points less than the U.S; However, in all other years, it was very close, tracking within two percentage points. The primary reason for the increase in load factors across the board is the “right-sizing” aircraft, as well as the consolidation of six mainline carriers to three during the same period.

Figure 10—PVD Average Load Factors Compared to U.S. Load Factors

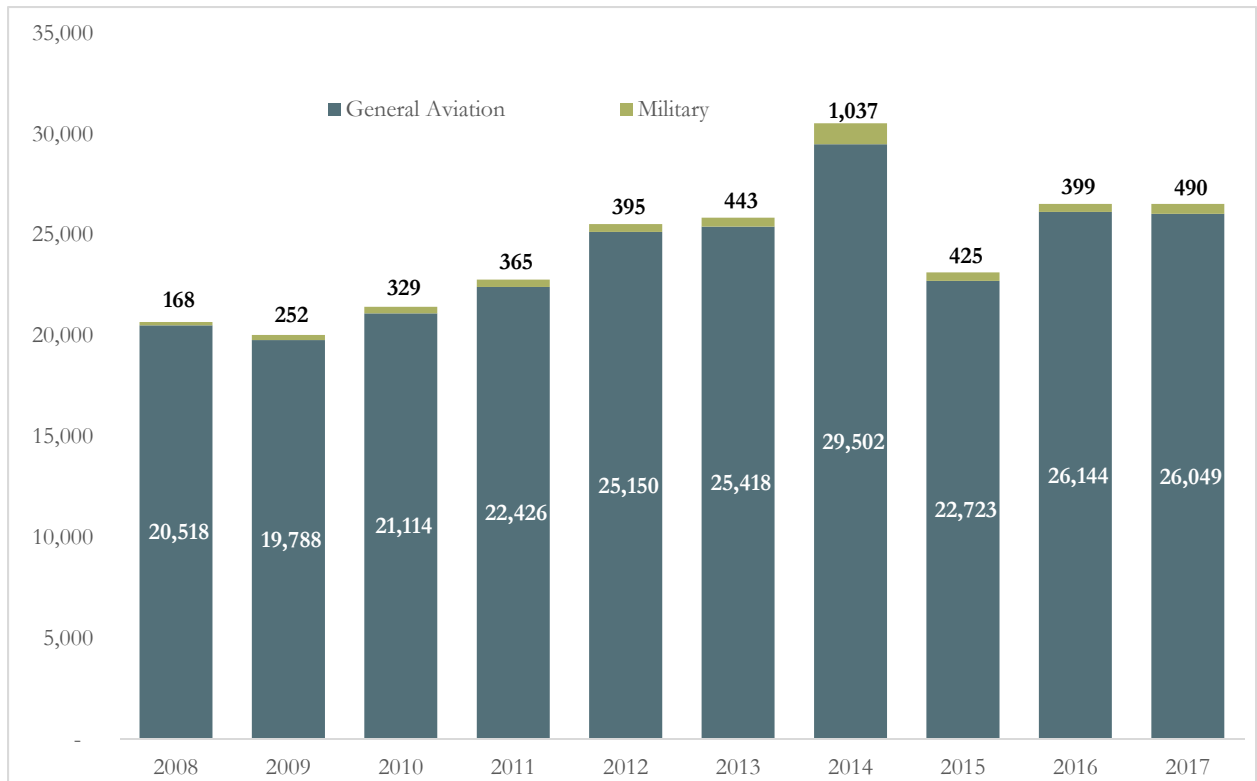


Source: RIAC Records, Official Airline Guide; Compiled by WSP.

### 3.2 Non-Commercial Activity

Figure 11 presents the non-commercial (general aviation and military) aircraft operations from 2008 to 2017. General aviation aircraft operations represent approximately 98 percent of non-commercial aircraft operations, while military aircraft operations have routinely accounted for less than 500 annual aircraft operations. As shown in the figure, general aviation aircraft operations have increased from approximately 20,000 in 2008 to 26,000 in 2017. General aviation aircraft operations increased at a compound annual growth rate of 2.7 percent. This trend is the opposite of the trend experienced nationwide with non-commercial aircraft operations decreasing due to the Great Recession and continuing to decline, as the number of single engine aircraft is replaced with smaller general aviation turbine aircraft.

Figure 11—PVD Non-Commercial Aircraft Operations



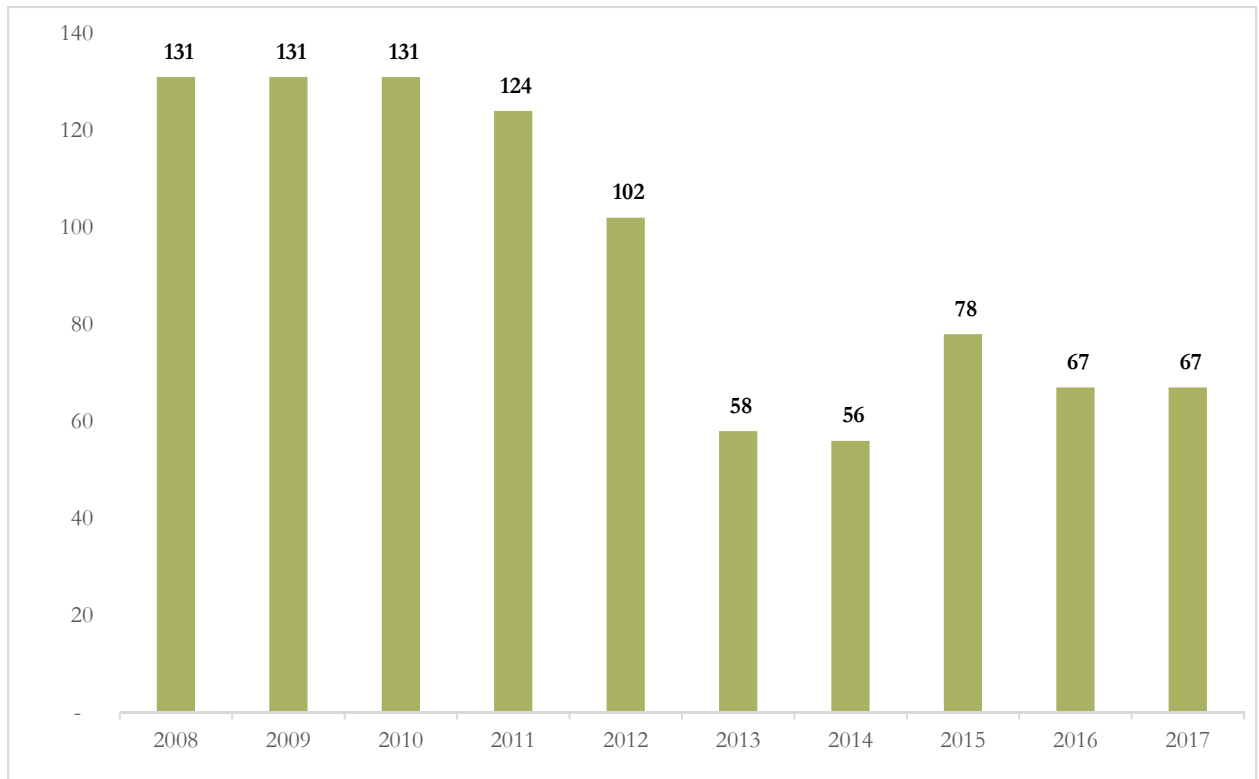
Source: RIAC Records; Compiled by WSP.

based

Similar to the U.S., the FAA Terminal Area Forecast shows PVD having decrease in the number of based aircraft. There is limited historical data for based aircraft and the fleet mix of based aircraft at PVD. The FAA Terminal Area Forecast provides a total number of based aircraft, which was compared to actual data presented in the Rhode Island Aviation System Plan (RIASP), which provided an inventory of based aircraft for 2014 at PVD. To estimate the historical based aircraft at PVD the year-over-year based aircraft changes presented in the FAA Terminal Area Forecast were adjusted based on the actual 2014 observation presented in the RIASP. Figure 12 presents the estimated historical based aircraft at PVD.



Figure 12—PVD Historical Estimated Based Aircraft



Sources: RIASP, FAA Terminal Area Forecast; Compiled by WSP.

### 3.3 Air Cargo Activity

Table 7 presents air cargo activity for PVD from 2008 to 2017. The table shows combined cargo weights for all-cargo and belly freight (in pounds) have increased at an average annual growth rate of 4.1 percent from 2008 to 2017. The growth in air cargo at PVD comes from the recent addition of scheduled cargo service by Atlas Air and Air Transport International. From 2008 to 2017, all-cargo aircraft operations have decreased at an average annual rate of 4.1 percent. However, during the past 5-years (2013 to 2017) aircraft operations increased at an average annual growth rate of 3.6 percent.

Table 7—PVD Historical Cargo Activity

Calendar Year	All-Cargo Lbs.	Belly Freight Lbs.	Total Lbs.	% Change	Aircraft Operations	% Change
2008	27,927,672	2,517,320	30,444,992		1,624	
2009	19,042,649	1,974,692	21,017,341	-31.0%	941	-42.1%
2010	19,880,584	1,535,241	21,415,825	1.9%	973	3.4%
2011	20,491,597	2,195,158	22,686,755	5.9%	1,006	3.4%
2012	22,684,847	1,519,625	24,204,472	6.7%	1,011	0.5%
2013	24,790,166	1,499,607	26,289,773	8.6%	1,002	-0.9%
2014	25,882,148	1,451,921	27,334,069	4.0%	1,007	0.5%
2015	25,793,876	1,246,622	27,040,498	-1.1%	1,024	1.7%
2016	26,467,362	1,250,909	27,718,271	2.5%	1,035	1.1%
2017	42,573,283	960,612	43,533,895	57.1%	1,109	7.1%
Compound Annual Growth Rate						
2007-2017	4.8%	-10.2%	4.1%		-4.1%	
2013-2017	14.5%	-10.5%	13.4%		2.6%	

Sources: RIAC Records, TFMSC Data; Compiled by WSP.

### 3.4 Commercial Aircraft Fleet Mix

Fleet mix is the allocation of aircraft operations by a particular type of aircraft. The historical commercial aircraft fleet mix at PVD is presented in Figure 13. The graph shows how the commercial aircraft fleet mix at PVD has shifted from 2008 to 2017. As stated earlier aircraft operations using 50-seat regional jets have decreased, being replaced with service on 70-seat to 90-seat aircraft and narrow body aircraft. The end result is fewer aircraft operations to transport the same amount or more passengers.

