GRAND CANYON
NATIONAL PARK AIRPORT
ARIZONA

Chapter Five

ALTERNATIVES

AIRPORT MASTER PLAN

ADOT

Chapter Five

ALTERNATIVES

The previous chapter outlined airside and landside facilities needed to satisfy forecasted aviation demand through the long range planning period of the Master Plan. The next step in the planning process is to evaluate reasonable and practical ways these facilities can be provided. The purpose of this chapter is to formulate and examine rational development alternatives that can address the short, intermediate, and long term planning horizon levels. Because there are a multitude of possibilities and combinations, it is necessary to focus on those opportunities which have the greatest potential for success. Each alternative provides a differing approach to meet existing and future facility needs, and these layouts are presented for purposes of evaluation and discussion.

Some airports become constrained due to limited space availability, while others may be constrained due to adjacent land use development. Careful consideration should be given to the layout of future facilities and impacts to potential airfield improvements at Grand Canyon National Park Airport (GCN or Airport). Proper planning at this time can ensure the long term viability of the Airport for aviation and economic growth.

The primary goal of this planning process is to develop a viable plan for meeting the needs resulting from the projected market demand over the next 20 years. The plan of action should be developed in a manner that is consistent with the future goals and objectives of the Arizona Department of Transportation (ADOT), airport users, the local community, and surrounding region, all of whom have a vested interest in the development and operation of GCN.

GRAND CANYON
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The ultimate goal is to develop an underlying rationale which supports the final recommended concept. Through this process, an evaluation of the highest and best uses of airport property will be made while also weighing local development goals, efficiency, cost, physical and environmental factors, capacity, and appropriate airport design standards.

AIRPORT DEVELOPMENT OBJECTIVES

It is the overall objective of this Master Plan to produce a balanced aviation facility to serve forecast demands. Before defining and evaluating specific alternatives, airport development objectives should be established. As owner and operator, ADOT provides the overall guidance for the operation and development of GCN. The primary goal for the Master Plan is to define a future concept which positions the Airport to be developed and safely operated for the betterment of its users and the region as a whole. With this in mind, the following development objectives have been defined for this planning effort.

- Conform to Federal Aviation Administration (FAA) and Arizona Department of Transportation – Multi-Modal Planning Division – Aeronautics Group (ADOT-MPD – Aeronautics Group) design and safety standards, where practical, for the mix of aircraft that are projected to use the Airport during the 20-year planning period.
- Develop a safe, attractive, and efficient aviation facility in accordance with applicable federal, state, and local regulations.
- Provide sufficient capacity which will meet the long term planning horizon demand levels.
- Reflect and support the long term planning efforts currently applicable to the region.
- Develop facilities to safely and efficiently serve aviation users and support future growth.
- Develop a facility with a focus on sustainability both operationally and financially.
- Ensure that future development is environmentally compatible.

REVIEW OF PREVIOUS AIRPORT PLANS

The previous Master Plan for GCN was completed in 2005 and detailed airside and landside development potential over the next several years. More recently, a Terminal Area Plan was prepared in 2009 that focused solely on the potential enhancement of terminal landside facilities in order to meet projected demand.

The Airport Layout Plan (ALP) that resulted from the 2005 Master Plan is shown on **Exhibit 5A**. The previous Master Plan recommended several airfield improvements related to continued rehabilitation of runway and taxiway pavements. The most notable improvements in the previous Master Plan called for extending Runway 3-21 to 10,000 feet and constructing a 5,600-foot parallel runway adjacent to the west side of the existing runway to improve airfield capacity. In addition, the replacement and expansion

