Chapter 2.0 – Precision Approach Feasibility

The purpose of this chapter is to evaluate the feasibility of a precision approach at North Central Airport. Instrument approaches are classified as either precision or non-precision, depending on the accuracy and capabilities of the navigational aids (also known as Navaids) used. Precision approaches utilize both lateral (Localizer) and vertical (Glide Slope) information. A Non-Precision Approaches (NPA) provides lateral course information only. There is currently a non-precision instrument approach procedure to Runway 5.

Precision approaches are classified by the FAA in three major categories based on landing minimums. As the landing category increases from CAT I to CAT II and III, decision height and visibility minimums decrease. The following table provides minimums for the various landing categories.

Table 2.1
Landing Categories for Precision Instrument Approaches

Precision Approach Minimums	Runway Visual Range (RVR)	Decision Height (DH)
CAT I*	2,400 feet	200 feet
CAT II	1,200 feet	100 feet
CAT IIIa	700 feet	0 feet
CAT IIIb	150 feet	0 feet
CAT IIIc	0 feet	0 feet

*Category I minimums can be reduced to 1,800 feet RVR with the installation of Touchdown Zone Lights and Centerline Lights. Source: FAA AC- 120-29

Initially, this effort intended to analyze the feasibility of implementing a “traditional” Instrument Landing System (ILS) precision approach (Localizer and Glide Slope ground based equipment). However a number of related factors lead RIAC to rethink its position. They include:

- The FAA made it clear that their current policy is to move away from ILS and toward GPS technology. This is because the increasing availability of LPV approaches no longer made establishing “traditional” ILS a high priority.
- Achieving the level of airport activity needed to qualify for FAA ILS equipment is quite remote.
- Even if it were shown to be feasible and eligible, it optimistically would take a minimum of five years to get FAA funding, equipment in place and the approach procedure.

As a result, it was agreed to redirect the primary focus of this effort toward implementing an LPV (“localizer performance with vertical guidance”) approach to Runway 5.

Therefore, the purpose of this chapter has been revised to provide an insight on the development and benefits of an LPV approach to Runway 5. It should be noted that the level of effort is based upon preliminary information. Survey work consistent with FAA ACs 150-5300-16, -17 and -18 will be completed in 2010 by the FAA for the RIAC. Prior to any RIAC request for the approach, the airport would have to verify the LPV surfaces are clear.

2.1 – Wide Area Augmentation System

Under the umbrella of the FAA Wide Area Augmentation System (WAAS), an LPV approach offers an opportunity for SFZ to gain a precision approach capability without acquiring and installing a Glide-Slope. In fact, the LPV approach will require no ground based equipment at the airport other than the existing Localizer antennae.

WAAS is a navigation service using a combination of Global Positioning System (GPS) satellites and the WAAS geostationary satellites to improve the navigational service provided by GPS. The system is owned and operated by the Federal Aviation Administration (FAA). WAAS is known to improve the navigational system accuracy for en route, terminal, and approach operations over all the continental United States.