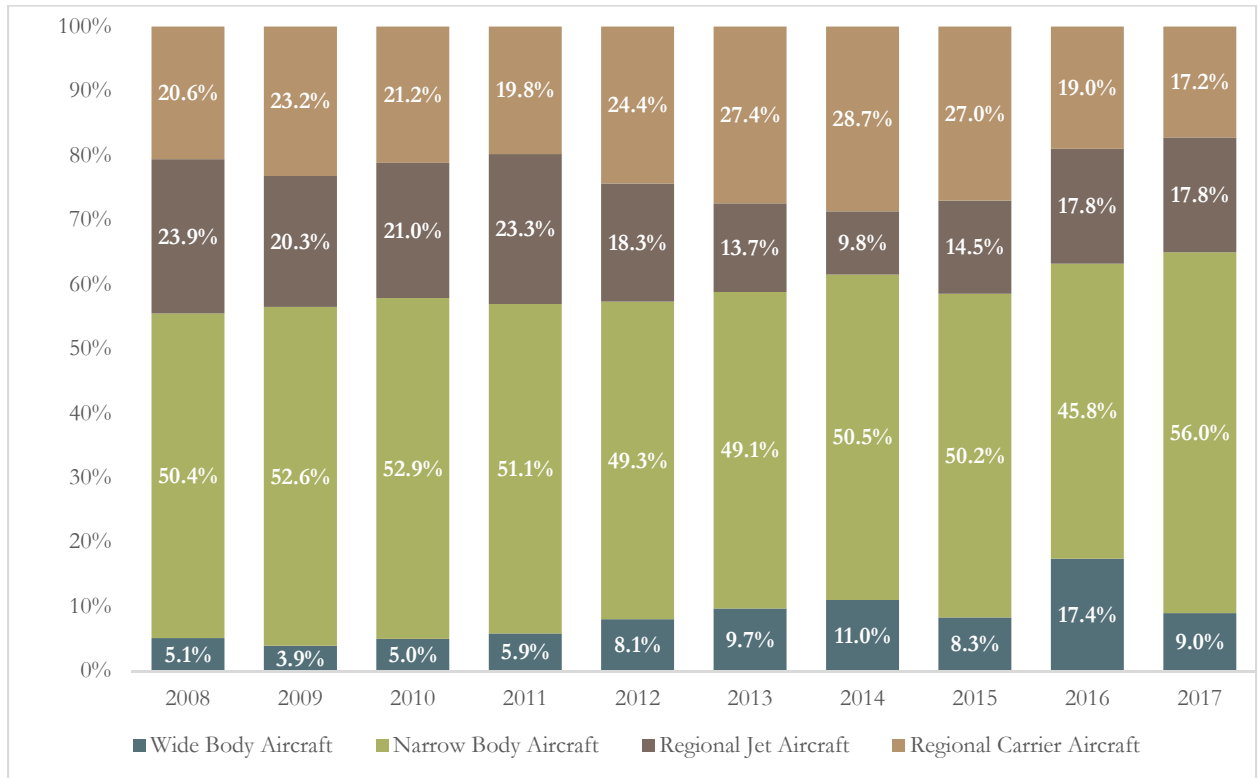
Narrow body aircraft operations accounted for approximately 50 percent of scheduled aircraft operations from 2008 to 2017. The largest share of scheduled narrow body aircraft operations was with Boeing 737 aircraft. The Boeing 737 represented 45 percent of total scheduled aircraft operations in 2008 and 34 percent in 2017. In recent years, there has been a shift away from the Boeing 737 to the McDonnell Douglas 88 and the Boeing 757. They had the second and third largest share of narrow body aircraft operations in 2017, at approximately 11 percent and 5 percent respectively.

The largest share of scheduled aircraft operations was with Airplane Design Group (ADG)<sup>2</sup> III, with approximately 81 percent in 2008 and 71 percent in 2017. This decrease is a result of the shift number of scheduled operations on ADG IV aircraft to ADG III and ADG II,

<sup>2</sup> Airplane Design Group is an FAA classification that categorizes aircraft by wing span and tail height. Smaller aircraft are ADG I and larger aircraft are ADG VI.

with the initiation of service by Cape Air to serve island destinations, such as Block Island, Nantucket, and Martha’s Vineyard, in the summer months from PVD.<sup>3</sup>

Figure 13—PVD Historical Fleet Mix by Aircraft Type



Source: Official Airline Guide; Compiled by WSP.

<sup>3</sup> Cape Air discontinued air service at PVD in Summer 2015.

## Section 4—Forecast Methodology

In an effort to quantify the anticipated level of aircraft activity for PVD, a base case forecast was developed for the 20-year planning period (2018 to 2037). The base case forecast will be reviewed by the FAA for consistency with the TAF and ultimately utilized for airport planning in this Master Plan. In addition to the base case, additional forecast scenarios are presented in this chapter to evaluate potential variations in future service. The base case forecast includes projections for enplanements, aircraft operations, fleet mix, peak hour enplanement and peak hour operations.

The typical methodology used for developing an aviation demand forecast is statistical regression analyses. For a statistical regression analysis to be meaningful, it is necessary to have a variable that positively correlates to variable being forecast and a long history of data that shows a consistent trend. The Airport's enplanements have been on the downward trend since before the Great Recession. In 2005 enplanements were at their all-time high of approximately 2.5 million annually. Due to factors, such as airline consolidation and the initiation of low cost air service at BOS, enplanements at PVD have declined approximately 35 percent in the past 12 years.

Regression analyses are typically based on factors such as population and/or income, as these factors can determine the propensity of a traveler to utilize air travel versus other modes of transportation. Because of this decline in enplanements, it is difficult to find a statistical relationship with a socioeconomic variable such as population for the PVD air service area, which has remained fairly level since 2005. Because of the lack of a correlation with socioeconomic factors, a market share approach was utilized to develop the enplanement forecasts for PVD. The trend of PVD's relationship to the activity of the Boston Region and the nation was used to develop the aviation demand forecasts contained in this study.

The latest FAA Terminal Area Forecast and *FAA Aerospace Forecast, Fiscal Years 2018 – 2038* were utilized to provide the projected enplanements for the Boston Region airports and the U.S. utilized for developing the PVD enplanement forecast. Other factors, such as the recent international service initiated by Norwegian Air International was used to qualitatively justify adjustments in the short-term forecast to the PVD historical share. The enplanement forecasts were then used to develop the scheduled/passenger airline aircraft operations and fleet mix projections based on historical trends in average seats per departure and load factors. Historical trends in PVD's fleet mix for scheduled aircraft operations and projected trends in the U.S. domestic carriers' aircraft fleet mixes outlined in the *FAA Aerospace Forecast* were used to develop the fleet mix projections for the planning horizons.

Because cargo activity is closely tied to economic activity, the *FAA Aerospace Forecast for RTMs* was utilized to determine future cargo weights. The cargo weights were converted to

aircraft operations based on the historical trend of tonnage per aircraft operation at PVD. General aviation aircraft operations were developed using the growth rates contained in the FAA Terminal Area Forecast. Given the overall decline in general aviation traffic projected for the U.S., a forecast specific to PVD was the most applicable. The FAA Terminal Area Forecast was used to develop the projections for other activity segments, such as non-commercial aircraft operations and based aircraft.

## Section 5—Aviation Demand Forecast

This section presents the aviation demand forecasts for passenger activity, general aviation, and cargo activity. In addition, several peak hour forecasts are derived from the annual forecasts. These include peak hour passengers and peak hour aircraft operations. The forecasts in this section are critical to planning in the Facility Requirements and Alternative Analysis chapters of this Airport Master Plan.

### 5.1 Passenger Airline Activity

This section presents the forecasts for future passenger demand. It includes activity for enplanements and aircraft operations.

#### 5.1.1 Enplanements

Table 8 presents projected enplanements for PVD, the Boston Region, BOS, and the U.S. from 2017 to 2037. As shown, enplanements at PVD are projected to increase at compound annual growth rate of 3.5 percent, compared to increases for BOS and the U.S. of 2.7 percent and 2.0 percent, respectively. PVD's share of the Boston Region airports is projected to increase from 8.0 percent to 9.0 percent, which is consistent with the average share over the last 10 years.