Runway Data

RUNWAY DETAILS	EXISTING RUNWAY 3-21	ULTIMATE RUNWAY 3R-21L	EXISTING —	ULTIMATE RUNWAY 3L-21R
Runway Category/ Airplane Design Group	C-III	Same	—	B-II
Runway True Azimuth	40.65° True	Same	—	40.65° True
Maximum Runway Elevation (MSL)	6,608.7 feet	Same	—	---
Runway Dimensions	8,999' x 150'	10,000' x 150'	—	5,600' x 75'
Runway Instrumentation/ FAR Part 77 Category	Precision/Visual	Same	—	Visual/Visual
Approach Visibility Minimums	1/2-Mile/1-Mile	Same	—	1-Mile/1-Mile
Approach Slope	50:1/20:1	Same	—	20:1/20:1
Displaced Threshold	None	Same	—	None
Runway Stopway	None	200' x 200' (Rwy 3R)	—	None
Runway Safety Area (RSA)	10,999' x 500'	12,000' x 500'	—	6,200' x 150'
RSA Distance Beyond Runway End	1,000'	Same	—	300'
Runway Object Free Area (OFA)	10,999' x 800'	12,000' x 800'	—	6,200' x 500'
OFA Distance Beyond Runway End	1,000'	Same	—	300'
Runway Obstacle Free Zone (ROFZ)	9,399' x 400'	10,400' x 400'	—	6,000' x 400'
ROFZ Distance Beyond Runway End	200'	Same	—	200'
Runway Pavement Strength (Thousands of lbs.)	88(S), 108 (D), 180 (DT)	Same	—	12.5 (S)
Runway Pavement Material	Asphalt	Same	—	Asphalt
Runway Markings	Precision/Non-Precision	Same	—	Visual/Visual
Runway Gradient	0.8%	Same	—	1.07%
Runway Lighting	MIRL	Same	—	MIRL
Approach Lighting System (ALS)	MALSR (Rwy 3)	Same	—	None
Runway ℄ to Parallel Taxiway ℄ Separation	407'	Same	—	300'
Runway ℄ to Parallel Runway ℄ Separation	---	700'	—	700'
Taxiway ℄ to Fixed or Movable Object	93'	Same	—	65.5'
Taxiway ℄ to Parallel Taxiway ℄ Separation	152'	Same	—	105'
Taxiway Pavement Material	Asphalt	Same	—	Asphalt
Taxiway Lighting	MITL	Same	—	MITL
Taxiway Markings	Centerline	Same	—	Centerline
Taxiway Object Free Area Width	186'	Same	—	131'
Taxiway Safety Area Width	118'	Same	—	79'
Taxiway Wingtip Clearance	34'	Same	—	26'
NAVAIDS	VOR-DME, ILS, GPS	Same	—	None
Approach Visual Aids	VASI-4L (Rwy 21)	VASI-4L (Rwy 21L)	—	PAPI-4L/ PAPI-4L
Touchdown Zone Elevation (TDZE)	6,556.2' /6,608.7'	Same	—	6,620.0'/6,630.0'
Design Acft – B-737-500, APCH SP kts	N/A	—	—	N/A
Design Acft – B-737-500, (Wing span ft)	94.8'	—	—	N/A
Design Acft – B-737-500, MAX CTOW	133,500 lbs	—	—	N/A
Line-of-Sight Requirement	MET	—	—	N/A

Airport Data

AIRPORT INFORMATION	EXISTING	ULTIMATE
Airport Name (ICAO Identifier)	Grand Canyon National Park Airport (GCN)	Same
Airport Reference Code (ARC)	C-III	Same
Range and Township/ Sections	T 30 N, R 2 E/ 23, 24, 25, 26, 27, 34, 35	Same
County	Coconino County, AZ	Same
Airport Sponsor	ADOT, Aeronautics Division	Same
NPIAS Category	Primary (PR) Commercial Service	Same
Design Aircraft (Type/Model)	Boeing 737-800	Same
ARFF Index	Index B	Same
Airport Elevation– Mean Sea Level (MSL)	6,608.7 feet	Same
Airport Reference Point (ARP)	35-57-08.50 N, 112-08-49.10 W	35-57-12.26 N, 112-08-49.09 W
Mean Maximum Monthly Air Temperature (F)	84° F (July)	Same
Airport and Terminal NAVAIDS	VOR-DME	Same
Instrument Approach Procedures	ILS, VOR-DME, GPS	Same
Weather Reporting System	ASOS- III	Same

Existing and ultimate ARP coordinates reflect NGS 405 Survey dated 11-05-99 in North American Datum (NAD 83) and North American Vertical Datum (NAVD 88).