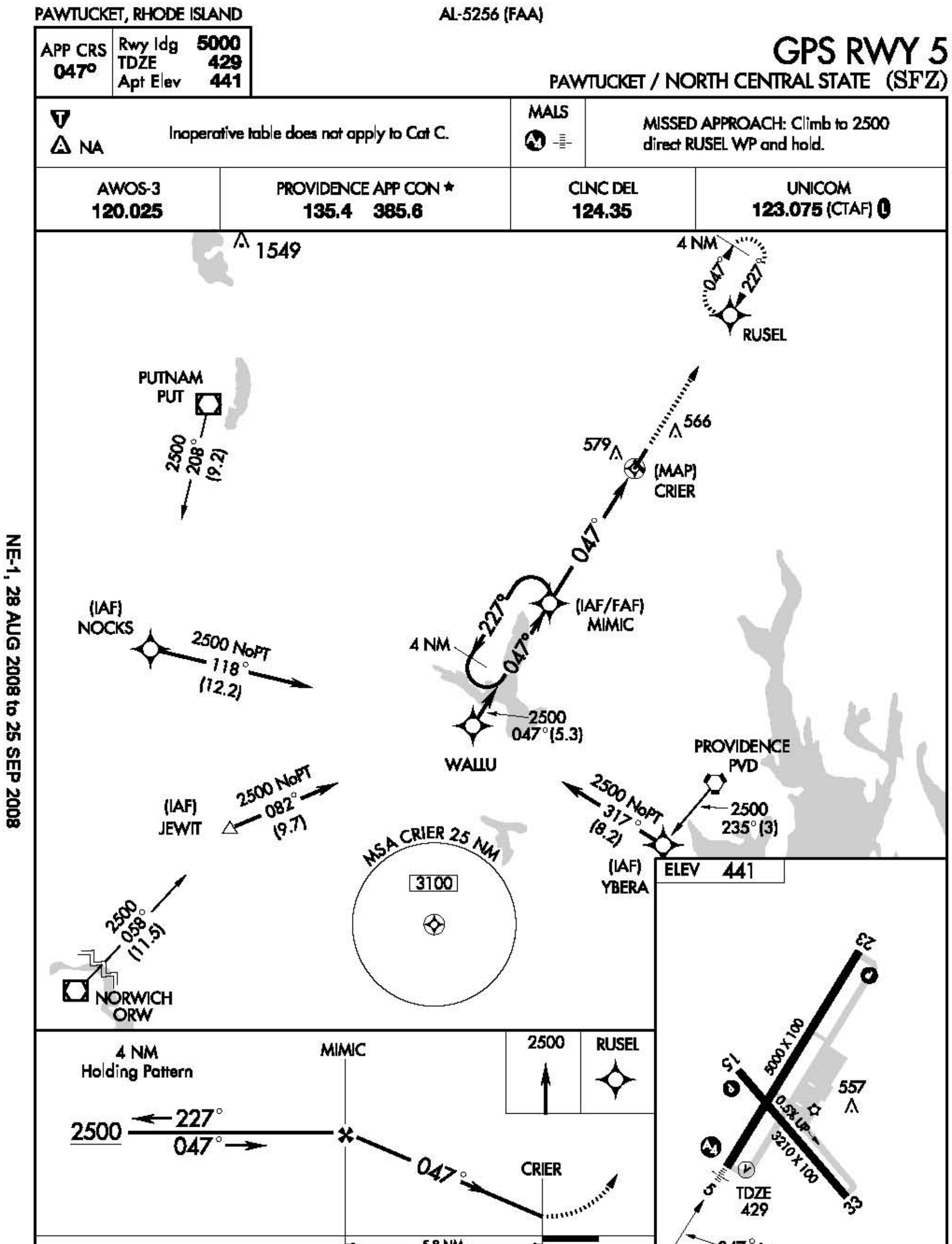
This new navigational technology supports vertically-guided instrument approaches to all qualifying runways in the U.S. Vertically-guided approaches reduce pilot workload and provide safety benefits compared to non-precision approaches. As mentioned, vertically-guided approach procedures (called LPV) can provide ILS equivalent approach minimums as low as 200 feet at qualifying airports. Actual minimums will be based upon SFZ's current infrastructure, as well as an evaluation of any existing obstructions. The current lowest minimums to Runway 5 are 400 foot ceiling and ¾ mile visibility, as illustrated in Figure 2.1 on the next page.

2.1.1 Advantages of an LPV Approach

There are many advantages of a WAAS-enabled LPV approach. They are:

- LPV procedures have no requirement for ground-based transmitters;
- As a result, the often difficult task of siting ground based navigation equipment is eliminated, as well as providing and maintaining critical areas around the facility, or providing access for maintenance vehicles;
- From a pilot's viewpoint, an LPV approach looks and flies like an ILS, but the WAAS approach is more stable than that of an ILS; and,
- WAAS equipped users can fly area navigation (RNAV) and basic required navigation performance (RNP) procedures, as well as LPV procedures, and the avionics costs are relatively inexpensive considering the total navigation solution provided.
- Provides the opportunity to reduce the existing weather minimums, allowing better access to the airport during inclement weather conditions.