Table 8—PVD, Boston Region, and U.S. Projected Enplanements

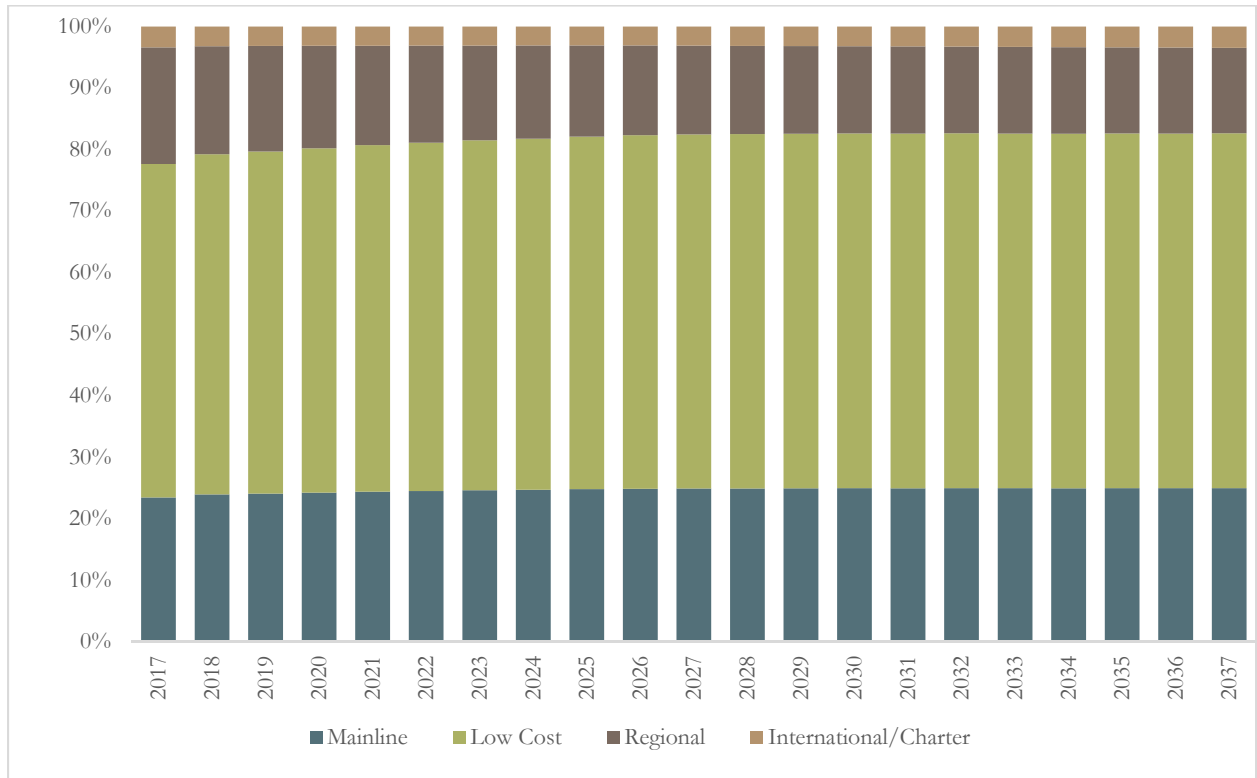
Calendar Year	PVD Enplanements	PVD % Change	BOS Enplanements	BOS % Change	Boston Region Enplanements	Boston Region % Change	U.S. (in millions)	U.S. % Change	PVD % Share Boston Region	BOS % Share Boston Region	PVD % Share of U.S.
2017	1,969,966	7.8%	18,521,638	6.5%	24,636,809	6.0%	840.4	2.5%	8.0%	75.2%	0.234%
2018	2,171,769	10.2%	20,049,771	8.3%	26,573,668	7.9%	879.9	4.7%	8.2%	75.4%	0.247%
2019	2,278,619	4.9%	20,690,237	3.2%	27,388,113	3.1%	908.7	3.3%	8.3%	75.5%	0.251%
2020	2,375,291	4.2%	21,270,171	2.8%	28,128,038	2.7%	923.2	1.6%	8.4%	75.6%	0.257%
2021	2,461,877	3.6%	21,815,510	2.6%	28,819,697	2.5%	934.1	1.2%	8.5%	75.7%	0.264%
2022	2,553,530	3.7%	22,367,304	2.5%	29,526,114	2.5%	947.8	1.5%	8.6%	75.8%	0.269%
2023	2,647,732	3.7%	22,919,158	2.5%	30,237,137	2.4%	963.5	1.7%	8.8%	75.8%	0.275%
2024	2,740,908	3.5%	23,471,435	2.4%	30,949,847	2.4%	979.9	1.7%	8.9%	75.8%	0.280%
2025	2,835,137	3.4%	24,026,045	2.4%	31,667,217	2.3%	996.8	1.7%	9.0%	75.9%	0.284%
2026	2,932,123	3.4%	24,593,088	2.4%	32,403,099	2.3%	1,013.7	1.7%	9.0%	75.9%	0.289%
2027	2,997,929	2.2%	25,180,056	2.4%	33,130,325	2.2%	1,030.7	1.7%	9.0%	76.0%	0.291%
2028	3,066,292	2.3%	25,788,605	2.4%	33,885,817	2.3%	1,049.5	1.8%	9.0%	76.1%	0.292%
2029	3,136,468	2.3%	26,411,693	2.4%	34,661,337	2.3%	1,070.3	2.0%	9.0%	76.2%	0.293%
2030	3,207,033	2.2%	27,038,395	2.4%	35,441,148	2.2%	1,091.0	1.9%	9.0%	76.3%	0.294%
2031	3,278,328	2.2%	27,671,401	2.3%	36,229,039	2.2%	1,113.1	2.0%	9.0%	76.4%	0.295%
2032	3,349,233	2.2%	28,299,689	2.3%	37,012,620	2.2%	1,135.8	2.0%	9.0%	76.5%	0.295%
2033	3,419,284	2.1%	28,920,435	2.2%	37,786,752	2.1%	1,159.4	2.1%	9.0%	76.5%	0.295%
2034	3,491,661	2.1%	29,561,435	2.2%	38,586,593	2.1%	1,184.2	2.1%	9.0%	76.6%	0.295%
2035	3,565,842	2.1%	30,217,774	2.2%	39,406,379	2.1%	1,207.7	2.0%	9.0%	76.7%	0.295%
2036	3,640,918	2.1%	30,882,443	2.2%	40,236,051	2.1%	1,231.6	2.0%	9.0%	76.8%	0.296%
2037	3,715,999	2.1%	31,546,306	2.1%	41,065,768	2.1%	1,257.0	2.1%	9.0%	76.8%	0.296%
Compound Annual Growth Rate											
2017-2022	5.3%		3.8%		3.7%		2.4%				
2017-2027	4.3%		3.1%		3.0%		2.1%				
2017-2037	3.2%		2.7%		2.6%		2.0%				

Sources: FAA Terminal Area Forecast, *FAA Aerospace Forecasts*, and WSP Analysis; compiled by WSP.

Figure 14 presents the projected allocation of enplanements between mainline, low cost, regional, and international/charter categories. The *FAA Aerospace Forecast* reflects an increase in international traffic at faster rate than mainline air carrier (including low cost carriers) and regional airline traffic through 2037. Regional airline enplanements for the U.S. are expected to increase at a slower rate than mainline air carrier enplanements. International/charter enplanements and regional air carrier enplanements at PVD were forecast to increase at the same rate as projected in the *FAA Aerospace Forecast*, respectively. The remaining enplanements were allocated between the mainline and low cost air carriers at the same percentage as in 2017. As shown, the share of international traffic is projected to increase through 2037 and the regional carrier share is projected to decrease. Overall levels of each category are expected to increase during the projection period. Mainline and low cost air carrier traffic are projected to increase at a compound annual growth rate of 3.5 percent, while international/charter enplanements and regional carrier enplanements are projected to increase at compound annual growth rates of 3.4 percent and 1.6 percent, respectively. The overall compound annual growth rate for enplanements at PVD from 2017 to 2037 is projected to be approximately 3.2 percent, compared to the FAA Terminal Area Forecast, which forecasts

PVD enplanements to increase at a compound annual growth rate of 2.8 percent during the same time period.

Figure 14—PVD Enplanement Market Share by Category Forecast



Source: WSP Analysis.

### 5.1.2 Aircraft Operations

Total air carrier and air taxi operations were developed using the annual growth rates in the *FAA Terminal Area Forecast* applied to actual aircraft operations in 2017 as a starting point. Within the categories of air carrier and air taxi, there are scheduled, non-scheduled, and all-cargo aircraft operations.

Scheduled aircraft operations were developed utilizing projected load factors and average seats per departure. As previously mentioned the average load factor at PVD was approximately 81.1percent in 2017. According to the *FAA Aerospace Forecasts*, load factors for the U.S. are expected to increase to approximately 85 percent and then remain constant 2030. In addition, as presented earlier, average seats per departure for the U.S. and PVD are expected to increase during the forecast period. Typically, when load factors of 85 percent are consistent it will result in the need to add additional flights. However, as the average load factor increases, the average seat size of the aircraft departing PVD will also increase.



Also, seats per departure for passenger airline aircraft operations have increased and this trend is expected to continue in the future as the number of regional jets decreases and the number of wide body aircraft increases. Scheduled aircraft operations were derived from the enplanement forecasts using a formula that applies the average load factor to average seats per departure to determine the number of enplanements per departure. Enplanements are then divided by the result to calculate the number of scheduled airline aircraft operations.

After the number of scheduled airline operations were determined, additional non-scheduled air carrier and air taxi operations that were calculated by subtracting projected scheduled aircraft operations and all-cargo aircraft operations from the combined air carrier and air taxi operations developed from the utilization of the *FAA Terminal Area Forecast* growth rates.

Table 9 presents the calculation of scheduled aircraft operations for PVD. As shown, scheduled aircraft operations are projected to increase at a compound annual growth rate of 1.5 percent from 2017 to 2037.

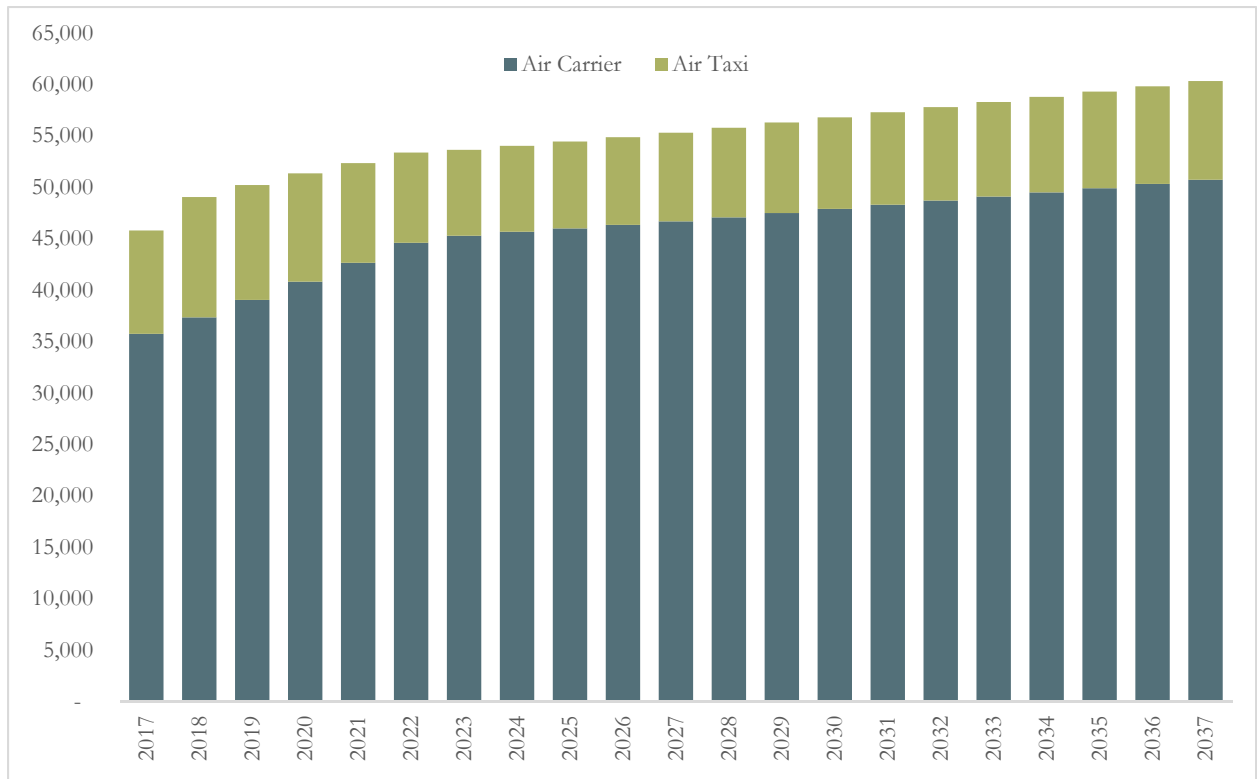
Table 9—PVD Projected Scheduled Aircraft Operations

Calendar Year	Enplanements	Load Factor	Average Seats	Scheduled Aircraft Operations
2017	1,969,966	82.6%	117.9	41,238
2018	2,171,769	83.8%	121.2	42,792
2019	2,278,619	84.4%	124.6	43,331
2020	2,375,291	84.6%	128.1	43,872
2021	2,461,877	84.7%	131.6	44,175
2022	2,553,530	84.8%	135.3	44,521
2023	2,647,732	84.8%	139.1	44,861
2024	2,740,908	84.9%	143.0	45,135
2025	2,835,137	85.0%	147.1	45,380
2026	2,932,123	85.0%	151.2	45,623
2027	2,997,929	85.1%	155.4	45,350
2028	3,066,292	85.1%	155.4	46,362
2029	3,136,468	85.1%	155.4	47,402
2030	3,207,033	85.2%	155.4	48,451
2031	3,278,328	85.2%	155.4	49,512
2032	3,349,233	85.2%	155.4	50,568
2033	3,419,284	85.3%	155.4	51,612
2034	3,491,661	85.3%	155.4	52,692
2035	3,565,842	85.3%	155.4	53,802
2036	3,640,918	85.3%	155.4	54,925
2037	3,715,999	85.3%	155.4	56,049
Compound Annual Growth Rate				
2017-2022	5.3%			1.5%
2017-2027	4.3%			1.0%
2017-2037	3.2%			1.5%

Source: WSP Analysis.