PACS & SACS

ID NO.	GEODETIC COORDINATES	MARKER	ELEV.
PACS AC6806	35-57-51.189 N, 112-08-01.121 W	MR	6,619.5 feet
SACS AC6807	35-56-33.984 N, 112-09-20.570 W	SD	6,530.1 feet
SACS AC6808	35-57-05.551 N, 112-08-48.202 W	SD	6,581.0 feet

PACS– Primary Airport Control Station
SACS– Secondary Airport Control Station
MR– Metal Rod
SD– Survey Disk
See General Notes #10

Runway End Coordinates

RUNWAY END	EXISTING	ULTIMATE	ELEVATION (FT)	HIGH/LOW POINTS
Runway 3	35-56-34.74 N, 112-08-24.70 W	--	6,532.8'	(E) LOW POINT
Runway 21	35-57-42.23 N, 112-08-13.42 W	SAME	6,608.7'	(E) HIGH POINT
Runway 3L	---	35-57-04.72 N, 112-08-04.24 W	6,565.0'	
Runway 21R	---	35-57-46.74 N, 112-08-19.87 W	6,608.7'	
Runway 3R	---	35-56-27.20 N, 112-08-32.65 W	6,532.8'	(U) LOW POINT

Existing and ultimate runway end coordinates reflect NGS 405 Survey dated 11-05-99 in North American Datum (NAD 83) and North American Vertical Datum (NAVD 88).

General Notes

1. There are No OFZ Object Penetrations.

2. There are No Threshold Siting Surface Object Penetrations.

3. The existing passenger terminal building is inadequate to accommodate future peak hour passenger demand and is recommended to be replaced. The southwestern portion of the terminal area complex, spanning the southwestern apron area, will be ultimately reserved for future aviation/ terminal building expansion area. Future location, layout, capital outlays, project scheduling and space allocations will be generated as part of a future terminal area plan project.

4. The Papillon Grand Canyon Helicopter structure is located within the Runway 21 RPZ. Places of public assembly such as this represent land uses that are prohibited from occupying space within the RPZ. The Papillon structure and associated facilities are recommended to be removed and relocated. Future location, layout and timeframe for relocation will be determined as part of a future terminal area plan project.

5. The airport access road located to the north of the terminal area complex encroaches upon the Runway 21 OFA which represents a non standard condition that requires mitigation. The access road is recommended to be realigned and relocated out side of the future Runway 21R OFA. Ultimate alignment, cost and scheduling for improvement will be determined as part of a future terminal area plan project.

6. Due to the remoteness of the Airport from adequate accommodations to support housing to meet the unique requirements of a commercial service airport, a residential area is designated to support the FAA and airport personnel that provide 24/7 operational capability for the Airport.

7. As part of an initiative to reduce automobile congestion within the Park, Grand Canyon Railroad, located in Williams, proposed a regional transportation plan that would provide railroad access to the airport, as well as shuttle bus surface transportation to/from the Grand Canyon Village to manage vehicular flow during peak tourism periods. Approximately 25 acres of NFS land located to the southwest of terminal area complex would be acquired to accommodate auto parking facilities, a railroad staging area and depot, as well as a rail spurline in the event that this long-range transportation plan would be successfully implemented.