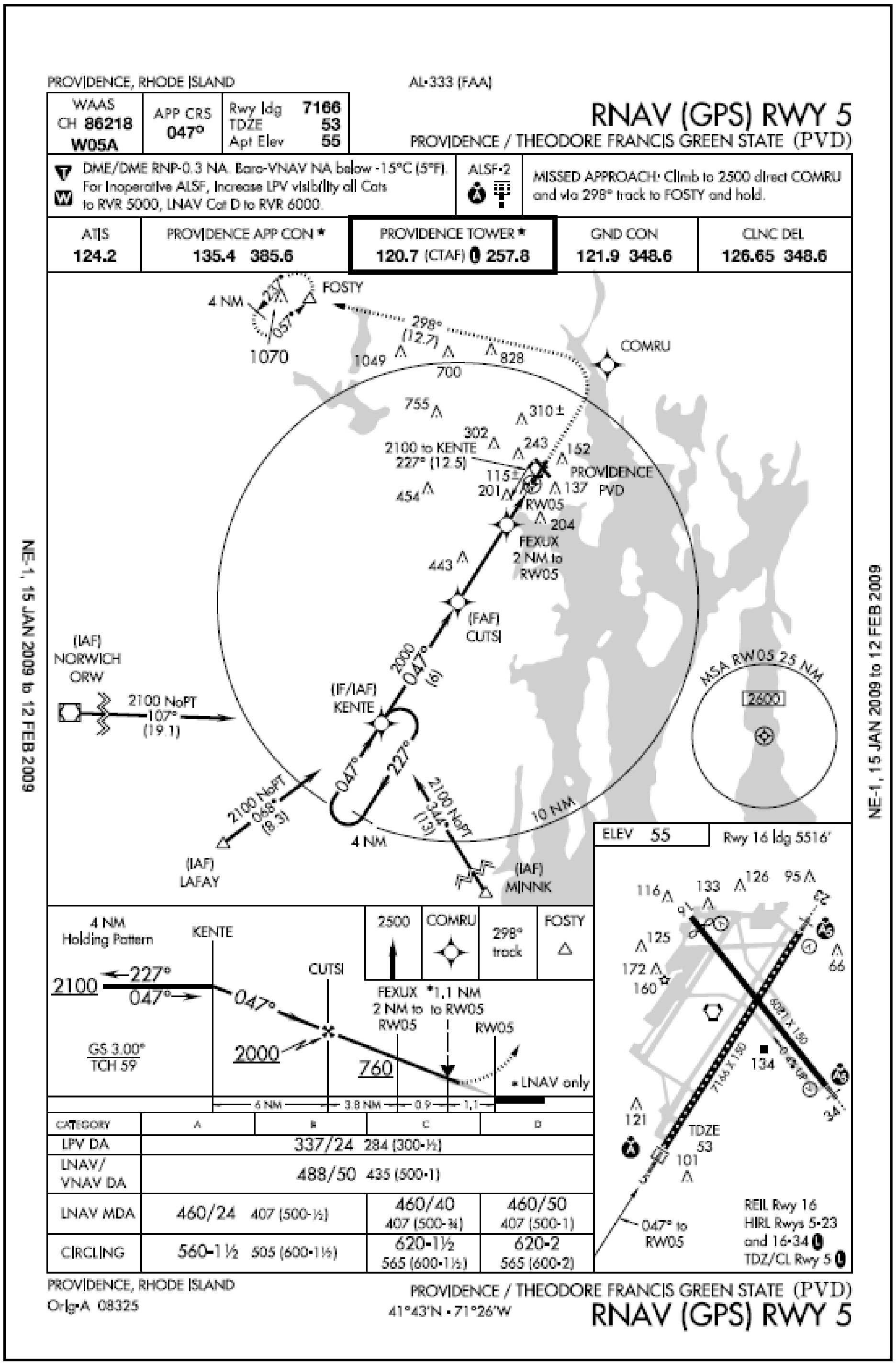
Figure 2.1
GPS Approach to SFZ Runway 5



CATEGORY	A	B	C	D
S-5	840-¾ 411 (400-¾)		840-1¼ 411 (400-1¼)	NA
CIRCLING	980-1 539 (600-1)		980-1½ 539 (600-1½)	NA

Figure 2.2 depicts a typical LPV approach procedure plate that the pilot refers to while flying the aircraft. The title denotes the approach as an RNAV procedure. Notice that each RNAV procedure typically includes three approach types; LPV, LNAV/VNAV, and LNAV. This enables as many GPS-equipped aircraft to use the procedure as possible and provides operational flexibility if WAAS becomes unavailable.

Figure 2.2
Sample LPV Approach Plate



It is important to note that flying a WAAS LPV approach requires an aircraft with WAAS-LPV avionics. If for some reason the WAAS service becomes unavailable, all GPS or WAAS equipped aircraft can revert to the LNAV decision altitude and land safely using GPS-only, which is available nearly 100% of the time.

2.2 – Preparing for an LPV Approach at SFZ

The WAAS navigation service is fully operational and ready to provide the capability. Even though navigational equipment is not required there are still some airport infrastructure requirements to get a LPV approach. This section will provide preliminary information (i.e., weather, design standards, and obstruction surfaces) to assist RIAC in determining if it is feasible and practical to accommodate this type of approach procedure.

2.2.1 Weather Analysis

Weather analysis is an essential part in determining if it is realistic to provide reduced minimums at SFZ (i.e., better than the current 400 foot and ¾ mile). Consequently, a review of both visibility and ceiling height was conducted for the period 1997 through mid 2008. Table 2.2 summarizes the review and provides the percentage of the total measurements, taken for the period, that the airport is operating at various Instrument Meteorological Conditions (IMC).