Figure 15 presents the projected air carrier and air taxi aircraft operations. As shown, air carrier and air taxi aircraft operations are projected to increase from approximately 46,000 in 2017 to approximately 60,000 in 2037. This reflects a compound annual growth rate of 1.4 percent during the forecast period compared to the FAA Terminal Area Forecast’s projected compound annual growth rate of 1.4 percent for PVD. Higher growth is projected for air carrier aircraft operations, which are projected to increase at a compound annual growth rate of 1.8 percent, while air taxi aircraft operations are projected to decrease at an annual rate of 0.2 percent.

Figure 15—PVD Projected Air Carrier and Air Taxi Aircraft Operations



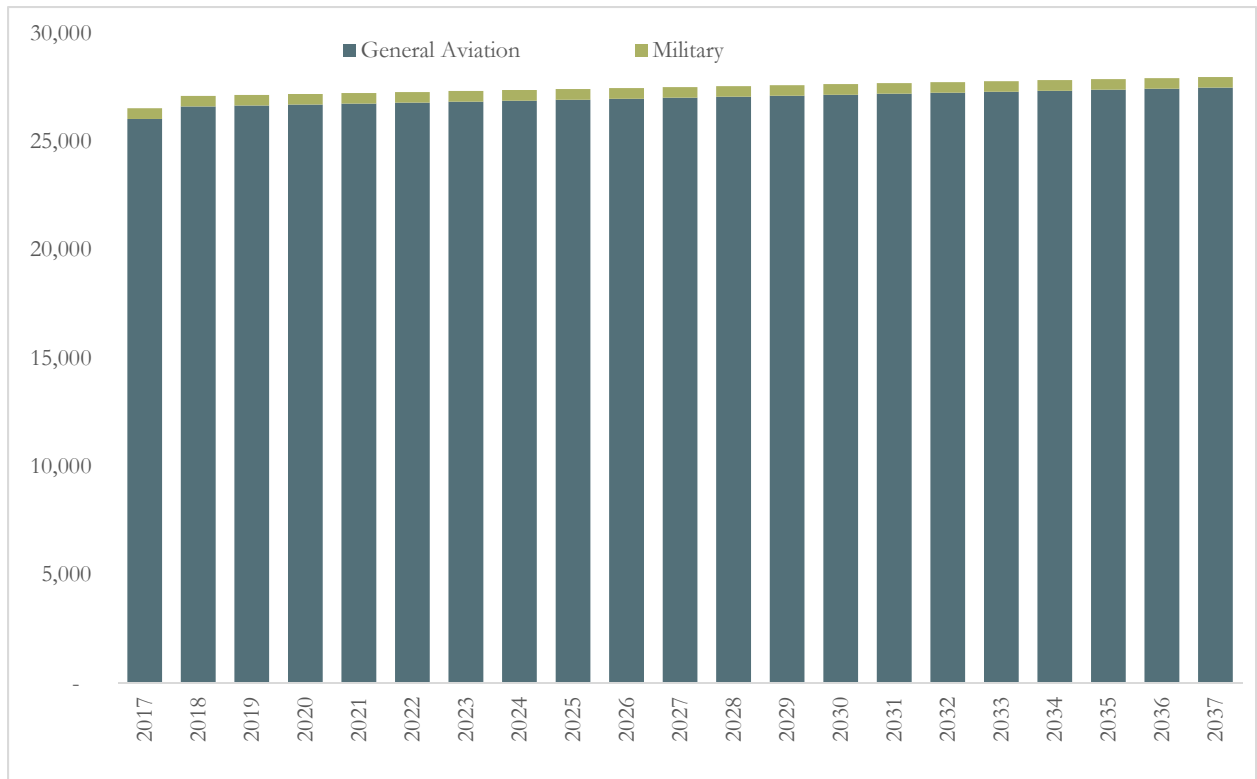
Source: RIAC Records; TFMSC Data; FAA Terminal Area Forecast; WSP Analysis; Compiled by WSP.

## 5.2 Non-Commercial Activity

This section presents the forecast for non-commercial aircraft operations and based aircraft at PVD for the forecast period.

As previously noted, since 2008, non-commercial aircraft operations have decreased at PVD and in the U.S. The *FAA Aerospace Forecast* projects non-commercial aircraft operations will increase slightly through 2037. The *FAA Terminal Area Forecast* also projects that non-commercial aircraft operations at PVD will slightly increase. Figure 16 presents the forecast for non-commercial aircraft operations at PVD. As shown, general aviation aircraft operations are projected to increase from approximately 26,000 in 2017 to 27,500 in 2037, reflecting a compound annual growth rate of 0.3 percent. Military aircraft operations are projected to remain constant at approximately 500 annually throughout the projection period.

Figure 16—PVD Non-Commercial Aircraft Operations Forecast



Source: WSP Analysis.

The FAA Terminal Area Forecast indicates that based aircraft at PVD will remain flat throughout the forecast period. Using the FAA Terminal Area Forecast to adjust RIASP based aircraft for 2014 to 2018 levels, based aircraft are projected to remain steady at 67 through 2037. Similar to the U.S., it could be expected that the number of piston aircraft could be expected to decrease, while the number of turbine aircraft will likely increase during the projection period.

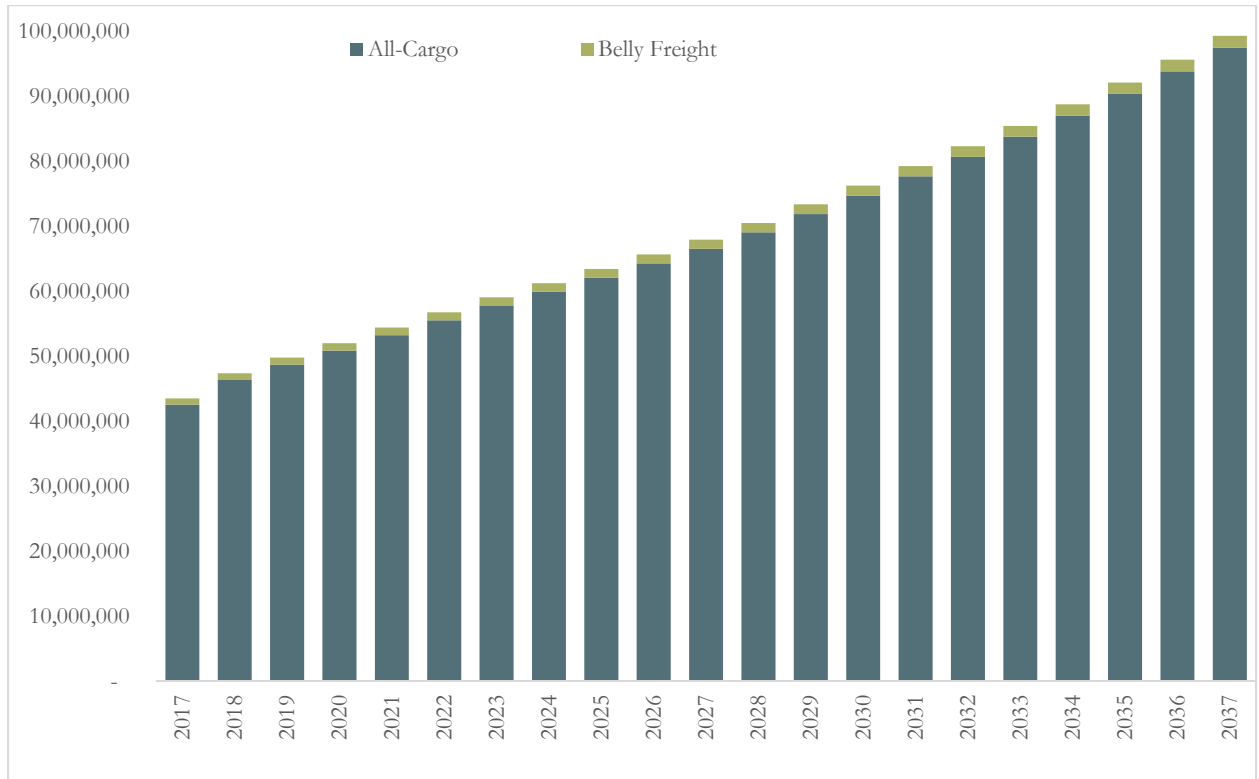
### 5.3 Air Cargo Activity

As previously noted, air cargo activity for the U.S. is projected to increase from 2017 to 2037. In addition, cargo at PVD has had double digit growth from 2013 to 2017. From 2008 to 2017 PVD’s cargo activity has outpaced that of the U.S. with a compound annual growth rate of 4.1 percent compared to the U.S. annual growth rate of 0.1 percent.

PVD’s cargo forecast is based on the growth rates for U.S. activity for all-cargo and belly freight activity. Figure 17 presents the cargo forecast for PVD. As shown, all-cargo is projected to increase from 43.5 million pounds in 2017 to 99.3 million pounds in 2037, reflect-

ing a compound annual growth rate of 4.2 percent. All-cargo activity is projected to approximately 98 percent of total cargo throughout the forecast period, which further continues the trend of reduced belly freight and increased all-cargo at PVD.

