CHAPTER NINE
SENSITIVITY ANALYSIS

I. INTRODUCTION

The Pennsylvania Statewide Airport System Plan (SASP) has developed recommendations that, if implemented over the 20-year project period, would improve the airport system's performance relative to the performance measures that were developed for the system at the initiation of the study. The recommendations developed in the SASP are the result of analyses that focused on developing system performance measures, measuring relative current system performance, and then examining and recommending options that provide the best and most feasible means for improving system performance. In the analysis of options for improving system performance, the existing system evaluation was used as a baseline. Because the system plan is a 20-year planning document, several factors that will impact the system over the planning period were included in the analysis. Some of the factors that will impact the system over the planning period that were included in the development of SASP recommendations include the following:

- Projections of future aviation activity
- Projected population growth, by county, in the Commonwealth
- Planned roadway improvements

Each of the factors listed above will impact the performance of the Commonwealth's airport system over the planning period. By including projected and planned changes in the factors listed above in the analysis of SASP options, recommendations were developed that not only improve system performance given existing conditions, but also address the planned and projected changes to the Commonwealth.

It is important to understand, however, that the Commonwealth and its aviation system is constantly changing. For example, at the initiation of the SASP, there were 142 public-use airports in Pennsylvania. Nearing the completion of the SASP, the number of public-use airports has decreased to 135, as several airports have transitioned to private use. It is impossible to identify and examine all potential changes or impacts that could occur to the Commonwealth's airport system over the 20-year planning period of the SASP. The sensitivity analysis presented in subsequent sections of this chapter examines some example scenarios that could impact the recommendations contained in the SASP. While these examples are not all inclusive, they are representative scenarios of the types of changes or impacts that could occur to the system. The goal of the sensitivity analysis is to identify a process and methodology with which PennDOT can examine changes to the aviation system. The methodology can then be applied to the example scenarios identified in this chapter, or any other change that may arise over the 20-year planning period, to determine their overall impact to the SASP recommendations and the Commonwealth's airport system as a whole.

II. SENSITIVITY ANALYSIS

A. Approach

The SASP sensitivity analysis examines potential changes or impacts to the aviation system in several broad categories. Although it is impossible to identify all potential factors that could be included in each of the categories, this analysis has identified example scenarios. In each of the categories, one example "what-if" scenario is examined in detail. The major categories of potential system changes that are examined in the sensitivity analysis include the following:

- Air Service Changes
- Transportation/Technology Changes
- Airport System Changes

The sensitivity analysis identifies a methodology that should be used to examine changes to the Commonwealth's aviation system to determine if the potential changes significantly impact the aviation system and/or the recommendations identified in the SASP. Recommendations may also be presented regarding approaches that PennDOT could take to eliminate or minimize the potential negative impacts of the what-if scenarios examined in this analysis. In some cases, changes to the aviation system may benefit system performance and/or modify or nullify system needs that were identified in the SASP.

B. Methodology

The goal of the SASP sensitivity analysis is to identify a process that can be used by PennDOT to evaluate future changes to aviation in the Commonwealth that may impact the system of public-use airports and the recommendations of the SASP. After this process is identified, it will be applied to specific scenarios in the categories of potential change identified above. In general, the SASP acknowledges that it is impossible to identify all changes that may occur to the aviation system over the 20-year period. Instead of guessing and analyzing specific scenarios, this approach will illustrate a methodology that can be used on any potential scenario that may arise over the 20-year period and will provide PennDOT with a process to identify airports that may be impacted by any change. This process will also help PennDOT identify its role in addressing any potential change as well as determine potential implications of and solutions to the changes.

The recommended methodology for addressing aviation and airport system changes that may arise over the project period includes the following steps:

- Identify the system change or trend
- Identify airports impacted by system change or trend
- Determine the implications to the system
- Determine PennDOT's role in addressing the system change or trend
- Identify potential options for addressing the system change or trend
- Pursue most feasible solution

These steps are discussed in more detail in the following sections.

1. Identify Change/Trend

The first step in analyzing any scenario that may arise is to specifically identify the change and/or trend that may be affecting the airport system. Changes or trends impacting the system should be identified through PennDOT's monitoring of the system which involves airport 5010 inspections, regional chats, and interactions between Bureau of Aviation engineers, planners, and inspectors with airport sponsors and managers. While not every trend or change that may be identified within the system will warrant a sensitivity analysis, it is important to continuously monitor the system and define trigger events that may warrant a full-blown sensitivity analysis. While it is impossible to completely identify all events that may warrant a sensitivity analysis at this point, the following are some types of trends or system changes that would likely warrant a detailed analysis:

- Sale and/or closure of a core system airport (included in the advanced, intermediate, or basic functional level)
- Significant decreases in commercial airline service levels at Commonwealth airports
- Major changes to the airline operating environment which may include airline mergers or bankruptcies
- New security measures related to general aviation or commercial service airports that would impact a number of system airports

In general, changes or trends that impact a number of system airports or impact single airports that play important roles within the system are examples of scenarios that could warrant a detailed sensitivity analysis.

2. Identify Impacted Airports

After a specific trend or system change has been identified and determined to warrant further examination, the next step in conducting a sensitivity analysis is to identify the airports that may be impacted. While the process that will be used to identify impacted airports will vary significantly based on the scenario, the general goal of this process is to identify an order-of-magnitude estimate of the number of airports that could be impacted, and specifically identify the impacted airports, if possible. It is important to understand the relative importance of the impacts that any trend or change may have on the system. For example, a scenario impacting a single airport will most likely require a different type of analysis than a scenario that impacts the entire system. The schedule and urgency of examining potential sensitivity scenarios will be determined partly by the number or types of airports impacted.

3. Determine Implications to System

In addition to identifying the impacted airports, sensitivity analyses must also define potential implications of any scenario on the airport system as a whole. Identifying those specific airports that are impacted by a change or trend is the first step in the process of determining system implications. This step in the process uses data on the impacted airports, as well as a number of

other factors and data related to the airport system, to determine the importance or priority of addressing the impacts of any scenario. For example, a scenario that impacts a number of airports in the limited functional level may not be as important, in terms of overall implications to the system, as a scenario that may force the closure of a single airport that is in the advanced functional level. Similarly, a trend or system change that may impact the overall safety or security of the Commonwealth's public-use airport system would most likely have a higher priority than a change that impacts funding eligibility of hangar projects, for instance, at system airports. Again, although it is impossible to identify all potential scenarios that may arise, each trend or system change needs to be examined to not only identify the specific airports that are impacted, but also to determine the implications of the change on the entire system.

4. Determine PennDOT's Role

Any potential scenario that arises needs to be examined to determine the role, if any, that PennDOT may have in addressing impacts to the system. The Bureau of Aviation's mission has been defined as providing expertise and assistance in the development of the Commonwealth's aviation system. Within that role, a number of responsibilities have been delegated to the Bureau of Aviation, some specifically related to airport development grant funding processes as well as airport licensing and safety inspections. Therefore, the Bureau of Aviation would most likely play a role in addressing system changes that may impact airport safety and/or licensing compliance. There are, however, some aspects of the aviation system and the activities that occur at system airports that are beyond the Bureau of Aviation's and/or the Commonwealth's direct control.

Decisions regarding the provision of commercial air service at specific airports, which are under the direct control of airlines, are examples of scenarios in which the Bureau of Aviation's role in addressing system impacts would be significantly limited. In such cases where the Bureau of Aviation's role and/or ability to address system impacts may be limited, it may be impractical for the Bureau of Aviation to further examine the scenario, identify options to address the impacts, and pursue resolutions to them. In all cases, however, it is important that the Bureau functions as a data and information source related to scenarios that may impact the airport system as well as its role, or lack thereof, in addressing and resolving impacts.

5. Identify Possible Solution

For those scenarios in which the Bureau of Aviation may have role in resolving impacts to the system, a thorough analysis of options is necessary. The types of options that may be available to resolve impacts to the system resulting from potential trends and changes will need to be developed on a case-by-case basis for each scenario that may arise. In some cases, the Bureau of Aviation may need to examine a number of different options individually as well as in combination. In general, options that should be examined could typically be categorized as one of the following:

- Options that resolve the impacts of potential sensitivity scenarios at those system airports that are directly impacted

- Options that examine the ability of other system airports to augment or replace impacted system airports to ensure overall airport system performance
- Combinations of one or more of the options included in the above categories

It is important to understand that interaction with other agencies or organizations may be required to identify options, examine their feasibility, and pursue their ultimate implementation. For example, policy changes within the Bureau of Aviation may address the impacts of some sensitivity scenarios. However, in other scenarios, legislative changes may need to be pursued at either the State or local level to address system impacts. In other scenarios, interaction with airport managers, airport sponsors, the FAA, or all of these may be required.