Table 2.2
SFZ Weather Review
(Based upon 177,447 Total Measurements)

Visibility	# of Measurements	Percentage
> 1	174,361	98.26%
< 1 but ≥ ¾	718	0.40%
< ¾ but ≥ ½	981	0.55%
< ½	1,387	0.78%
Ceiling*	**# of Measurements**	**Percentage**
> 400’	160,883	90.66%
400’	2,742	1.55%
300’	3,451	1.94%
200’	4,554	2.57%
100’	5,817	3.28%
400’ to 200’	10,747	6.06%

As shown, SFZ is operating at below the current visibility minimums (i.e., less than ¾) 1.33% of the total measurements taken for the period 1997-2008, and only .55% at the LPV operating threshold (greater than or equal to ½ mile). Furthermore, SFZ is operating below the current ceiling minimum (i.e., 400’) 6.06% for the same period.

Quantitatively speaking, the first impression is there appears to be little benefit in providing reduced minimums. However, with the FAA’s added focus on WAAS (LPV) approaches across the U.S., SFZ may realize an added operational benefit in implementing an LPV to include added safety benefits and making the airport more accessible when it is needed under these climatological conditions. Qualitatively speaking, the weather conditions shown are a small portion of the overall time at the airport, but it can’t be stressed enough that improving the approach capabilities with lower minimums also enhances the level of safety when the pilot needs it most. As an added measure of safety, many pilots will fly an instrument approach during visual, good weather conditions. RIAC receives frequent inquiries and requests by pilots for reduced minimums, which further enhances the justification for pursuing an LPV at SFZ. It's a "catch 22" situation. FAA is prepared to do the Survey, but not address the clearing requirements. The clearing will be the responsibility of RIAC and it is eligible for AIP reimbursement.