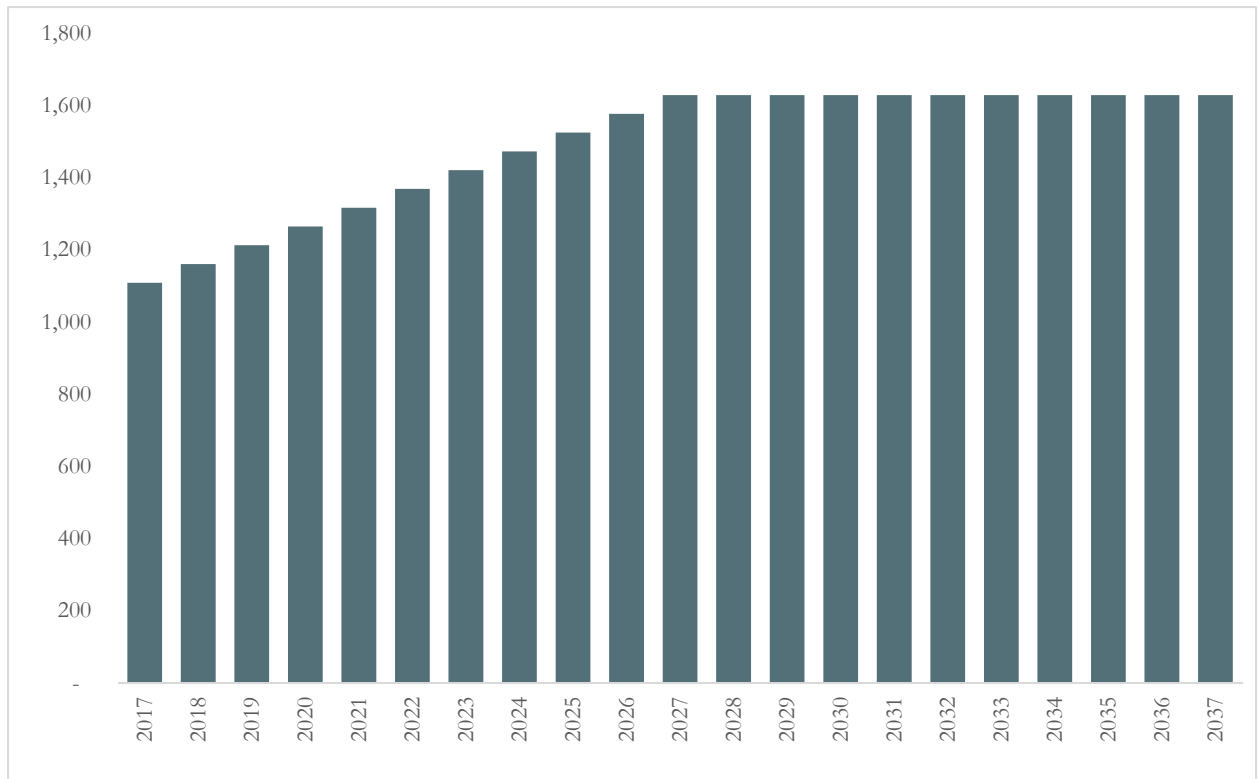
Figure 17—PVD Cargo Activity Forecast



Source: WSP Analysis.

As a result of the increase in cargo tonnage, it is also projected that all-cargo aircraft operations will also increase. Figure 18 presents projected all-cargo operations through 2037. As shown, all-cargo aircraft operations are projected to increase from approximately 1,100 in 2017 to 1,600 by 2027. After 2027, all-operations are projected to level off given the increase in aircraft size and the ability to carry additional freight with the same number of aircraft operations.

Figure 18—PVD All-Cargo Aircraft Operations Forecast

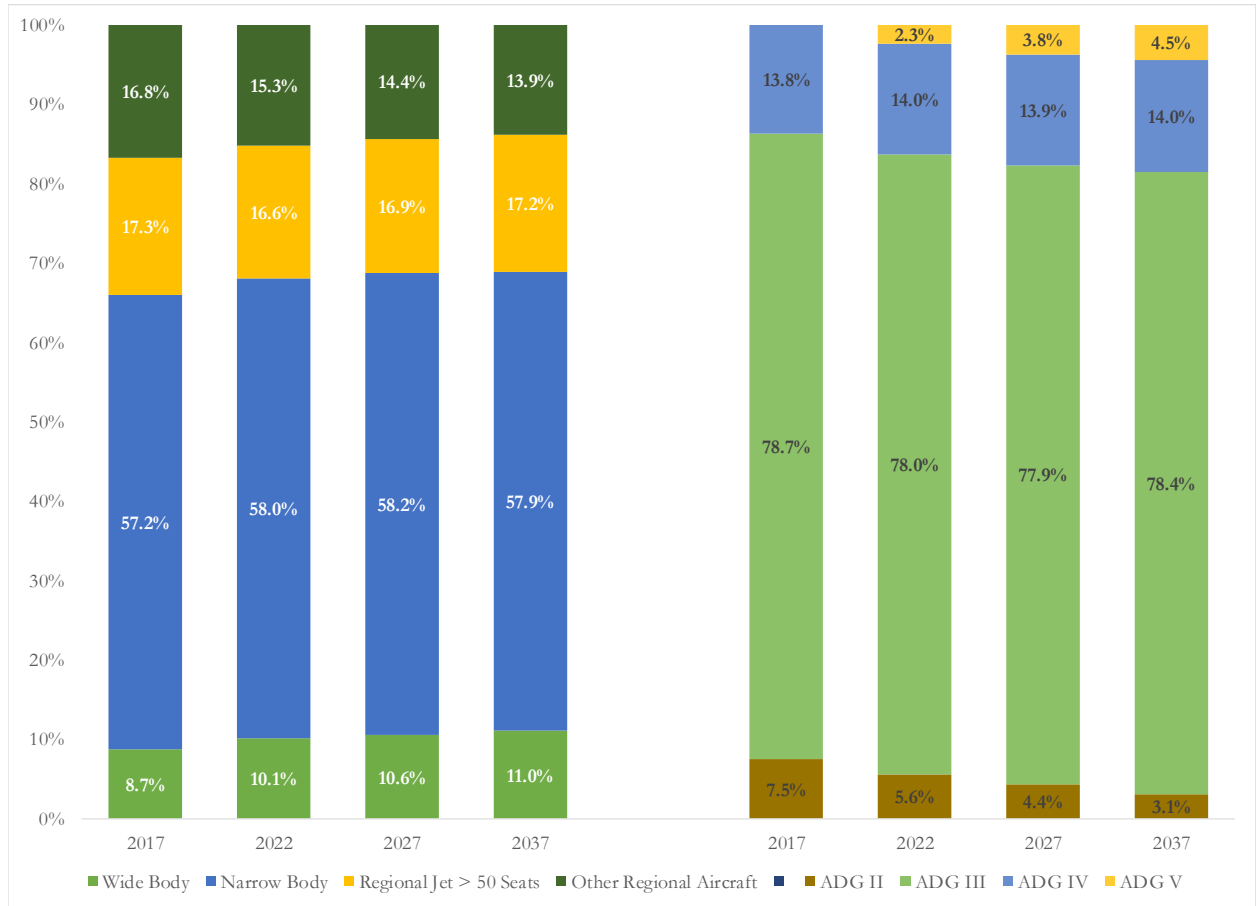


Source: WSP Analysis.

## 5.4 Commercial Aircraft Fleet Mix

This section provides the commercial aircraft fleet mix (scheduled airlines and cargo) projections for the five-, 10-, and 20-year planning horizons. The development of these fleet mix projections was based on the *FAA Aerospace Forecast* trends related to aircraft utilized by mainline and regional air carriers in the U.S. Figure 19 presents the projected commercial aircraft fleet mix for the forecast period. It is presented by aircraft category and FAA ADG. As shown in the figure, ADG III and narrow body aircraft will continue to be the primary commercial service aircraft utilized at PVD during the forecast period. Table 10 presents the aircraft operations for each of the planning horizons. As shown, ADG V annual aircraft operations are projected to increase from approximately 540 in 2022 to approximately 1,300 in 2037. The increase in the use of ADG V aircraft at PVD is predicated on the increased usage of larger aircraft by both all-cargo air carriers and those carriers that are focusing on international routes at the Airport. As volumes and passengers increase, the air carriers may choose to meet demand by using larger aircraft rather than increase the frequency with smaller aircraft.

Figure 19—PVD Projected Aircraft Fleet Mix by Aircraft Type and ADG



Source: WSP Analysis.

Table 10—PVD Projected Operations by Aircraft Type and ADG

	2017	2022	2027	2037
<b>BY AIRCRAFT TYPE</b>				
Wide Body	1,852	2,323	2,490	3,178
Narrow Body	12,110	13,302	13,715	16,661
Regional Jet > 50 Seats	3,673	3,820	3,991	4,944
Other Regional Aircraft	3,549	3,500	3,385	4,010
Total Aircraft Operations by Aircraft Type	21,184	22,945	23,580	28,793
<b>BY AIRPLANE DESIGN GROUP</b>				
ADG II	1,584	1,293	1,028	890
ADG III	16,682	17,895	18,379	22,575
ADG IV	2,918	3,222	3,281	4,042
ADG V	-	534	892	1,286
Total Aircraft Operations by Airplane Design Group	21,184	22,945	23,580	28,793

Source: WSP Analysis.

## 5.5 Derivative Forecasts

In planning for facilities, it is important to understand the activity during peak times, so the facilities required can be planned appropriately. The derivative forecasts developed for this analysis include peak hour estimates for passenger airline activity and peak day activity for non-commercial activity.

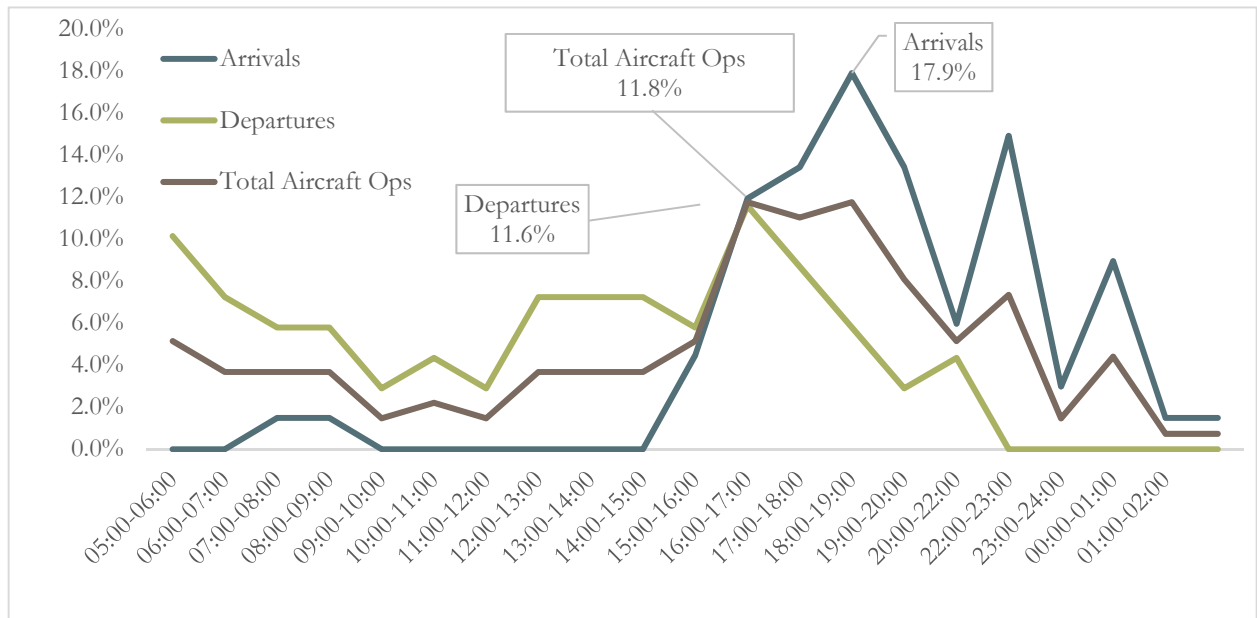
### 5.5.1 Passenger Airline

This section provides derivative forecasts for the peak hour average day of the peak month for both enplanements and scheduled aircraft operations to determine terminal facility requirements and for international arriving passengers to understand the requirements related to federal inspection facilities.