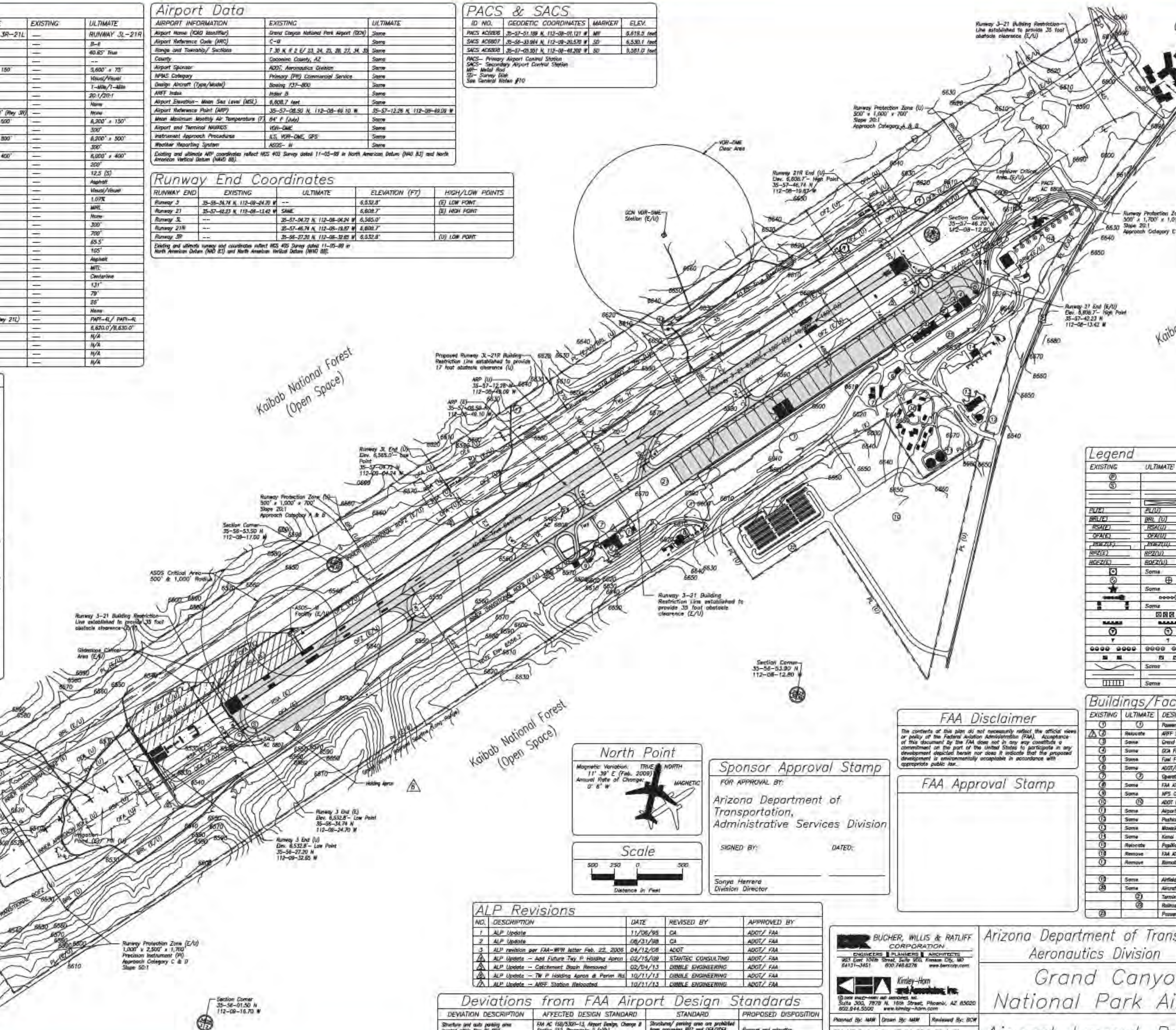
8. Contour elevation information derived from Western Air Maps planimetric mapping (June 2005).

9. A survey of structural height on the airport will be part of a future AIP grant.

10. The PACS/SACS monuments will be protected as part of a future AIP grant.

11. The North Point Arrows on Sheets 2 through 11 are oriented correctly for the drawing.

12. The LINE OF SIGHT requirement is met.



North Point

Magnetic Variation: 11° 39' E (Feb. 2009)
Annual Rate of Change: 0° 6' W
TRUE NORTH
MAGNETIC

Scale

500 250 0 500
Distance in Feet

Sponsor Approval Stamp

FOR APPROVAL BY:

Arizona Department of Transportation, Administrative Services Division

SIGNED BY: DATED:

Sonya Herrera
Division Director

FAA Disclaimer

The contents of this plan do not necessarily reflect the official views or policy of the Federal Aviation Administration (FAA). Acceptance of this document by the FAA does not in any way constitute a commitment on the part of the United States to participate in any development depicted herein nor does it indicate that the proposed development is environmentally acceptable in accordance with appropriate public law.

FAA Approval Stamp

Legend

EXISTING	ULTIMATE	DESCRIPTION
Ⓟ		Primary Airport Control Point
Ⓢ		Secondary Airport Control Point
		Pavement Areas
		Structures
PL(E)	PL(U)	Airport Property Line
BRL(E)	BRL (U)	Building Restriction Line (BRL)
RSA(E)	RSA(U)	Runway Safety Area (RSA)
OFA(E)	OFA(U)	Object Free Area (OFA)
POFZ(E)	POFZ(U)	Precision Obstacle Free Zone (POFZ)
RPZ(E)	RPZ(U)	Runway Protection Zone (RPZ)
ROFZ(E)	ROFZ(U)	Runway Obstacle Free Zone (ROFZ)
	Same	VOR-DME Station
		Airport Reference Point (ARP)
	Same	Rotating Beacon
		Automated Surface Observing System (ASOS)
	Same	Vertical Approach Slope Indicators (VASI)
		Precision Approach Path Indicators (PAPI)
		Hold Position Marking
		Lighted Wind Cone/Segmented Circle
		Supplemental Wind Sock Locations
		Runway Threshold Lighting
		Runway End Indicator Lights (REIL)
	Same	Ground Contour(s)
		Perimeter Fencing
	Same	Localizer Transmitter Antenna