2.2.2 Design Standards

Although site requirements typically required for an ILS are unnecessary with an LPV approach, compliance with the design standards of Advisory Circular 150/5300-13 "Airport Design" still is required. Since the LPV approach may improve the existing capability, the airport infrastructure may require upgrading to accommodate the potential for increased activity by larger more complex aircraft. For this reason, a "table-top" evaluation was performed to determine if further actions, such as land acquisition, obstacle clearing, and upgrading airfield geometry and runway markings are required to achieve the full benefit of the LPV procedure. Once the scope of the infrastructure needs and costs are understood, informed decisions on the feasibility of implementing an LPV approach, along with options for funding can be realized.

A review of the primary design standards was conducted under the premise that if and when SFZ implements an LPV approach, the increased usage of larger or complex aircraft may cause the airport to change from the current ARC B-II design standard to the expanded ARC C-II design requirements. Table 2.3 shows the comparison between the existing airport conditions and the C-II design standard. To accommodate the difference would require capital improvements to bring the airfield up to the C-II standard.

Table 2.3
SFZ Design Standards (Current vs. C-II)

Design Standard	Existing (ft)	C-II (ft)	Deficit (ft)
Runway CL to Taxiway CL	350	400	(50)
Runway CL to Aircraft Parking	420	500	(80)
Runway Width	100	100	Meets Reqt.
RSA Width	500	500	Meets Reqt.
RSA Length – 5 End	300	1,000	(700)
RSA Length – 23 End	300	1,000	(700)
OFA Width	500	800	(300)
OFA Length	300	1,000	(700)
RPZ Runway 5	IW- 1,000 OW- 1,510 L- 1,700	IW- 1,000 OW- 1,750 L- 2,500	IW- 0 OW- (240) L- (800)

There is no evidence in the forecast (Chapter 3), suggesting that the airport activity level for the higher performance aircraft (C-II) would dramatically increase because of the LPV. Nonetheless, if the design aircraft of the airport were to change, requiring C-II design standards; the costly investment in airport infrastructure needs to be understood now. These investments include, but are not limited to:

- Substantial filling and grading at each end of Runway 5-23 to achieve the required 1,000' RSA or partial fill and installation EMAS to achieve compliance;
- Shifting Runway 5-23 or relocating Albion Road to accommodate the increased OFA width;
- Shifting the parallel taxiway 50' to achieve C-II separation standards;
- Adding aircraft parking apron area development to offset aircraft parking lost from shifting the parallel taxiway and subsequent encroachment of the OFA;
- Acquiring land required for the increased RPZ at the Runway 5 end and increased RSA at the Runway 23 end; and,
- The cost of environmental and engineering studies required to implement all the improvements.

Figure 2.3 illustrates the increased RSA, OFA, and RPZ from B-II to C-II.

Based upon the desired minimums (200 foot decision height and ¾ mile visibility), the LPV requirements for runway length, lighting, and all-weather markings, as well the need for a parallel taxiway will need to be in place at SFZ. As shown in Table 2.4, with the exception of all-weather marking, SFZ currently meets the LPV requirements.

Table 2.4
Infrastructure Required for LPV Approach

	RWY 5/23	Meets Requirements
Runway Length ≥ 4,200'	5,000'	✓
High Intensity Runway Edge Lighting (HIRL)	HIRL	✓
Parallel Taxiway	Yes	✓
Precision Approach Runway Markings	No	

The goal is to cost effectively provide an infrastructure allowing for the lowest minimums and greater access to the airport in all weather conditions.

2.2.3 Obstacle Environment and Key Surfaces

The guidance accuracy required for a LPV approach is similar to that of an ILS. As such, the certification criteria used to define the lateral and vertical safety boundaries within which the aircraft will approach the runway are those used for an ILS. The certification criteria used to define the lateral and vertical tolerances are more critical than those used for non-precision approaches.

In turn, this means that many obstacles which fall within the much wider V-shaped area of a non-precision approach may require a higher Decision Height (DH) to provide clearance over them and will fall outside the narrower LPV approach path. Ultimately this allows aircraft pilots to use a lower DH and makes for a more reliable airport.