6. Pursue Most Feasible Options

At the completion of the sensitivity analysis methodology that has been described, it is important to identify and work to implement the most feasible options for addressing the impacts of potential sensitivity scenarios. The options that should be pursued are the ones that minimize system impacts, maintain or improve system performance relative to the SASP benchmarks, and utilize available resources given system and airport characteristics/environs. In some scenarios, negative impacts to the system that may result from sensitivity scenarios may be unavoidable, while in others, it may be possible to completely negate any negative impacts. In all cases, it is important to include the Bureau of Aviation's customers, partners, and airport users in the process of adapting to and addressing any sensitivity scenario that may arise.

III. AIR SERVICE CHANGES

Commercial airline service is one of the most dynamic industries, as the private businesses (airlines) rely on the public sector (airports) to provide facilities to meet demand. The airports have little influence, however, on the aircraft used by the airlines, the routes flown, and the decisions of the traveling public to use the airline service provided. These factors all impact the needs of the airports to provide varying levels of facilities to accommodate the airlines and their customers.

In the past 15 years, commercial airline service has experienced wide swings, from high profits to substantial losses, from service by large jets to service on regional jets or turboprop aircraft, and from a high number of carriers to a consolidation of only a few carriers. These wide swings impact the service provided at airports throughout Pennsylvania and will continue to result in additional changes at the commercial service airports. Some specific examples of air service changes that the SASP has identified as potential impacts to the Commonwealth's aviation system, especially its commercial service airports, include the following:

- Change in hub carrier service patterns to Pennsylvania airports due to capacity limits at Philadelphia International Airport
- Impact on service levels and enplanements from a reduced fare structure at a spoke airport such as Arnold Palmer Regional Airport
- Impact of high percentage of originating international travel on the viability of Pennsylvania spoke airports

- Impact on small community air service due to the conversion of regional airlines fleet from turbo props to regional jets

Each of these scenarios and their potential impacts on Pennsylvania's commercial service airports is summarized in the following sections. One example, the impact on small community air service due to the conversion of regional airlines fleet to regional jets, is examined in detail and the sensitivity methodology identified in this chapter is applied to it.

A. Capacity Limitations at Philadelphia International Airport

The land and hold short operations (LAHSO) at Philadelphia International Airport clearly have a negative impact on turboprop operations from spoke airports in Pennsylvania to Philadelphia. Philadelphia's short length on its new commuter runway and the LAHSO requirements on Runway 17 limit the types of aircraft that can be operated on these runways when the mainline jet flow to the east-west main parallel runway are heavy. Within US Airways' commuter carrier fleets, the DeHavilland Dash 8 is the only aircraft capable of operating in this environment. All 19-seat aircraft operating into Philadelphia (Beech 1900 and Jetstream 31 aircraft) are required to operate in the mainline jet flow, not in the flow to this new runway. This mainline flow is currently restricted to 67 departures during Visual Flight Rule (VFR) conditions and reduces to 37 in Instrument Flight Rule (IFR) conditions. These operational capacity restrictions have the effect of capping the number of passengers that can flow through the airport. Thus, carriers wanting higher passenger flows must increase load factors and/or use larger aircraft at Philadelphia.

When the Precision Runway Monitoring (PRM) system became operational at Philadelphia International Airport on June 3, 2002, the capacity was to immediately increase by 18% when weather presents low ceilings and visibilities (IFR conditions), and could eventually double. The gain was expected to come from air traffic controllers' ability to more closely monitor the location of aircraft making instrument approaches to closely spaced parallel runways, so the aircraft can operate with separation closer to that permitted in visual conditions. PRM shows controllers the location of all aircraft once a second, which gives them time to safely correct any deviations from intended flight paths.

Despite the capacity gains during IFR, the more significant constraining capacity flow at Philadelphia is its runway system during good weather conditions. For US Airway Express carriers feeding the US Airways hub in Philadelphia, the capacity limitations have translated into a policy of not adding any more 19-seat aircraft flights into the airport. Only 30-plus seat turboprops will be considered for additional flight operations in the future. Pennsylvania airports not receiving the 30-plus-seat aircraft equipment will not be afforded new or additional flights into Philadelphia. Airports potentially impacted include Bradford Regional, Venango Regional, Latrobe-Arnold Palmer Regional, and Williamsport Regional[1]. The impact of this policy is somewhat mitigated due to the ability to feed 19-seat aircraft into the Pittsburgh hub, where no significant caps on small commuter aircraft have been necessary. The potential impact to

[1]Although Williamsport receives both Saab 340 and Beech 1900 aircraft, the Beech 1900s have been used in providing Philadelphia service.

Pennsylvania's airports as a result of capacity limitations at Philadelphia is a loss of service, limiting access to a significant business center. It is possible that the capacity limitations at Philadelphia will result in service to only one in-state airline hub (Pittsburgh), reducing revenue that could be collected to support airport improvements at Philadelphia as a result of reducing in-state connecting passengers.

B. Impact of Reduced Fare Structure

Fare structures and seat capacity restrictions are the number one concern of Pennsylvania communities when visiting with their respective airline service providers. There are two primary issues with regard to fares and pricing from the spoke airport:

- First is the actual fare structure and competitive pricing versus the nearby hub and medium density airports
- The second area of concern is the discount seat capacity controls required to optimize profitability on a 19-seat aircraft

From the airlines' perspective, the difficulty in initiating a reduced pricing structure from a spoke airport is rooted in the make up of the spoke airport customer. Nearly 90 percent of the passengers traveling from small Pennsylvania spoke airports are connecting on to a final destination either through Philadelphia or Pittsburgh. Reduced or low fare pricing structures work when primary markets can be identified and supported by sustainable traffic levels. An example of this is Jet Blue's pricing strategies for Buffalo customers traveling to New York City. Jet Blue prices this route very low, but the route is nonstop and has a significant amount of traffic that originates in Buffalo, destined only for New York, without connecting to another market. This is a sustainable market with significant numbers of passengers that allow for profitability through volume. That is a very difficult concept for spoke feeder airports to mirror when the destinations are so diversified.

The most effective approach has been an add-on fare for connecting passengers that will make driving to the hub or nearby medium market unattractive. An example would be a $40 one-way add on for coach fares and $50 round trip add on fares for discretionary or leisure travel. Certainly these are examples for discussion purposes and an extensive survey would need to be completed to determine the market sensitivity. This has worked in the past, and the competitive environment and lack of attention by the air carriers have lead to a deterioration of the concept. More recently, DuBois has proposed the idea to Mesa Air Group (US Airways Express), spurring discussions regarding possible implementation of such a pricing scheme with US Airways for a number of Pennsylvania air service spoke cities. The potential impact of changing the pricing structure to implement an add-on fare in Pennsylvania spoke cities is likely to be positive. This could result in more local passengers remaining in the outer markets instead of driving to hub airports such as Pittsburgh and Philadelphia, or even out-of-state airports. Increased passenger loads in the local market areas could result in the eventual ability of the local airports to support larger aircraft, thus sustaining these airports over a longer period as the airlines move toward use of larger aircraft such as regional jets.

The second issue of importance is capacity restrictions used by airlines operating in turboprop markets. Typically, discount seat inventories (called K and V fares) used for 7, 14, and 21-day advance purchase discount fares are limited and adjusted by individual carriers. Typically there may be 10 to 20 percent of the aircraft capacity dedicated to discount pricing. In the case of a 126-seat aircraft, roughly 25 or 30 seats would be available for sale. In the case of a 19-seat aircraft, that results in 2 to 4 seats available for sale. Once those seats are sold, the customer will be quoted the next lowest available fare and the difference between that fare and the fare offered at the hub airport where larger aircraft are used may be significant. This will occur even though the fare structure versus the hub may be identical. Therefore, the problem is not with the fare structure, but rather with the size of the aircraft serving the market. The smaller the market, the fewer discount seats available for sale. This applies to frequent flyer mileage redemptions as well. Because of the limits, a family of four cannot leave on vacation using frequent flyer awards in 19-seat airline markets.