Buildings/Facilities

EXISTING	ULTIMATE	DESCRIPTION
1	1	Passenger Terminal Building Expansion Area (See General Note No.3)
△ 2	Relocate	ARFF Station (Relocated)
3	Same	Grand Canyon Airlines (GCA) Terminal
4	Same	GCA FBO Hangar
5	Same	Fuel Farm
6	Same	ADOT/FAA Airport Administration Building
7	7	Operations/SRE Buildings (ARFF– Ultimate)
8	Same	FAA ATCT Facility
9	Same	NPS Clear Span Hangar/Office Trailer
10	10	ADOT Employee Residential Area (See General Note No. 6)
11	Same	Airport Water Supply Tanks
12	Same	Pashkiai Trading Post
13	Same	Maverick Helicopter Tours
14	Same	Kenai Helicopter Service
15	Relocate	Papillon Grand Canyon Helicopters (See General Note No. 4)
16	Remove	FAA ATCT (Abandoned)
17	Remove	Remote Communications Outlet – RCO (Abandoned)
19	Same	Airfield Lighting Electrical Vault
20	Same	Aircraft De-Icing Pad
	21	Terminal Area Apron Expansion
	22	Railroad Depot/Staging Area (See General Note No. 7)
23		Passenger Terminal Building Auto Parking Area

ALP Revisions

NO.	DESCRIPTION	DATE	REVISED BY	APPROVED BY
1	ALP Update	11/06/95	CA	ADOT/ FAA
2	ALP Update	08/31/98	CA	ADOT/ FAA
3	ALP revision per FAA-WPR letter Feb. 22, 2006	04/12/06	ADOT	ADOT/ FAA
4	ALP Update – Add Future Twy P Holding Apron	02/15/09	STANTEC CONSULTING	ADOT/ FAA
5	ALP Update – Catchment Basin Removed	02/04/13	DIBBLE ENGINEERING	ADOT/ FAA
6	ALP Update – TW P Holding Apron & Perim Rd.	10/11/13	DIBBLE ENGINEERING	ADOT/ FAA
7	ALP Update – ARFF Station Relocated	10/11/13	DIBBLE ENGINEERING	ADOT/ FAA

Deviations from FAA Airport Design Standards

DEVIATION DESCRIPTION	AFFECTED DESIGN STANDARD	STANDARD	PROPOSED DISPOSITION
Structure and auto parking area located within Rwy 21 RPZ	FAA AC 150/5300-13, Airport Design, Change 8 Section 212, Paragraphs 2 (a)(b)	Structures/ parking area are prohibited from occupying RPZ and OFA/ROFA	Removal and relocation
Access road located within the Rwy 21 OFA/ROFA	FAA AC 150/5300-13, Airport Design, Change 8 Section 307, Runway Object Free Area	Access road is not to be placed within the OFA/ROFA	Realignment and relocation

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Planned By: MAW	Drawn By: MAW	Reviewed By: BCW

FAA AIP Project No. 03-04-0019-20 & 21
BWR Project No. 2003-0074.01

Arizona Department of Transportation
Aeronautics Division

Grand Canyon National Park Airport

Airport Layout Drawing

Sheet 2 of 11
February 15, 2009

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Friday, January 24, 2014 9:12:28 AM

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of the existing passenger terminal building was programmed to better accommodate existing and forecasted peak passenger demand levels.

The 2009 Terminal Area Plan further detailed commercial passenger terminal needs, ultimately recommending the construction of a new replacement passenger terminal building farther south on the airfield with a new vehicle access, parking, and circulation plan. The ALP as depicted does not include the proposed terminal enhancements since it was completed prior to the Terminal Area Plan study.

The analysis presented in this chapter will revisit the recommendations presented on the ALP and in previous planning efforts. Since completion of the last plan, the FAA has made some significant modifications to airport design standards as outlined in the previous chapter. As such, some of the previous plan's elements may be carried over to the Master Plan and others may be changed and/or removed from further consideration. For instance, a future parallel runway as outlined in the previous Master Plan will not be pursued as part of this planning effort based on projected aviation demand.