Several factors determine the minimums for an instrument approach. Implementing a LPV approach is no different. The two driving factors are the obstacles in the environment surrounding the airport and the airport infrastructure. The Height Above Touchdown (HAT) of the approach is based solely on the obstacles (natural or manmade) and how close they come to penetrating the glide slope obstacle clearance surfaces. Often these are beyond the control of airport management to clear and will affect the HAT for the approach. The visibility requirement for the approach is partly dependent upon the airfield infrastructure.

Achieving the lowest visibility requires an obstacle clear surface and, as discussed in Section 2.2.2, the appropriate airport infrastructure to support the approach. The current obstruction data for SFZ does not provide all the information needed to make a detailed assessment of the appropriate airport surfaces. To obtain the detailed information would be premature and expensive at this point in the decision process and there are other variables that need to be considered first. Absent that data a broad “table-top” exercise was completed using guidance contained within TERPS FAA Order 8260.3B. This exercise reviewed the LPV clearance requirements based upon three key surfaces, which are the Glidepath Qualification Surface (GQS), the Obstacle Clearance Surface (OCS), and the Precision Object Free Zone (POFZ). These surfaces are defined as follows:

- Glidepath Qualification Surface: The GQS extends from the runway threshold along the runway centerline extended to the Decision Altitude (DA) point. It limits the height of obstructions between DA and runway threshold. When obstructions exceed the height of the GQS, an approach procedure with positive vertical guidance (e.g., LPV) is not authorized, and subsequent review of the OCS is not necessary.

- Obstacle Clearance Surface: The OCS is composed of the "W," "X," and "Y" surfaces (the "W," "X," and "Y" surfaces are designed to protect both sides of the final approach course when the reported weather is 800 feet or less and the visibility is two SM or less and the aircraft is on final within two NM of the runway threshold.

- Precision Object Free Zone: The POFZ is an area designed to protect the area of short final during very low ceilings of less than 300 feet or visibilities less than ¾-statute mile (SM) or less than 4,000 feet runway visual range (RVR).

Because the “table-top” exercise could not accurately identify specific obstructions, the effort was primarily focused on identifying the extent of the areas impacted, and based upon a review of the ground contours, the potential for obstructions based upon an aerial review. Figure 2.4 illustrates the GQS and Figure 2.5 illustrates the OCS (internal W surface only) and the POFZ.

[Insert Figure 2.4 – Runway 5 Glidepath Qualification Surface]

[Insert Figure 2.5 – Runway 5 Obstacle Clearance Surface]

As illustrated in Figure 2.4, the GQS appears to be clear of obstructions at a 28.7:1 slope up to the potential Decision Height (DH) of 200 feet. The terrain drops off from the Runway 5 threshold to the southeast. The POFZ appears to be clear of obstructions. However, as illustrated in Figure 2.5, the OCS-W surface, at a 0 slope for 2,579 feet could potentially have obstructions. Initial review indicates that the potential tree obstructions may exist inside and outside the airport property boundary. As Figure 2.6 illustrates, areas within the OCS-W surface have been outlined that have not been cleared (specifically Areas B and C), to date, and may contain obstructions.

The following assumption has been made in effort to estimate the total acreage that will require clearing:

- Ten (10) to Forty (40) percent of the areas both on and off RIAC property that have not been cleared (i.e., Areas B and C) may require obstruction removal.

Tables 2.5 and 2.6 show the estimated clearing requirement (in acres) within the OCS-W surface and associated cost for obstruction removal.

Table 2.5
10 Percent - SFZ OCS-W Surface Clearing Estimate (Acreage and Cost)

OCS – W Surface[1]	Acres	10% of Total Acreage	Estimated Unit Cost[2]	Estimated Cost to Remove	Add Easement Cost	Total Estimated Cost
Area A	N/A – Area is Clear					
Area B	21.6	2.16	$8k/acre	$17,280	$0	$17,280
Area C	10.6	1.06	$8k/acre	$8,480	$50,000	$58,480
Area D	N/A – Area is Clear					
40% Total Estimated Cost (Rounded):						$76,000