Recently, Mesa Air Group has offered to test a program whereby more seats on their Beech 1900s can be used for reduced fare tickets. Such a program was tested by Horizon Air in west coast markets and proved successful. If used in Pennsylvania, it could serve to decrease the gap between large and small airport pricing, thereby reducing some of the drive-fly leakage that is now experienced between large and small airports. The potential impact of additional discount seats is similar to that of an add-on fare from the outer Pennsylvania markets. It is likely that provision of these reduced fare tickets could result in more passengers enplaning at the local airports, increasing enplanement levels to make service in the smaller markets more viable.

C. Impact of Originating International Traffic

Certainly originating international traffic has a positive affect on revenues at the spoke airports primarily due to typically high yields. This traffic is generally business-related and very profitable for the airline. The issue is the real potential for significant numbers generated by small communities. A look at international enplanements numbers for Philadelphia for 2001 reveals an average 14 percent of all enplanements pre-September 11, 2001. The last quarter of 2001 international passengers accounted for roughly 11 percent of total enplanements. An in-depth analysis of the international traffic potential from a particular spoke airport would have to be completed, but on the surface the numbers appear small enough that even a significant percentage increase may not have a noticeable impact on overall viability.

For Pennsylvania spoke cities, **Table 9-1** presents a listing of the international traffic percentages for each market. As shown, the Pennsylvania spoke airport average of 6.1 percent international Origin & Destination (O&D) traffic was exceeded at the larger airports (Harrisburg and Lehigh Valley). In addition, University Park stands out as a significant generator of international O&D passengers, due primarily to the international composition of Penn State University. At the smaller spoke airports, percentages were much lower, reflecting either a leakage of international traffic to other larger airports or a lack of international business connections locally.

Table 9-1
International O&D Passengers at Pennsylvania Spoke Airports

Airport	2000 Enplanements	Intl. O&D	Percent
Lehigh Valley International	503,000	40,740	8.1%
Altoona-Blair County	15,946	734	4.6%
Wilkes-Barre/Scranton International	221,517	7,089	3.2%
Bradford Regional	13,500	216	1.6%
Dubois-Jefferson County	15,829	459	2.9%
Erie International	154,293	6,789	4.4%
Venango Regional	5,365	150	2.8%
Williamsport Regional	42,235	1,436	3.4%
Johnstown-Cambria County	19,852	357	1.8%
Arnold Palmer Regional	22,683	590	2.6%
Lancaster	14,814	356	2.4%
Harrisburg International	639,000	42,813	6.7%
Reading Regional	37,850	908	2.4%
University Park	122,215	8,799	7.2%
TOTALS	**1,828,099**	**111,514**	**6.1%**

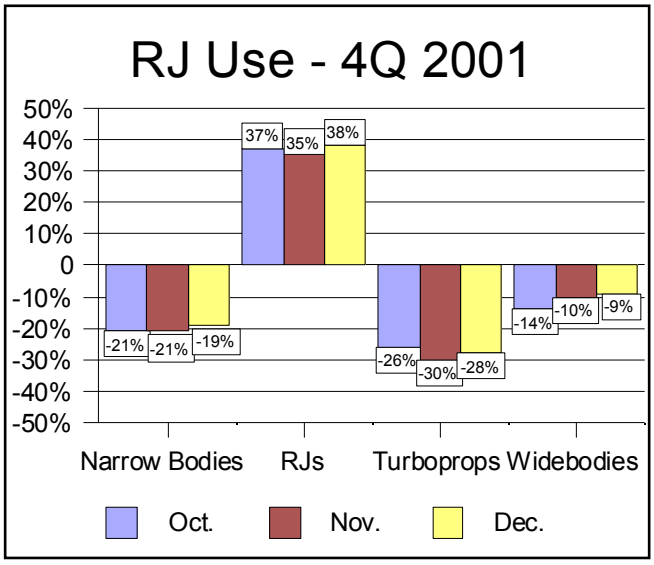
Source: Airport Records, U.S. DOT, Air Passenger O&D Survey, reconciled to schedules T-100 and 298C T-1.

Typically, there is very little outside impact that can be brought to bear on international travel demand from a spoke airport. This is due to the nature of the demand itself. Either the local corporate environment requires international traffic or it doesn't. It is led by a company's ownership or client base as they exist and not by incentive programs. Thus, the high-yield type of international travel desired by the airlines (business rather than vacation) has a price-inelastic demand and not impacted by promotions. A high percentage of originating international travel is helpful but is not likely to significantly impact the type of service provided in spoke markets due to the relatively low numbers of these types of passengers.

D. Regional Jet Impact

The fastest growing segment of the airline industry in 2001 was the regional jet (RJ) fleet. RJ departures systemwide increased over 35 percent in the fourth quarter of 2001 (see **Exhibit 9-1**). At the same time, turboprop departures decreased nearly 30 percent. While it must be noted that much of the decline in Pennsylvania spoke airport turboprop flying resulted from the events of September 11, 2001, certainly the RJ growth had an impact.

Exhibit 9-1
2001 vs. 2000 Monthly Schedule Comparison: % Difference in Flights



Source: Bombardier & Innovata

The focus of the large regional airlines today is clearly on the regional jet. RJs are used by airlines in five primary roles:

- *Large Jet Replacement* - Carriers that cannot profitably operate larger 100+ seat aircraft in multiple daily nonstop frequencies may offer these routes to their affiliates to operate with RJs.
- *Off-peak Scheduling* - RJs can be used in scheduling off-peak periods of the day or week as appropriate to the smaller size of the aircraft.
- *Hub Extension* - RJs provide significantly longer-range capability relative to turboprop aircraft and can serve to comfortably extend the reach of low-density markets to a carrier's hub.
- *Turboprop Growth* - Some markets will outgrow 30-seat aircraft during peak periods. These markets could potentially be capable of suporting supplemental scheduling of RJs.
- *Point-to-Point (Hub Bypass)* - There are some low-density markets that will support point-to-point non-stop service with RJs. Traditionally, these markets have been joined through spoke-and-hub routings.

Given the aviation industry's excitement with the RJ and its immediate acceptance by the traveling public, manufacturers are building the aircraft as fast as they can produce them. There were more than 500 units in service in 2000. It is estimated that the number of RJs operated by the major airlines and their regional partners could reach near 1,500 units by the year 2004. This number swells to almost 1,600 when all regional carriers are included in the mix (see **Table 9-2**).

Table 9-2
RJ Fleet Expansion Forecast for Major Airlines & Their Regional Carriers.

Calendar Years					
	2000A	**2001E**	**2002E**	**2003E**	**2004E**
Delta	177	234	299	350	385
United	46	79	151	243	267
Continental	96	137	188	236	272
American	90	129	160	178	196
Northwest	45	66	89	122	146
America West	21	29	44	67	77
US Airways	44	68	70	105	140
Grand Total	**519**	**742**	**1,001**	**1,301**	**1,483**
% Change		**43%**	**35%**	**30%**	**14%**

Source: Regional Airline Association

Code-share agreements between regional airlines and major carriers govern the revenue-side economics of operating both turboprop and regional jet aircraft. For regional jets, agreements with major airlines are moving toward fixed fee or fee per departure agreements. This means that regardless of the number of passengers carried, the regional jet operator receives a payment covering the cost of providing the flight. As a result of these agreement economics, major carriers will not be interested in including unprofitable turboprop flying in such agreements. The result is going to be a substantial reduction in turboprop flying to small communities by today's existing regional airlines.

Atlantic Coast Airlines (ACA) has announced intentions to remove all 19-seat turboprop aircraft from their fleet in 2002. Mesa Air Group, a substantial service provider in small Pennsylvania spoke markets, has reduced their 19-seat turboprop fleet by over 50 percent in the last two years and continues to reduce those numbers. The crisis facing Pennsylvania spoke cities, particularly communities with only one 19-seat turboprop operator providing service, is that most of these markets cannot alone support 50-seat or 30-plus-seat regional jets[2]. As the focus of the regional airlines shifts, markets unable to support small jets continue to experience decreased service levels.