Historically the peak month for scheduled aircraft operations has been either July or August each year, with the exception of 2017 when it was October. Peak month aircraft operations averaged 10 percent from 2008 to 2017. Thus, 10 percent was applied to total annual scheduled aircraft operations to derive the peak month average day (PMAD) peak hour activity for the five-, 10- and 20-year planning horizons. Peak hour scheduled operations include a peak for arrivals, departures and total aircraft operations. To determine the percentage to apply to the total average day of the peak month aircraft operations, an analysis of the peak month for 2017 was conducted to determine the hourly distribution of arrivals, departures and total aircraft operations. Figure 20 below presents the distribution of aircraft operations by segment for October 2017.



Figure 20—PVD Distribution of Daily Scheduled Aircraft Operations



Sources: Official Airline Guide; WSP Analysis; Compiled by WSP.

The trend was very similar with scheduled enplanements, with the peak month averaging at 9.6 percent from 2008 to 2017. This percentage was applied to annual enplanements and then the PMAD was multiplied by the peak hour departures distribution (11.6 percent) to determine the PMAD peak hour enplanements.

PMAD peak hour international arriving passengers are also a key measure of activity that is required for planning airport facilities. To determine the PMAD peak hour international arriving passengers, the OAG schedule for the last 12 months was utilized. The peak month was August 2017 with a distribution percentage of 13.8 percent of total international arrivals. This percentage was applied to annual international enplanements to determine the total peak month passengers. The OAG schedule was consulted to determine the timing of arriving flights during the peak month. Since the schedule did not include any flights within 45 minutes of another, the PMAD arriving passengers was multiplied by a load factor of 85 percent to determine the PMAD peak hour arriving international passengers.

Table 11 below presents the calculation of PMAD aircraft operations, enplanements, and arriving international passengers.

**Table 11—PVD Projected PMAD Peak Hour Activity**

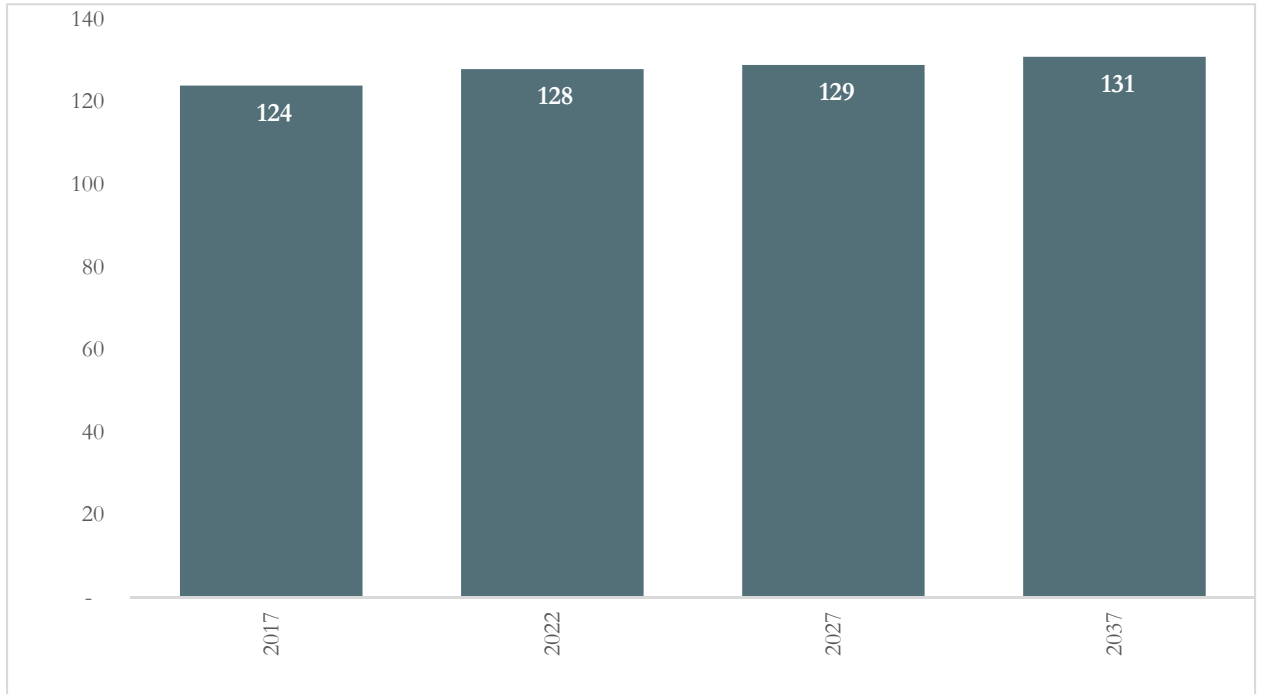
	2017	2022	2027	2037
ANNUAL COMMERCIAL OPERATIONS	41,238	44,521	45,350	56,049
Peak Month (10% of Total)	4,100	4,500	4,500	5,600
Peak Month Average Day (PMAD) (PM/31 days)	132	145	145	181
PMAD Peak Hour Aircraft Operations (11.8% of PMAD)	16	17	17	21
PMAD Peak Hour Arrivals (17.9% of PMAD)	12	13	13	16
PMAD Peak Hour Departures (11.6% of PMAD)	8	8	8	10
ANNUAL ENPLANEMENTS	1,969,966	2,553,530	2,997,929	3,715,999
Peak Month (9.6% of Total)	189,100	245,100	287,800	356,700
Peak Month Average Day (PMAD) (PM/31 days)	6,100	7,906	9,284	11,506
PMAD Peak Hour Enplanements (11.6% of PMAD)	708	917	1,077	1,335
ANNUAL INTERNATIONAL DEPLANEMENTS	66,575	79,293	93,408	128,887
Peak Month (13.8% of Total)	9,200	11,000	12,900	17,800
Peak Month Average Day (PMAD) (PM/31 days)	297	355	417	575
PMAD Peak Hour Int'l Deplanements (LF of 85%)	34	41	48	67

Source: WSP Analysis.

### 5.5.2 Non-Commercial Peak Day Activity

The peak month average day activity was developed for non-commercial aircraft operations. For the past 10 years, the peak month of non-commercial activity was August. Peak month non-commercial aircraft operations were approximately 14.5 percent of total non-commercial aircraft operations. This percentage was applied to total annual aircraft operations to develop the peak month non-commercial aircraft operations for the five-, 10- and 20-year planning horizons. The peak month activity was divided by 31 days to calculate the PMAD non-commercial aircraft operations. Figure 21 presents the PDAM non-commercial aircraft operations for 2017 and projected for each of the planning horizons.

Figure 21 – PVD Peak Month Average Day Non-Commercial Aircraft Operations



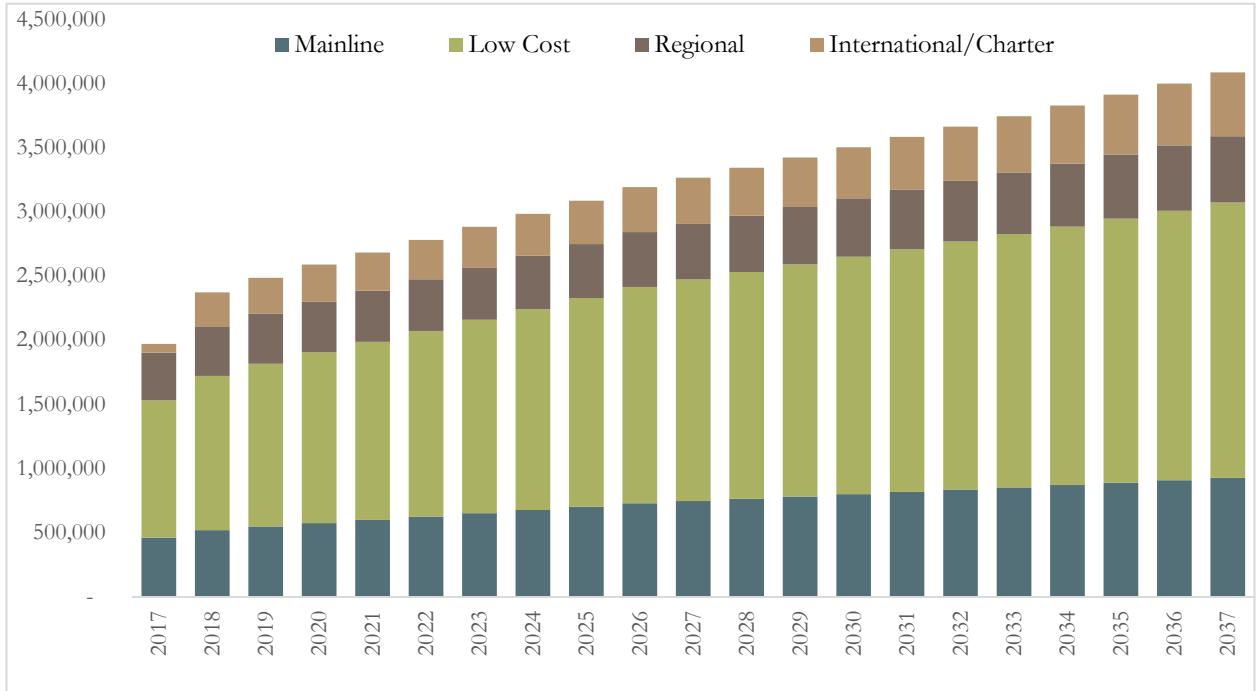
Source: WSP Analysis.