[1] Refer to Figure 2.6
[2] Obstruction Removal. Unit was derived from SFZ Engineers Opinion of Construction Costs for the Vegetative Obstruction Removal and Obstruction Lighting project (Fall 2008)

Table 2.6
40 Percent - SFZ OCS-W Surface Clearing Estimate (Acreage and Cost)

OCS – W Surface[1]	Acres	40% of Total Acreage	Estimated Unit Cost[2]	Estimated Cost to Remove	Add Easement Cost	Total Estimated Cost
Area A	N/A – Area is Clear					
Area B	21.6	8.64	$8k/acre	$69,120	$0	$69,120
Area C	10.6	4.24	$8k/acre	$33,920	$75,000	$108,920
Area D	N/A – Area is Clear					
40% Total Estimated Cost (Rounded):						$180,000

[1] Refer to Figure 2.6
[2] Obstruction Removal: Unit was derived from SFZ Engineers Opinion of Construction Costs for the Vegetative Obstruction Removal and Obstruction Lighting project (Fall 2008)

A more detailed Aeronautical Survey, which is discussed in Section 2.3, is necessary to verify the estimations provided in Tables 2.5 and 2.6, and Figure 2.6 as well as allow a more detailed analysis of the OCS- X and Y peripheral surfaces. That survey is recommended as a component of the Phase I development recommendations.

Figure 2.6 Here.

2.3 – Recommendation and Next Steps

As discussed in the previous section, a preliminary review of the clearance surfaces indicates that SFZ appears to be a viable candidate for an LPV approach to Runway 5. Furthermore, LPV requirements indicate that SFZ meets all but one requirement, that is, Precision Approach, all weather runway markings. An investment to upgrade runway markings is relatively small.

If the airport were to experience a significant increase in C-II aircraft operations (> 500 operations/year), this would then require significant and costly infrastructure upgrades listed in Section 2.2.2. The forecasts provided in this report (Chapter 3) indicate that such an increase in C-II operations is unlikely.

Implementation of an LPV approach at SFZ is warranted due to the added benefit of the new and increasingly utilized technology. The gains for aircraft operators are significant considering the number of airports like SFZ that do not have an ILS. Most business oriented aircraft operations are conducted from non ILS airports and are restricted to use non precision approaches. As more complex aircraft are being equipped with WAAS capability, SFZ could experience an 'opportunity gained' by implementing the LPV approach and realizing the full potential of the airport. Use of the precision LPV approach at SFZ would enhance the use of the airport during poor weather conditions by achieving lower instrument approach minimums rather than diverting to an alternate airport. By its very nature this also improves the safety of the airspace system.

Since the last obstruction study for SFZ was completed in 1996, an updated obstruction analysis is essential to determine the exact approach minimums the installation of an LPV would achieve. However, review of this obstruction data suggests that there would be at least some improvement.

Before an LPV can be implemented, several steps must be performed which include the following:

1. Perform an LPV Aeronautical Survey Update at the Runway 5 end (previous survey was conducted in 1996). Requests for new or revised Instrument Approach Procedures (IAP) require the submittal of current and accurate airport data meeting FAA requirements (see Attachment A for sample Scope-of-Work); Research indicates that the costs associated with implementing an LPV approach at SFZ range from $200,000 to $450,000 based on the following approximate costs:

o Aeronautical Survey	$150,000
o Design, Easements and Obstruction Removal	200,000
o EA for tree clearing/obstruction removal	
o Runway Markings	50,000
o Contingency	50,000
Approximate Cost:	$450,000

2. Analyze survey results to determine the LPV approach minimums; and,
3. Submit an official request for development of the LPV procedure to the FAA.

After the obstruction survey is analyzed and the LPV minimums are determined, there will be relatively no cost associated with publishing the LPV approach at SFZ. Once the request is submitted, it will be reviewed by the FAA. This review usually incorporates FAA airports, flight procedures, flight standards, and air traffic control to provide a single coordinated review of the request. Once approved by the FAA, the priority for publication is established and the procedure development scheduled.