Adding to the carrier cost issues relating to 19-seat turboprop aircraft in the markets of Bradford, Dubois, and Franklin, negative impact is seen as a result of increased regional jet service from Erie. This passenger dilution is not entirely a result of lower fares, but also a result of Erie's ability to support growth from turboprop to regional aircraft. Surveys have shown a "turboprop avoidance factor" in roughly 50 percent of potential air travelers. The turboprop avoidance

[2]This would include the 50-seat Canadair CRJ and Embraer ERJ 145 models and the 37-seat Embraer ERJ 135 and 32-seat Dornier 328 Jet.

factor helps to permit a 60 to 120 minute drive to a non-local airport to become acceptable to the traveling public. Thus in Erie, the increase in regional jet traffic, combined with airline competition for passengers in the form of lower fares, has the effect of continued erosion of passengers in the outer, 19-seat markets. In order for small spoke communities in Pennsylvania to maintain service, dramatic new approaches and unconventional wisdom need to be applied to this issue and it needs attention immediately. Communities unable to provide in excess of 15,000 enplanements per year will likely be faced with a loss of voluntary local air service. In these cases, Essential Air Service (EAS) may be invoked where applicable[3], however, these minimal levels of government-subsidized service are not likely to provide adequate coverage in the eyes of business users.

On the other hand, medium sized markets such as Erie, Allentown, and Harrisburg will likely see a growing use of regional jets, as narrow-body jets are replaced in low-density city pairs. These Pennsylvania cities do have the market capacity to support regional jet fleets and rather than a loss of frequency these markets will likely see an increase in regional jet presence and continued acceptable levels of air service.

The sensitivity analysis methodology will be used to examine how the implementation of increased regional jet activity could impact the Commonwealth's airport system.

1. Identify the System Change or Trend

The potential change to Pennsylvania's commercial service airports would likely be either a reduced number of commercial service airports and/or reliance on the Federal EAS program where service reductions are made. Continued monitoring of the regional carriers serving Pennsylvania's smaller commercial service airports would be important in conducting a sensitivity analysis to examine the true impacts. It is important to note, however, that the Commonwealth, specifically the Bureau of Aviation, does not necessarily play a role in the air service provided within Pennsylvania. The commercial service airports are self-reliant in terms of their commercial airline service. The Bureau of Aviation has studied the Commonwealth's air service needs on a statewide basis in the hopes of providing sufficient information to the airports for their local action.

To define the system change as a result of increased regional jet activity or complete replacement of commercial airline turboprop aircraft, more detailed information would need to be gathered including:

- Names of carriers providing the service (not just US Airways Express, but Mesa Air Group, Shuttle America, etc.)
- Exact transition plans for the carrier (timing of deliveries of regional jet aircraft, whether replacing or adding to fleet)
- Airport and community desires for service and availability of financial incentives for the carriers

[3]EAS determinations have been made for the following PA cities: Altoona, Bradford, State College, DuBois, Erie, Johnstown, Franklin, Reading, and Williamsport.

Again, monitoring of the situation provides the most reliable means of being able to identify the system change as it relates to increased regional jet activity and its impact on Pennsylvania's commercial service airports.

2. Identify Airports Impacted by System Change or Trend

In this scenario, the potential airports that could be impacted are limited to the 16 existing commercial service airports. Given the current airline operating environment, and the environment over the past five years, it is not likely that other Commonwealth airports that are currently without scheduled airline service will initiate service in the near future. To more specifically identify the airports that could be impacted would require knowledge of the carriers providing the current service and those carriers' fleet expansion and reduction plans. The approach that could be used would include continued monitoring and possibly meeting with the commercial service airports to determine what potential role the Bureau of Aviation could play in impacting the situation within the Commonwealth.

3. Determine the Implications to the System

The potential implications to the Commonwealth's system of airports from a conversion of the regional airlines' fleets to regional jets are significant. If this conversion occurs in the immediate future, potential implications to the airport system could include the following:

- Airports with only turboprop airline service could be upgraded to regional jet service. If this occurs, the airports impacted would need to ensure that adequate facilities are in place to accommodate the upgraded equipment. Potential needs might include a longer runway, a higher standard for airport facilities (increased airport reference code-ARC), larger terminal facilities, a jet bridge to the airplane, and larger automobile parking areas. Analysis of the facility needs and ability of the airports to accommodate the aircraft would need to be conducted immediately, if not already done, to ensure that service could be provided without interruption to construct needed facilities.

- Airports with only turboprop airline service could see a complete shutdown in service if it is determined that the market is not likely to support regional jet service. A shutdown in commercial airline service would not necessarily mean a need for reduced facilities at the airport, but could have an impact on neighboring airports if the neighboring airports do not have sufficient facilities to accommodate an increased level of passengers in the terminal and parking areas. The airport that experienced the loss of scheduled airline service would need to evaluate its market to determine the support for possibly searching for a new carrier, potentially a smaller, non-affiliated carrier, or remaining a business-class general aviation airport. Significant coordination within the local community would be needed as part of the evaluation. Other impacts associated with the loss of airline service at an airport could include the following; a decrease in the amount of FAA entitlement funding that the airport receives (typically $1 million for a commercial service airport versus $150,000 for a general aviation airport), a change to the

development projects in the airport's capital improvement program, and a change to the airport's status under the block grant program.

The most significant issue in evaluating the implications to the system is the potential for the conversion to occur quickly, without sufficient notice to enable the airports to provide the necessary facilities. While rumors abound regarding the potential for this conversion to take place, without certainty and an announcement that such conversion is going to take place, it is difficult to confirm that the airports that might get regional jet service could be sufficiently ready for the service. Because airlines are private businesses, there is no requirement that they work with the airports, in either a positive or negative way, to make them aware of the airlines' plans for fleet changes. In addition, with recent events, including the filing of Chapter 11 by US Airways, uncertainty regarding the airlines' future remains not only for airports and communities, but also for the airlines' employees, many of which are residents of the Commonwealth.

4. Determine PennDOT's Role in Addressing the System Change or Trend

As previously noted, PennDOT's Bureau of Aviation does not necessarily have a role in impacting the decision of airlines to serve the Commonwealth's commercial service airports. PennDOT's role would primarily be in the form of a liaison between the State and the airline, acting in the best interest of the entire Commonwealth. PennDOT has provided support to airports in their pursuit of improved airline service, but has otherwise remained only an informational source as it relates to commercial airline service. With 16 scheduled service airports in the Commonwealth, including two airline hub airports, there is significant competition for passengers and airlines. While the competition may not be seen as direct, in the end the airports with the highest numbers of airlines and levels of service attract the highest number of passengers and revenues. As a state agency, PennDOT remains neutral and is supportive of all airports within the Commonwealth.

5. Identify Potential Options for Addressing System Change or Trend

The options available to PennDOT to address a conversion of the regional airline fleet to regional jets and the reduction of some mainline jet service to regional jets are limited due to the agency's limited role in commercial airline service. Airports and communities do have options, which would need to be addressed at the local level. Options that may be considered on the local level include development of a financial incentive package for an airline to operate in the market, pursuit of Federal funding such as the Small Community Air Service Pilot Program funded in 2002, and acceptance of the airport's potential role in serving business-class general aviation aircraft.

Because air service must be supported on the local level, it is not within the Commonwealth's current policy to provide commercial airline service to communities. Airlines are private businesses that are looking to generate the most profit possible. While airline service is sometimes viewed as a public service, the airlines do not view it from this perspective and must report to their shareholders who are looking for a positive return on their investment in the airline. Small communities that have effective air service are typically engaged with the airlines and the local passengers, keeping abreast of changes in the industry and conducting their own

sensitivity analyses. It is recognized that airline service changes on a regular basis and that in order to keep effective air service, it requires work on the local level to identify potential options for maintaining and improving air service.

6. Pursue Most Feasible Resolution

The most feasible resolution available to the community may not get to be decided by the community. As airlines are private companies, they serve communities at will within the guidelines of the contracts they sign. The contracts may bind them to pay for space rental and landing fees, but the contracts do not typically bind an airline to actually provide airline service to a community. The only type of contract that is binding in this manner is the Federal EAS program. Through participation in this program, a community is guaranteed a minimum level of service through a contract with a carrier who bids on the service package. Once awarded, the carrier can still choose the flight schedule and price used to provide the service in the local market. While the community is guaranteed service, it is not guaranteed that the service will meet their needs or desires.

A community may decide that the most feasible resolution to the pending transition to regional jet aircraft may be to encourage people in the local community to use the existing service to translate the desired "want" for air service into actual numbers that can substantiate the identified level of "need". This encouragement would likely need to take the form of a financial incentive wherein the carrier is guaranteed that the route will be profitable. The level of financial incentive needed to maintain service would need to be determined on the local level through analysis of potential passengers, costs, and revenues. Programs such as subsidy, revenue guarantee, and travel banks have been used in this way to show local commitment to airline service. Ultimately, however, the airlines make the decisions on which communities they will serve and it is a matter of working closely with carriers to convince them to serve the local market and that by doing so the airline will be guaranteed to make a profit.