## Section 6—Aviation Demand Forecast Scenarios

There are several qualitative factors that could provide differences between the aviation demand forecast presented in Section 5. These factors include additional growth in international markets, capacity constraints at airports in the Boston Region, and changes to the service offerings by the air carriers. The scenarios developed to reflect these factors are discussed in the following paragraphs:

- **Scenario 1:** PVD has seen tremendous growth in its international air service in the last few years. This increase is contributed to by the characteristics of the population served by the Airport. For example, there large populations of persons of Portuguese (Azores), Irish, Guatemalan, and Canadian (Montreal/Quebec) descent in the PVD air service area. Providence has the fifth largest population of Guatemalans in the U.S. and there is currently no non-stop service currently provided. PVD has seen the recent success of Norwegian Air International, who provided air service to Ireland in the summer months. This includes scheduled service to Belfast, Dublin, Shannon, and Cork. If this type of service were to increase, with the capture of low hanging fruit to serve Caribbean and warmer climates in the winter months, it could mean an increase of approximately additional 200,000 enplanements during 2018. This could be expected to grow through the remainder of the forecast period. Figure 22 below graphically depicts this scenario. Increases in enplanements may also be possible with increases in domestic traffic; however, for purposes of this scenario, it is assumed that the growth is a result of increased international traffic.

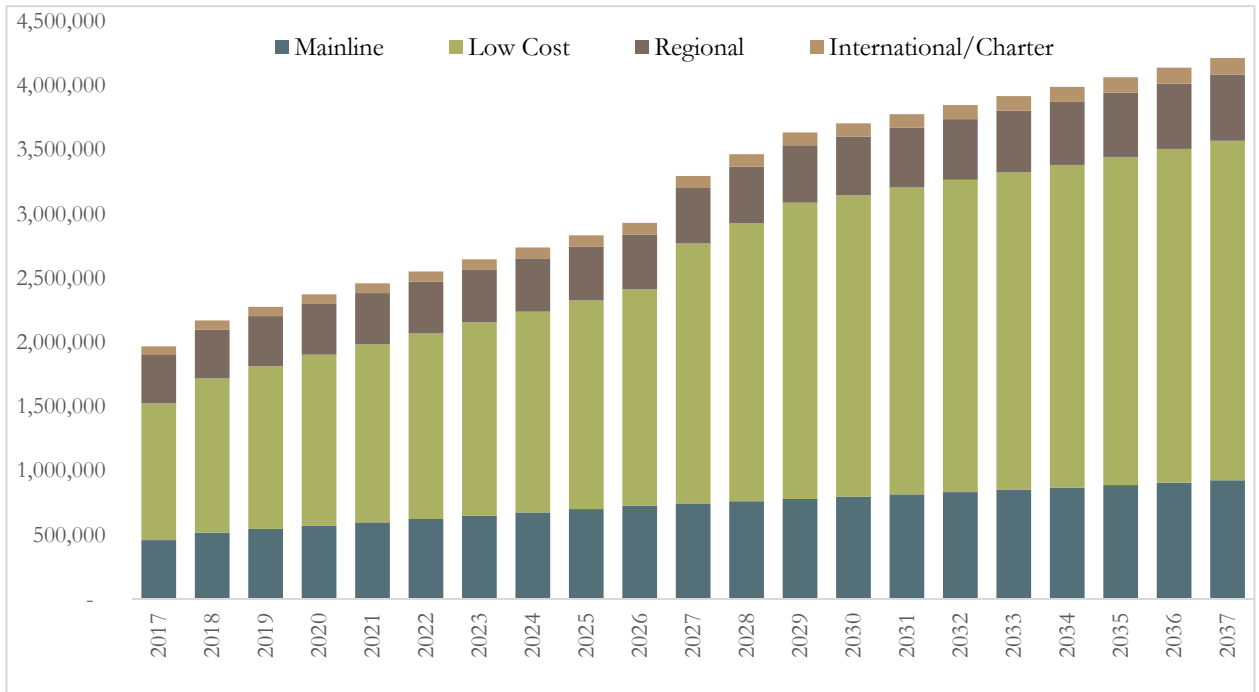
Figure 22 – Scenario 1: PVD Increase in International Traffic Enplanements by Type



Source: WSP Analysis.

- Scenario 2:** There may be a point during the forecast period when BOS is at capacity, especially in the medium- to long-term. If this would occur, PVD could anticipate a segment of the Boston Region air service market currently served by low cost carriers returning to PVD. This would result in an increase in domestic passengers at PVD due to increased availability of flights on low cost carriers and mainline carriers that mimic those routes to compete on the basis of air fares. It could be expected that enplanement levels could increase by approximately 10 percent or 300,000 enplanements in 2027. Figure 23 below presents enplanements by type for this scenario.

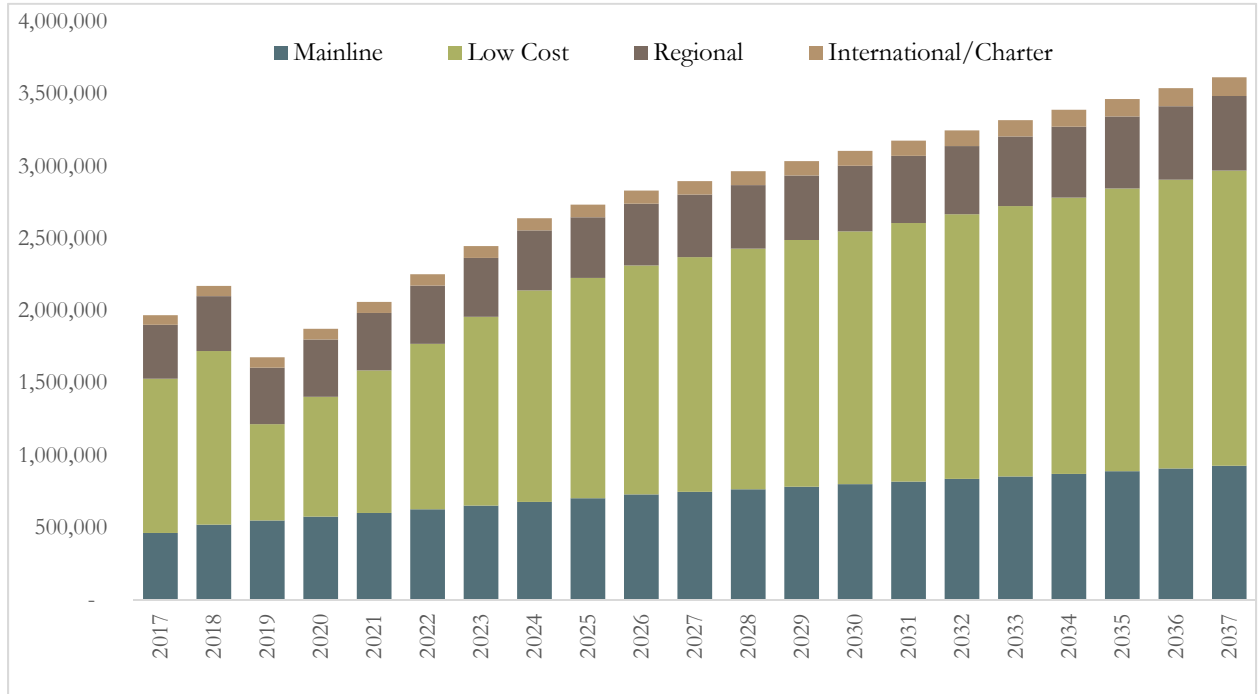
Figure 23 – Scenario 2: PVD Increase in Low Cost Carrier Traffic Enplanements by Type



Source: WSP Analysis.

- Scenario 3: An airport’s traffic is not only dependent on the strength of its origin and destination markets, but also the decisions that are made by airlines to serve or not serve particular markets. For example, PVD was greatly impacted when Southwest Airlines began serving BOS. Some of the frequencies to certain destinations were transferred to BOS over PVD, as well as mainline carrier routes were abandoned because of the lack of competition. This could happen again if the ultra-low cost carriers such as Allegiant and/or Frontier would decide to transfer service to another airport or eliminate service in the region all together. While their current market share is less than 100,000 enplanements, if the decision to pull out of the PVD market were to occur five to 10 years in the future, the impact could be as high as 500,000 annual enplanements depending on how quickly these airlines expand service at PVD. Figure 24 below presents enplanements for this scenario.

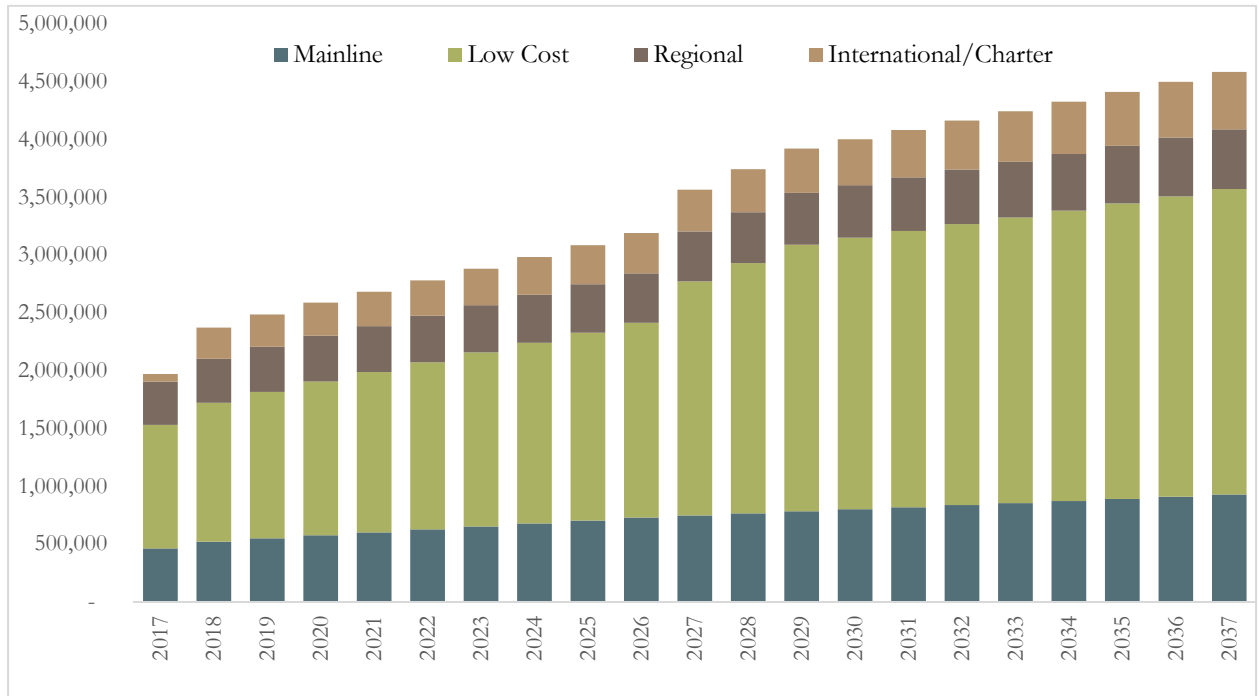
Figure 24 – Scenario 3: PVD Decrease in Low Cost Carrier Traffic Enplanements by Type



Source: WSP Analysis.