IV. TRANSPORTATION/TECHNOLOGY CHANGES

Changes that may occur in other transportation modes as well as aviation and aircraft technology could significantly impact the Commonwealth's aviation system and SASP recommendations. The development of other transportation modes could significantly impact statewide aviation demand as well as demand in specific areas of the Commonwealth. Potential improvements in aviation and aircraft technology could also impact levels of aviation demand throughout Pennsylvania as well as change design standards for system airports based on the operating characteristics that may exist for next-generation aircraft. Some specific examples of transportation/technology changes that the SASP has identified as potential impacts to the aviation system include the following:

- High-Speed Rail
- SATS Technology
- Fractional Ownership/New Aircraft Technology
- Impact of Approach Category Changes for Mid-size Corporate Jet Aircraft

Each of these potential scenarios and their potential impacts on the Commonwealth's aviation system is summarized in the following sections. One example, the Impact of Approach Category Changes for Mid-size Corporate Jet Aircraft, is examined in detail and the sensitivity methodology identified in this chapter is applied to it.

A. High-Speed Rail

The development of high-speed rail service the Commonwealth, similar to Amtrak's Acela Express service serving the Boston-Washington, D.C., corridor, in is an example of how changes in another mode of transportation could potentially impact Pennsylvania airports. In some cases, high-speed rail service could significantly impact aviation demand, specifically related to commercial airline service. A high-speed rail link connecting Harrisburg and Philadelphia, for example, may impact commercial service airports along that route, including Harrisburg, Lancaster, and Reading, by diverting commercial airline passengers from these airports. At these airports, passenger enplanements and air carrier service levels could be negatively impacted if a new rail service was able to attract potential air carrier passengers to travel by train to Philadelphia International Airport, for example, and then allow them to fly on to their final destination. High-speed rail service, however, could have the opposite effect as well. If airports, such as Harrisburg International Airport, attract low-fare air carrier service, high-speed rail services could attract potential passengers from the Philadelphia market area to Harrisburg.

The financial implications that may arise to system airports from this type of passenger diversion, attraction, and/or the scaling back or withdrawal of air carrier service could impact airport development plans as well as PennDOT's aviation development grant program. In some cases, airports impacted in this scenario may need to change the focus of their operation from commercial service activity to general aviation activity.

B. SATS Technology/New Aircraft Technology

The Small Aircraft Transportation System (SATS) is a program currently being championed by a consortium of aviation-related organizations including NASA, the Department of Transportation/Federal Aviation Administration, and state and local aviation and airport authorities. SATS technology is aimed at expanding the national air transportation system by developing safe, affordable, and technologically advanced aircraft that can access under-utilized general aviation airports. SATS technology, as the program is envisioned, would allow pilots to fly themselves point-to-point, in most weather conditions, in small general aviation aircraft, thereby allowing them to forego travel delays and congestion associated with using the hub-and-spoke system of commercial air carriers. Highly-advanced, yet easy to use, aircraft instruments and navigation systems currently being developed in the program are intended to make flying easier, hopefully making the pilot licensing process simpler and less expensive, and leading to a significant increase in the number of private pilots. In addition, developments in aircraft technology, partially driven by the SATS program, are leading to revolutions in aircraft design and manufacturing. The results may lead to general aviation aircraft that are much less expensive, but that provide performance characteristics comparable to current small jet aircraft while producing less aircraft noise.

While the long-term viability and potential impacts of the SATS program remain to be seen, some of the technological advances in aircraft design that have occurred in conjunction with the program could impact the Commonwealth's aviation system over the system plan's 20-year planning period. Impacts that the development of smaller, less expensive jet aircraft could have on Pennsylvania's aviation system include increased demand for aviation activity and based aircraft as well as changes to aircraft design standards and runway requirements based on the performance characteristics of the aircraft. Under this type of scenario, for example, the runway length requirement of these next-generation jet aircraft would likely be significantly shorter than existing jet aircraft, and therefore, a number of system airports that cannot currently accommodate jet aircraft traffic may be able to do so in the future. In this scenario, for example, the minimum runway length objective (4,000 feet) identified for intermediate airports in the SASP would most likely be able to accommodate this type of jet aircraft traffic. The impact of this scenario, therefore, may be positive to system performance because it may provide additional accessibility to system airports by jet aircraft. This scenario could also impact the system's needs, whereby additional airports might need to be considered for a higher classification to accommodate these aircraft operations throughout the Commonwealth.

C. Fractional Ownership/New Aircraft Technology

Similar to SATS technology, fractional ownership and the impacts that new aircraft technology may have on fractional ownership, may impact both the Commonwealth's aviation system and the recommendations identified in the SASP. Fractional ownership is an arrangement through which a group of individuals or corporations each buy a share, or portion, of a civil aviation aircraft. Each owner gets a specified number of annual flight hours for that aircraft based on the proportion of their ownership interest in the aircraft. This process is typically facilitated through an aircraft management company that purchases, manages, staffs, and dispatches the aircraft based on the needs of their clients. The concept of fractional aircraft ownership emerged in 1964, however, recent interest in this approach to aircraft leasing and its long-term viability gained prominence with the acquisition of Executive Jet by Berkshire Hathaway, Inc. in 1998. The number of individuals and corporations participating in fractional ownership of general aviation aircraft has grown significantly in recent years. Congestion, delays, and increased security concerns currently experienced at commercial air carrier airports are all factors that are anticipated to continue to increase the number of fractional aircraft owners in the future. The development of next-generation jet aircraft, with significantly lower acquisition and operational costs, may also generate additional demand for fractional aircraft ownership. As the cost of fractional aircraft ownership decreases, a increased number of individuals or corporations may begin to use such aviation services in their business activities or they may find fractional ownership to be a viable alternative to commercial air carrier service.

The impacts that could be anticipated with increased activity by fractional ownership aircraft at system airports might include increases in aircraft activity at smaller, commercial service airports, as well as other airports in the advanced functional level. The increase in activity at these types of airports would occur as fractional ownership and charter operations attract commercial airline passengers away from larger, scheduled service commercial airports. While this type of on-demand, point-to-point travel may not have the same impact as in the SATS scenario, it could significantly impact total aircraft operations and types of aircraft operations at

system airports. If operational levels by fractional ownership aircraft, especially jet aircraft, grow significantly throughout the system and at airports that may not have previously accommodated jet aircraft operations, the Commonwealth's airport system could be impacted. If corporate travel activity increases at smaller general aviation airports included in the intermediate functional level, the development of additional or expanded facilities may be justified at those airports. In such a case, runway dimensions and separation distances may need to be increased beyond that identified in the facility and service objectives used in the SASP and additional services may also need to be provided at system airports. In general, the impacts associated with the growth of fractional aircraft ownership and operations by this type of operator would be positive to the system, however, additional facility development may be required to support increased activity levels by jet aircraft at small commercial service and general aviation airports included in the advanced and intermediate functional levels.

D. Impact of Approach Category Changes for Mid-size Corporate Jet Aircraft

The impact that approach category changes in mid-size corporate jet aircraft may have on Pennsylvania's system of public-use airports has been briefly mentioned in previous sections of this chapter dealing with technological advances in aircraft design. This scenario will be examined in more detail below and the sensitivity methodology will be applied to it in an effort to better understand the potential implications to the system. As in the other scenarios examined in this analysis, it is impossible to identify and examine all potential impacts to the airport system that would result in this scenario. The purpose of this exercise is to illustrate the methodology that should be used if and when new aircraft designs lead to approach category changes and changes to activity patterns at State airports.

The FAA provides guidance for planning and design of airport facilities through FAA Advisory Circulars that promote airport safety, economy, efficiency and longevity. FAA Advisory Circular 150/5300-13, "Airport Design," presents airfield design standards for airport development. These standards define geometric design criteria for airport development, including runway, taxiway, and other airfield area design standards, based on the types of aircraft regularly using a facility. FAA standards for the planning and design of an airport are based on the airport's role, activity levels, and the "critical" aircraft that uses an airport. The critical, or design, aircraft is defined as the most demanding aircraft, or family of aircraft, that operates at an airport on a regular basis. Typically, an aircraft or family of aircraft must have 500 or more annual operations to be considered the critical aircraft. The Airport Reference Code, or ARC, is a coding system used to relate airport design criteria to the operational and physical characteristics of the design aircraft at an airport.