- **Scenario 4:** This scenario combines Scenario 1 and Scenario 2 described above, reflecting increases in both international traffic and in low cost carrier traffic.

Figure 24 – Scenario 4: PVD Increase in International and Low Cost Carrier Traffic Enplanements by Type



Source: WSP Analysis.

Table 12 below presents a summary of PMAD peak hour forecast of aircraft operations, arrivals, departures, enplanements, and international arrivals for each of the scenarios presented above.



Table 12—Scenario Comparison

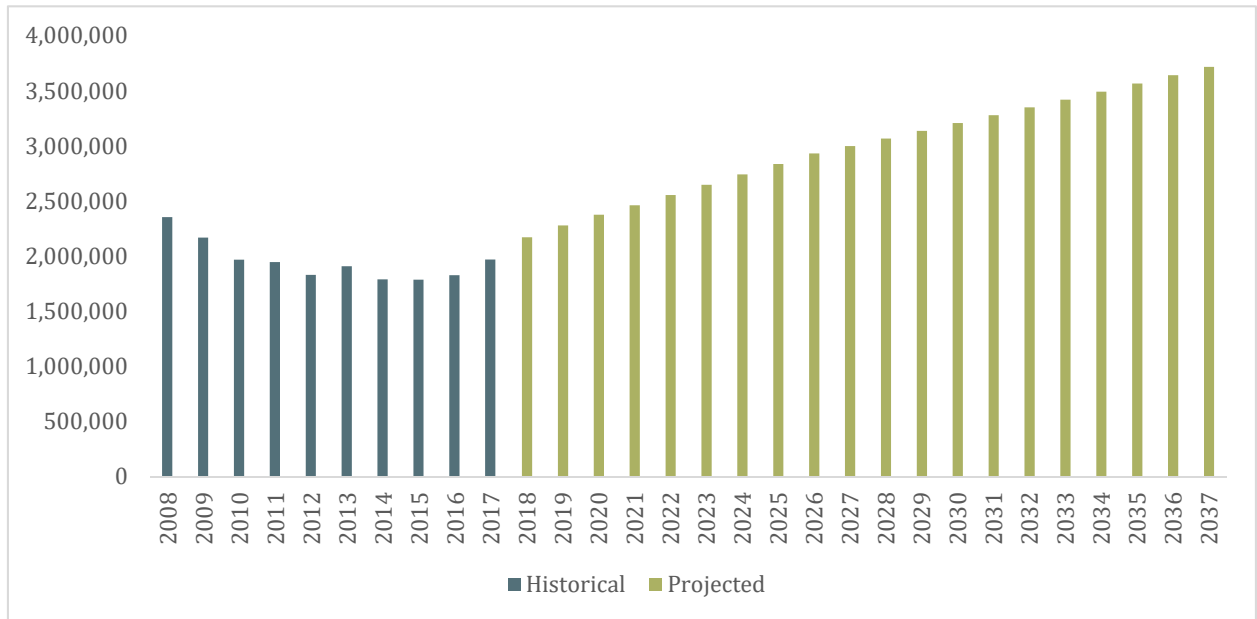
	2017	2022	2027	2037
<b>ANNUAL COMMERCIAL OPERATIONS</b>				
Base Case	41,238	44,521	45,350	56,049
Scenario 1: International Growth	41,238	48,475	49,390	61,609
Scenario 2: Low Cost Carrier Growth	41,238	44,521	49,888	63,591
Scenario 3: Low Cost Carrier Decrease	41,238	39,291	43,837	54,541
Scenario 4: International and Low Cost Carrier Growth	41,238	48,475	53,929	69,151
<b>PEAK HOUR COMMERCIAL AIRCRAFT OPERATIONS</b>				
Base Case	16	17	17	21
Scenario 1: International Growth	16	18	19	24
Scenario 2: Low Cost Carrier Growth	16	17	19	24
Scenario 3: Low Cost Carrier Decrease	16	15	17	21
Scenario 4: International and Low Cost Carrier Growth	16	18	21	26
<b>PEAK HOUR COMMERCIAL AIRCRAFT ARRIVALS</b>				
Base Case	12	13	13	16
Scenario 1: International Growth	12	14	14	18
Scenario 2: Low Cost Carrier Growth	12	13	14	18
Scenario 3: Low Cost Carrier Decrease	12	11	13	16
Scenario 4: International and Low Cost Carrier Growth	12	14	16	20
<b>PEAK HOUR COMMERCIAL AIRCRAFT DEPARTURES</b>				
Base Case	8	8	8	10
Scenario 1: International Growth	8	9	9	12
Scenario 2: Low Cost Carrier Growth	8	8	9	12
Scenario 3: Low Cost Carrier Decrease	8	7	8	10
Scenario 4: International and Low Cost Carrier Growth	8	9	10	13
<b>PEAK HOUR ENPLANEMENTS</b>				
Base Case	708	917	1,077	1,335
Scenario 1: International Growth	708	999	1,173	1,467
Scenario 2: Low Cost Carrier Growth	708	917	1,185	1,514
Scenario 3: Low Cost Carrier Decrease	708	809	1,041	1,299
Scenario 4: International and Low Cost Carrier Growth	708	999	1,281	1,647
<b>PEAK HOUR INT'L DEPLANEMENTS</b>				
Base Case	34	41	48	67
Scenario 1: International Growth	34	158	186	257
Scenario 2: Low Cost Carrier Growth	34	41	48	67
Scenario 3: Low Cost Carrier Decrease	34	41	48	67
Scenario 4: International and Low Cost Carrier Growth	34	158	186	257

Source: WSP Analysis.

## Section 7—Summary of Aviation Demand

This section presents a summary of the projections of aviation demand at PVD throughout the forecast period. Figure 25 below depicts historical and projected enplanements.

Figure 25—PVD Enplanements Historical & Projected



Sources: RIAC Records; WSP Analysis; Compiled by WSP.

Table 13 Below presents a summary of the key items contained in the forecast.

Table 13—PVD Forecast Summary

	2017	2022	2027	2037
<b>ANNUAL OPERATIONS</b>				
Air Carrier	35,774	44,631	46,711	50,763
Air Taxi	10,057	8,775	8,617	9,596
Cargo	1,109	1,369	1,629	1,629
General Aviation	25,259	25,989	26,210	26,664
Military	451	451	451	451
<b>Total Aircraft Operations</b>	<b>72,199</b>	<b>80,765</b>	<b>83,167</b>	<b>88,652</b>
<b>ANNUAL ENPLANEMENTS</b>				
PMAD Peak Hour Enplanements (11.6% of PMAD)	708	917	1,077	1,335
PMAD International Arriving Passengers	252	299	354	488

Sources: RIAC Records; WSP Analysis; Compiled by WSP.

Table 14 below presents a summary of the key items contained in the forecast compared to the TAF for PVD.

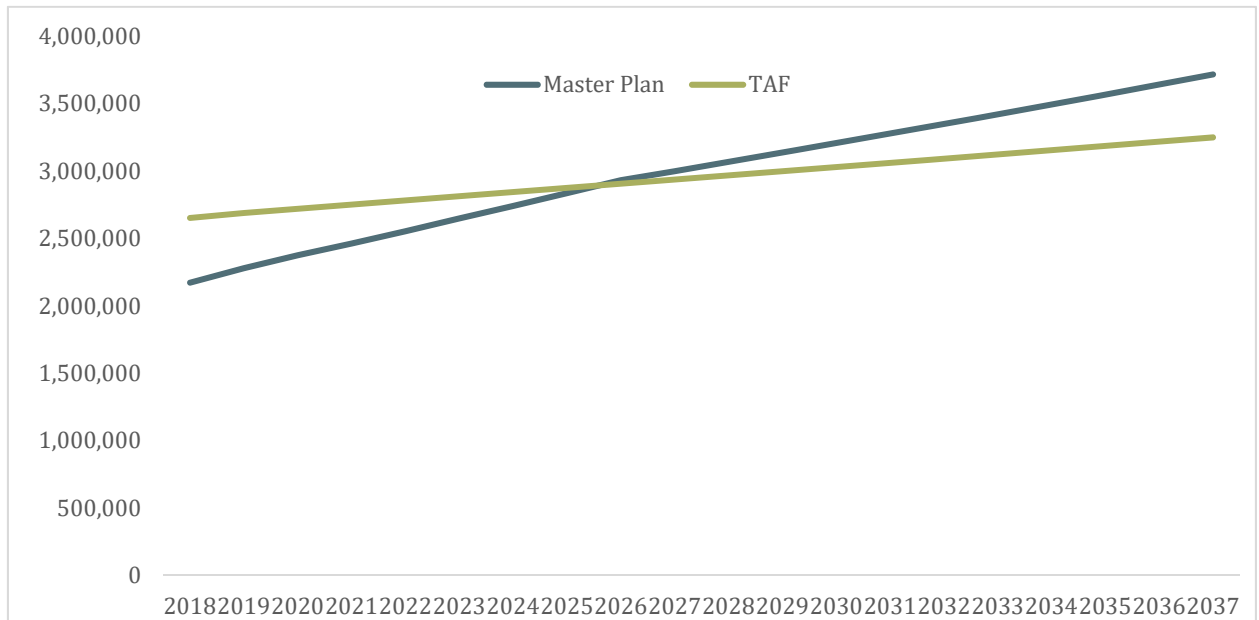
**Table 14—Comparison of the Base Case Forecast to the TAF for PVD**

	2017	2022	2027	2037
<b><u>Commercial Aircraft Operations</u></b>				
Base Case	46,940	54,776	56,957	61,988
TAF	44,096	51,242	53,246	57,965
Ratio MP/TAF	1.06	1.07	1.07	1.07
<b><u>Noncommercial Aircraft Operations</u></b>				
Base Case	25,710	26,440	26,661	27,115
TAF	25,710	26,440	26,661	27,115
Ratio MP/TAF	1.00	1.00	1.00	1.00
<b><u>Enplanements</u></b>				
Base Case	1,969,966	2,553,530	2,997,929	3,715,999
TAF	1,865,849	2,782,933	2,935,241	3,249,016
Ratio MP/TAF	1.06	0.92	1.02	1.14
<b><u>Based Aircraft</u></b>				
Base Case	67	67	67	67
TAF	67	67	67	67
Ratio MP/TAF	1.00	1.00	1.00	1.00

Sources: RIAC Records; WSP Analysis; TAF; Compiled by WSP.

Figure 26 below depicts a comparison of the Master Plan Base Case forecast to the TAF projected enplanements.

Figure 26–PVD Enplanements Historical & Projected



Sources: RIAC Records; WSP Analysis; Compiled by WSP.