The ARC has two components that relate to an airport's design based on the critical aircraft. The first component, depicted by a letter, is the aircraft approach category, as determined by the approach speed of the critical aircraft. Aircraft approach category designations are presented in **Table 9-3**.

Table 9-3
Aircraft Approach Category Classification

Approach Category	Approach Speed (knots)	Example Aircraft
A	Less than 91	Cessna 172, Beech Baron
B	91 but less than 121	King Air, Citation II
C	121 but less than 141	Lear 25, Gulfstream III
D	141 but less than 166	Gulfstream II and IV
E	166 or greater	Blackbird 71, Tupolev 144

Source: FAA AC 150/5300-13, "Airport Design"

The second component, depicted by a Roman numeral, is the airplane design group, as determined by the critical aircraft's wingspan (see **Table 9-4**). Generally, aircraft approach speed is a primary consideration in the design of runways and runway-related facilities. Airplane wingspan relates primarily to separation criteria involving runway to taxiways and taxiway to taxilane separation.

Table 9-4
Airplane Design Group Classification

Airplane Design Group	Wingspan (feet)	Example Aircraft
I	Less than 49	Cessna 172, Cessna 401
II	49 but less than 79	Citation II, Beech King Air
III	79 but less than 118	Dash 8, Boeing 737
IV	118 but less than 171	Boeing 757
V	171 but less than 214	Boeing 747
VI	214 but less than 262	C-5B Galaxy

Source: FAA AC 150/5300-13, "Airport Design"

In the past, the design and operating characteristics of medium-sized general aviation jet aircraft dictated that airports service aircraft in that category have runways and taxiways designed to accommodate approach category classification of at least a "C" and design group classifications of at least "II" or "III". New aircraft designs, however, could significantly impact ARC classifications and therefore also significantly impact airport design standards at Pennsylvania airports. The addition of significant numbers of next-generation, smaller corporate jets in the general aviation fleet could significantly impact activity characteristics and levels at system airports as jet aircraft operations could be dispersed to more general aviation airports in Pennsylvania.

The Eclipse 500 is one example of a new jet aircraft design that illustrates how changes to this component of the general aviation aircraft fleet could impact Pennsylvania airports. The Eclipse 500 completed its first flight in August 2002, and pending its certification, first deliveries of these aircraft are scheduled for January 2004. The Eclipse jet is a twin-turbofan aircraft with a cruise speed of 355 knots, a 1,300 nautical mile range with four passengers, and a 41,000 foot ceiling. New design, production, and manufacturing practices implemented by Eclipse have

significantly decreased the aircraft's production costs. As a result, acquisition costs of a new Eclipse 500 jet have been guaranteed by the company at approximately $840,000, significantly lower than many of the jet aircraft currently on the market. In addition, new engine designs developed for the aircraft will also make its cost of operation significantly lower than its counterparts, while also being much quieter than most small and medium sized general aviation jet aircraft.

Design and operating characteristics of the Eclipse 500 jet are significantly different than many of the jet aircraft in the current fleet. The aircraft's wingspan is 36 feet, placing it in the Design Group I classification. The aircraft's approach speed, estimated as 1.3 times its stall speed, is estimated at approximately 80 knots placing it in the Approach Category A classification. Therefore, while many jets in the current fleet have ARCs of B-II or greater, the Eclipse 500 would be classified as having an ARC of A-I based on current planning standards. Generally speaking, the size and operating characteristics of this aircraft would allow for jet aircraft operations at a significantly larger number of the Commonwealth's general aviation airports than currently receive this type of traffic. The following sections will examine the impacts that could be expected by the introduction of aircraft such as this to the active fleet through the implementation of the sensitivity analysis methodology developed in this chapter.

1. Identify the System Change or Trend

In this scenario, the system change or trend that could impact the recommendations developed in the SASP is the introduction of new jet aircraft whose next-generation design and reduced acquisition and operating costs could significantly impact system airports. In this scenario, the Eclipse 500 jet will be used as an example aircraft to facilitate this discussion. Relatively low anticipated acquisition and operating costs could put this aircraft in high demand to support corporate and individual jet transportation. As a result of advancements in aircraft design, construction, and engine components, the performance characteristics of the Eclipse 500 jet are anticipated to be significantly different than current jet aircraft in the general aviation fleet. For example, because of its relatively short wingspan and low approach speeds, the aircraft could be anticipated to have an ARC of A-I, given current classification standards. In addition, new aircraft and engine technologies are also anticipated to significantly impact the aircraft's performance and airport facility requirements.

Current performance data related to the Eclipse 500 jet aircraft includes the following:

- Takeoff Distance (sea level at maximum gross takeoff weight): 2,060 ft.
- Accelerate/Stop Distance: 2,595 ft.
- Landing Distance (at sea level at 3,820 lbs.): 2,050 ft.

Most of the jet aircraft operating in the current fleet have ARCs of B-II or greater, and many have runway length requirements for takeoff, landing, and/or accelerate/stop distances approaching 5,000 feet. As the data provided above indicates, introduction of the Eclipse 500 jet into the active fleet could significantly impact system airports' activity levels and characteristics.

2. Identify Airports Impacted by System Change or Trend

At the present time, it is difficult to identify those system airports that are likely to be impacted by changes resulting from the introduction of aircraft such as the Eclipse 500 jet to the active general aviation fleet. Additional data regarding the aircraft's actual performance capabilities, as well as its owner's/operator's facility requirements, would be required before system airports that could accommodate operations by these types of aircraft. In general, however, the introduction of these aircraft to the active fleet would likely lead to increased jet aircraft operations at Commonwealth airports currently serving jet aircraft and at other airports where few or no jet aircraft operate. Runway length requirements identified for the Eclipse jet indicate that these aircraft may be able to operate with a sufficient safety margin on runways measuring as low as 3,000 feet. If this is the case, in addition to advanced and intermediate airports, Commonwealth airports recommended to be included in the basic functional level may also be able to support jet aircraft operations. Once the actual performance capabilities of the aircraft have been determined, and its operators have established their facility needs based on insurance and/or other requirements, PennDOT should be able to identify those airports capable of accommodating operations by this type of jet aircraft.

3. Determine the Implications to the System

The overall implications to the system by the introduction of new aircraft, with dramatically different design and operating characteristics, will be determined if and when these aircraft are certified for operation and introduced to the active fleet. In addition, the numbers of these types of aircraft that are introduced to the active fleet will also help to determine implications to the system. Low acquisition and operating costs, however, would seem to indicate that aircraft similar to the Eclipse 500 could be in high demand to support corporate and individual jet transportation, and, therefore, their introduction into the active general aviation fleet could be rapid and significant. In the long term, successful introduction of these types of aircraft to the active fleet could generate additional aviation demand in the Commonwealth, resulting in additional based aircraft and aircraft operations. In addition, from what is currently known of the Eclipse 500's operating capabilities and runway length requirements, it should be assumed that aircraft such as this could operate at a larger number of Commonwealth airports, many of which have not previously accommodated jet aircraft operations.

Introduction of aircraft similar to the Eclipse 500 to the active fleet would be anticipated to benefit Pennsylvania's airport system and its overall performance by allowing for improved jet aircraft accessibility to more areas of the Commonwealth. Corporate and/or personnel users of these types of jet aircraft would likely be able to operate at a number of Commonwealth airports that have previously been unable to accommodate jet aircraft operations previously. While the overall impacts of this scenario would be beneficial to the airport system and its users, some additional implications could also be anticipated that may require action by PennDOT. If based aircraft and aircraft activity levels increase in the Commonwealth, aircraft storage and airfield operating capacity issues at system airports could be exacerbated. While aircraft similar to the Eclipse 500 would be anticipated to meet and exceed all current noise standards, the introduction of new and/or additional jet aircraft operations at system airports might lead to perceived aircraft

noise complaints in the airport environs. In addition, if corporate and or individual users of these types of jet aircraft begin using more airports in the intermediate and basic functional levels, it will be important for PennDOT and airport sponsors to work to provide the ancillary aviation facilities that may be needed by these new users.

It is important to understand that many of the recommendations developed in the SASP were based on each system airport's contribution to the overall system and its recommended role in the system. Facility recommendations for each system airport were developed to allow that airport to perform its recommended role in the system and to accommodate aircraft operations by the types of current active aircraft anticipated to use the facility based on its role. While the introduction of Eclipse-type jet aircraft may lead to increased jet activity at more Commonwealth airports, the facility recommendations that have been developed for system airports based on the current aircraft fleet are not anticipated to be impacted over the studies planning period. Over the planning period of the SASP, it should be assumed that the active aircraft fleet from which the facility and service objectives in the SASP were developed would continue to operate. Although new Eclipse-type jets may be introduced to the fleet, those aircraft that make up the existing fleet at the present time should be anticipated to remain in the active fleet. Therefore, system airports will need to continue to be designed to meet the performance characteristics of the existing fleet, even though they may be relatively more demanding than those of the next-generation jet aircraft.

4. Determine PennDOT's Role in Addressing the System Change or Trend

The introduction of aircraft similar to the Eclipse 500 jet to the active general aviation fleet will be market driven once they have been certified. PennDOT will have no role in the certification process of these types of aircraft and/or their eventual introduction to the fleet. PennDOT's role in this scenario will begin once these aircraft have become a significant component of the active general aviation aircraft fleet and they have begun to operate at Commonwealth airports. At that point, PennDOT will likely have several important roles in dealing with system impacts from this scenario including, but not limited to, the following:

- Education
- Facility planning and development

As the numbers of these type of aircraft grow and their operations at system airports increases, educating the public about changes in the aircraft fleet will become important. Citizens in airport environs that experience only propeller driven aircraft activity will likely notice increased operations by jet aircraft and may perceive higher levels of aircraft noise as a result. If this is the case, it will be important for PennDOT to educate interested parties about new aircraft technology, the benefits of additional activity to their airport and community, and work to address noise complaints whether noise impacts are perceived or real. Another important role of PennDOT in this scenario would be to work to provide ancillary facilities at airports that are able to support jet operations by the Eclipse type jet. At the present time, specific needs for the users of these aircraft are not known. If and when these aircraft become significant components of Pennsylvania's aircraft fleet, PennDOT should work through its planning and grants processes to meet the changing needs of airport users.

5. Identify Potential Options for Addressing the System Change or Trend and Pursue Most Feasible Resolution

The nature of this scenario, and its potential positive implications to the system, does not necessarily require PennDOT to identify options to address its implications or pursue a resolution. Instead, PennDOT should monitor the development and introduction of aircraft similar to the Eclipse 500 to the active general aviation fleet. If and when these aircraft become a significant component of the fleet, PennDOT should then address any issues that may arise. Only when the final performance capabilities of the aircraft have been determined, and the aircraft user's facility requirements have been understood, can PennDOT work to meet changing system needs that may arise. In this process, it will be important to educate airport sponsors and citizens in airport environs about next-generation jet aircraft and the perceived noise impacts that they may generate, if applicable.

V. AIRPORT SYSTEM CHANGES

Another category of scenarios that may require future sensitivity analyses is airport system changes. These changes could include scenarios that impact individual airports in the Commonwealth or all system airports. Some specific examples of airport system changes that have been identified as having the potential to impact the Commonwealth's aviation system during the study period include the following:

- Sale of Private Airports for Non-Aviation Use
- Transition of Some Privately-Owned Public-Use Facilities to Private Use
- Military Airfield and Other Facility Closures
- Impacts of Enhanced Security

Each of these example scenarios is summarized below. An example case, the Impacts of Enhanced Security scenario, has been selected for further analysis through the application of the sensitivity analysis methodology developed in this chapter.

A. Transition of Some Privately-Owned Public-Use Facilities to Private Use

Since the initiation of the SASP, a number of privately owned airports have transitioned from public-use facilities to private-use facilities. The primary reason for these transitions has been the privately owned airports' inability to meet State licensing requirements for public-use airports. The overall impacts of these transitions on the Commonwealth's airport system has been minimized because most of the airports going to private use status have been small general aviation airports, typically stratified in the limited functional level, with minimal numbers of based aircraft. In the future, it will be important for PennDOT to examine potential impacts of the proposed transition of airports to private use. Impacts to the system and SASP recommendations that could be anticipated in such scenarios might include the migration of based aircraft to other facilities and a decrease in the number of public-use facilities in the Commonwealth and corresponding decreases in overall airport coverage of Pennsylvania population. Should this type of a scenario occur at a larger general aviation airport with a

significant number of based aircraft, it will be vital for the Bureau of Aviation to determine if sufficient alternative aircraft storage facilities exist at other public-use airports in the area. If a significant number of airports transition to private use, or the impacts of any single airport transition would significantly impact the system, the Bureau of Aviation may need to take proactive steps to ensure improvements are made to those privately-owned, public-use airports that contribute significantly to the system, thereby assisting them to meet State licensing standards.

B. Military Airfield Closures

Several military facilities that support aviation activity, including Fort Indiantown Gap and Willow Grove Naval Air Station, are located in the Commonwealth. While these facilities are currently reserved for military use, the potential does exist that military base closures may impact these facilities and provide an opportunity to develop these facilities as civilian facilities. In such a scenario, the Bureau of Aviation would play an important role in determining the benefits and costs of transitioning such a facility to civilian use, working to identify potential public sponsors for the facility, and determining the impacts that may result to the existing aviation system and SASP recommendations. The transition of Willow Grove Naval Air Station to a civilian facility, for example, could provide a significant positive impact to the Commonwealth's aviation system. If the opportunity arises to transition Willow Grove to a civilian use facility with a public sponsor, and the costs associated with required development and environmental clean up are feasible, the facility could greatly improve system coverage in the densely populated Philadelphia metropolitan area. Willow Grove's existing facilities, including its 8,000-foot long runway, could allow the airport to function in the advanced functional level identified in the SASP. Developing an additional advanced airport in this region of the Commonwealth, one that would meet or exceed most of the advanced airport facility and service objectives, would significantly improve system performance in this area and could be of a great benefit to the Commonwealth.

C. Sale of Private Airports for Non-Aviation Use

There are a significant number of privately owned airports in the Commonwealth's airport system. Some of these private airports have accepted federal and/or State grants and are therefore under grant obligations that require them to continue to operate as an airport or risk paying back some or all of the grant monies the airport has received. Other system airports are privately owned and have not accepted grant funds of any kind; these airports are under no obligation to remain in operation. As a result, the potential for sale of privately owned system airports for non-aviation uses is an issue that could significantly impact the Commonwealth's aviation system and the recommendations contained in previous chapters of the SASP.

Should this scenario arise, the Bureau of Aviation must examine system airport losses on a case-by-case basis. The implications to the system and PennDOT's role in addressing those implications will depend on some or all of the following factors:

- The functional role of the airport that is closing
- The location of the airport

- The ability of other airports to fulfill the closing airport's role
- The ability of other airports in the area to accommodate activity that might be diverted as a result of the closure
- Long-term system needs related to operational capacity and aircraft storage capacity

Based on the factors listed above, and any others that may be applicable, it may be determined that no action should be taken, indicating that the airport closure would not significantly impact the system. In some cases, however, the impacts may be substantial enough to require PennDOT to take an active role in pursuing public ownership of the airport through acquisition by a local municipality, county, or other public entity. In some areas of the Commonwealth, the loss of an airport, regardless of its functional level, could significantly impact the system. The long-term feasibility of developing a new airport facility in some areas is minimal, therefore, the ability to retain existing facilities for existing and potential long-term future needs may be vital to overall system performance.

D. Impacts of Enhanced Security

Adequately securing airport, aircraft, and air carrier facilities has always been a paramount goal of the Pennsylvania aviation system. Following the terrorist attacks of September 11, 2001, the security of the nation's aviation system has been placed under increased scrutiny. Security requirements at airports have been drastically changed primarily as the result of perceived weaknesses in pre-existing security measures related to airports and aviation. The potential exists for major changes to occur related to required security measures at both commercial service and general aviation airports. Any such changes could significantly impact Pennsylvania's airport system. Examples of the general types of enhanced security measures that could have the potential to impact the Commonwealth's aviation system include the following:

- Changing security requirements related to commercial airline and charter aircraft passenger travel
- Development of standards related to security at general aviation airport facilities
- Implementation of permanent airspace restrictions in metropolitan or other security-sensitive areas

While these categories of impact are not all inclusive, they do provide an understanding of the types of enhanced security measures that could impact Pennsylvania's aviation system in the future. One specific example related to permanent airspace restrictions near nuclear facilities will be examined in detail.

There are five nuclear power plants in the Commonwealth, all of which currently have FAA temporary flight restrictions (TFRs) in the airspace in their environs. Pennsylvania's nuclear power plants and their locations are as follows:

- Beaver Valley Power Station, Shippingport Township (Beaver County)
- Limerick Generating Station, Limerick Township (Montgomery County)
- Peach Bottom Atomic Power Station (York County)
- Susquehanna Steam Electric Station, Salem Township (Luzerne County)

- Three Mile Island, Middletown (Dauphin County)

The TFRs currently in place near these nuclear power plants are in place as a result of perceived threats related to these facilities and the potential of aircraft to be used to damage or destroy them. Under the TFRs in place near these facilities, pilots are advised to "avoid the airspace above, or in proximity to, sites such as nuclear power plants, power plants, dams, refineries, industrial complexes, military facilities and other similar facilities. Pilots should not circle as to loiter in the vicinity of such facilities." Current TFRs are to be in place indefinitely, until further notice by the FAA.

While the temporary nature of current TFRs may not impact system airports over the long-term, there is a potential for increased security measures in the environs of nuclear power plants to significantly impact one or more Commonwealth airports or the system as a whole.

Pottstown-Limerick Airport is shown in the picture below.

As the picture illustrates, Pottstown Limerick Airport, an advanced airport, is an example of an airport that could be impacted by any flight restrictions related to nuclear power plants. The airport is located in proximity to the Limerick Generating Station and any permanent flight restrictions that the FAA may implement in the airspace around that nuclear power plant could significantly impact the airport.

The sensitivity analysis methodology will be used to examine how the implementation of permanent flight restrictions in the environs of nuclear power plants could impact the Commonwealth's airport system.

1. Identify the System Change or Trend

In this scenario, the change to the airport system would be permanent flight restrictions in airspace surrounding nuclear power plants. Gaining a complete understanding of the specific restrictions that may be put in place would be vital to performing a sensitivity analysis to examine the potential impacts to the system. Some specific factors that would need to addressed to completely define the system change could include:

- Identify the dimensions of restricted flight areas. These would probably be presented in terms of a circle having a radius of a specified number of nautical miles centered on the nuclear power plant.
- Identify the types of flight restrictions that would apply, for instance, is overflight allowed given a minimum altitude.
- Identify the types of aircraft operators to which the restriction applies; for instance, would the restriction apply to all aircraft or only large aircraft; or, does the restriction apply to general aviation aircraft only or all aircraft including commercial airliners.

These are some examples of the types of factors that would need to be examined in order to get a complete definition of the system change.

2. Identify Airports Impacted by System Change or Trend

Once the specific permanent flight restrictions have been identified and defined in this scenario, the next step of the sensitivity analysis would be to identify those system airports, as well as non-system, private-use airports, that would be impacted by the change. It would be important to include private-use airports in this analysis. The closure of private-use facilities could impact public-use airports if based aircraft relocate from a private-use airport to a public-use airport after the closure of the private-use facility. Once the location of all nuclear power plants to which the restrictions would apply were identified, PennDOT would need to examine the specifics related to the restriction to identify impacted airports. The general approach that would be used to identify impacted airports could include the following:

- GIS or mapped-based analysis to identify system airports located within the restricted airspace areas of a nuclear power plant. The specific dimensions of the restricted airspace areas would need to be defined before this process was started, however, the proximity of Harrisburg International Airport and Pottstown Limerick Airport, for example, would make them likely airports to be impacted by such restrictions.
- Identify airports that may have traffic patterns, approach procedures, and/or missed approach procedures that would be impacted by permanent flight restrictions in the environs of nuclear power plants.
- Examine typical instrument and visual flight paths (victor airways) that could be impacted by restrictions.

Examining the factors listed above, as well as other airport-specific conditions that may be applicable given the specifics of any permanent flight restriction, will likely identify all airports that could be directly impacted by such restrictions near nuclear power plants.

3. Determine the Implications to the System

Without understanding the exact nature of permanent flight restrictions that could be implemented in this scenario, it is impossible to identify their potential implications to the Commonwealth's existing airport system. If permanent flight restrictions are implemented in the airspace environs of nuclear power plants, potential implications to the airport system could include the following:

- Airports located proximate to nuclear power plants may be forced to close. Closure of airports could also impact other airports in the area of the closed airport as based aircraft and operations would be forced to move from the closed airports to other nearby airports. In general, those airports located within a 30-minute drive time of an airport that would be closed would also need to be examined to determine their ability to accommodate additional activity.
- Traffic patterns of airports located in the environs of nuclear power plants may need to be redesigned to avoid impacting areas having permanent flight restrictions.
- Flight patterns and victor airways may need to be redesigned to eliminate overflight of nuclear power plants, if applicable.

In this scenario, the implications of permanent flight restrictions would be identified once the potential number of airport closures and airspace redesigns have been quantified. Overall implications of this scenario to the Commonwealth's aviation system could range from minimal airspace redesign to significant impacts that would result from airport closures necessitated by the permanent flight restrictions. Once the magnitude of these potential impacts on the system have been estimated, it would then be important for the Bureau of Aviation to determine their role in addressing the system change.

4. Determine PennDOT's Role in Addressing the System Change or Trend

The nature of this sensitivity scenario, in that it would be based on permanent flight restrictions implemented by the FAA as a result of national security concerns, would impact PennDOT's role in addressing any of its potential impacts. The decision to implement permanent flight restrictions would most likely be made at the federal level of government, possibly through legislative means. PennDOT could have a role in the decision making process through interaction with the FAA and/or the Commonwealth's representatives in Washington. However, once a decision to implement permanent flight restrictions has been made, PennDOT's ability to affect change on those restrictions would be minimal. PennDOT's role would then shift from providing policy input to having primary responsibility in minimizing negative impacts on system airports.

5. Identify Potential Options for Addressing System Change or Trend

Once a decision has been made to implement permanent flight restrictions, PennDOT must begin identifying options that may exist to minimize the negative impacts of these restrictions on individual airports as well as the overall system. Options that would be examined include identifying replacement airports, with comparable airport roles, to supplant airports that may require closure. In addition, traffic pattern and flight pattern changes that may be necessary, given potential restrictions, would require airport specific analysis of options for implementing the changes. Options for addressing system changes that would be identified in this scenario should be examined, and their costs, benefits, and impacts to the system compared, to determine the most feasible options for implementation.

For example, permanent flight restrictions that may force the closure of Pottstown Limerick Airport would require the identification and examination of options for addressing impacts including the following:

- Pottstown-Limerick Airport is an advanced airport and is intended to play an important role in the Commonwealth's general aviation system. In this scenario, PennDOT should work to identify other airports in the area, probably within a 30-minute drive time of Pottstown Limerick Airport, that could fulfill its role in the system. Airports located proximate to Pottstown Limerick Airport, not impacted by potential permanent flight restrictions, could be considered as options for replacing it in the advanced airport functional level.
- Airports within a 30-minute drive time of Pottstown Limerick Airports should also be examined in this scenario to determine their ability to accommodate additional aviation activity that may be diverted from Pottstown Limerick. Development options that would allow impacted airports to accommodate additional activity may need to be examined.

In the scenario examined above, through the identification of options for addressing system impacts, the Bureau of Aviation would identify and examine all potential options that may exist for finding a nearby airport to fulfill Pottstown Limerick's advanced role in the system. If that is not possible, the ability of other airports in the area to accommodate the levels and types of activity that may be diverted from the airport would also be examined.

6. Pursue Most Feasible Resolution

At the conclusion of this process, those options identified as most feasible for minimizing the negative impacts of permanent flight restrictions on the Commonwealth's aviation system must be implemented. The implementation of these options may require changes to development plans and funding requirements at system airports. In general, the Bureau of Aviation should work to address impacts at airports in the advanced, intermediate, and basic functional levels, in that priority, and then address impacts at other airports as financial resources may become available. In this process, it will be important for the Bureau of Aviation to communicate and coordinate with its customers, partners, and system users to ensure that they are addressing the needs of the system and its users while minimizing the negative impacts to the system.

VI. SUMMARY

This chapter of the SASP has identified a methodology that can be used to analyze scenarios arising over the study's 20-year planning period that may substantially impact the Commonwealth's airport system and recommendations contained in the SASP. Understanding that it is impossible to identify all potential system changes that may impact SASP recommendations, this analysis identified general types of impacts that may occur, and applied the sensitivity analysis methodology to specific examples in each general category. The goal of this process was to establish a standard methodology that can be used by PennDOT to identify, address, and resolve potential changes to the Commonwealth's aviation system that may impact system performance and system recommendations identified in the SASP.