NO-DEVELOPMENT ALTERNATIVES

In analyzing and comparing the advantages and disadvantages of various development alternatives, it is important to consider no-development alternatives at GCN. No-development alternatives include the "no-build" or "no-action" alternative. These no-development alternatives essentially consider keeping the Airport in its present condition, not providing any type of improvements to the existing facilities (other than general airfield and facility maintenance projects). **Exhibit 5B** depicts the Airport in its existing condition, which would serve as the basic no-development alternative to be considered in this study. The primary result of this alternative would be the inability of the airport to satisfy the projected aviation demands of the airport service area and adhere to appropriate airfield safety design standards.

GCN is an important contributor to the development of the surrounding region which includes providing access to the Grand Canyon National Park (GCNP), as well as playing an important role in the continuity of the national aviation network. Not improving GCN to meet commercial service, air taxi/tour, and general aviation needs could limit future opportunities for the region.

Aviation demand forecasts and analysis of facility requirements outlined in the previous chapters indicated a potential need for improved facilities at GCN. Should demand dictate, potential improvements include a runway extension, taxiway enhancements, airfield approach upgrades, correction of airfield safety standard deficiencies, additional hangar facilities, and the improvement of terminal area services. Without these improvements, users of the Airport will be constrained from taking maximum advantage of the facility's air transportation capabilities.

There is a significant public and private investment at the Airport. The pursuit of a no-development alternative would slowly devalue these investments and lead to infrastructure deterioration and potentially the loss of significant levels of federal and state funding for airport improvements. If facilities are

not maintained and improved so that the Airport provides a pleasant experience for the visitor or business traveler, or if delays become unacceptable, then these individuals may consider doing business elsewhere. Ultimately, the safety of aircraft, pilots, and persons on the ground could be jeopardized.

By owning and operating GCN, ADOT is charged with the responsibility of developing aviation facilities necessary to accommodate aviation demand and minimize safety and operational constraints. To propose no further development at GCN could adversely affect the long term viability of the Airport, resulting in negative economic impacts on the region as well as increased airfield safety concerns for users of the facility. No-development alternatives are also inconsistent with the long term goals of the FAA and ADOT-MPD – Aeronautics Group, which are to enhance local and interstate commerce.

The analysis to follow considers airside and landside development alternatives that take into account an array of facility demands including safety, capacity, access, and efficiency. While these alternatives consider improvements to the Airport, it is important to analyze the impact of a no-development alternative for each specific development consideration, whether it is airside or landside in nature.

AIRPORT ALTERNATIVE CONSIDERATIONS

The development alternatives are categorized into two functional areas: airside and landside. Airside considerations relate to runways, taxiways, navigational aids, lighting and marking aids, etc. and require the greatest commitment of land area to meet the physical layout of an airport, as well as the required airfield safety standards. The design of the airfield also defines minimum set-back distances from the runway and object clearance standards. These criteria are defined first to ensure that the fundamental needs of the airport are met. Landside considerations include hangars, aircraft parking aprons, terminal services, as well as utilization of remaining property to provide revenue support for the airport and to benefit the economic development and well-being of the regional area.

Each functional area interrelates and affects the development potential of the others. Therefore, all areas must be examined individually and then coordinated as a whole to ensure the final plan is functional, efficient, and cost-effective. The total impact of all these factors must be evaluated to determine if the investment in GCN will meet the needs of the surrounding area, both during and beyond the planning period of this study.

Exhibit 5C presents both airside and landside alternative considerations that will be specifically addressed in this analysis. These issues are the result of the findings of the aviation demand forecasts and facility requirements evaluations, as well as input from the Planning Advisory Committee (PAC), airport management, and general public.

The remainder of this chapter will describe various development alternatives for airside and landside facilities. Although each area is treated separately, ultimate planning will integrate the individual requirements so that they can complement one another.


LEGEND
Airport Property Line
Runway Safety Area (RSA)
Runway Obstacle Free Zone (ROFZ)
Runway Object Free Area (ROFA)
Precision Obstacle Free Zone (POFZ)
Runway Protection Zone (RPZ)
Safety Area Deficiency
RPZ Incompatibility
A Taxiway Designation
NORTH
0
1,200
2,400
SCALE IN FEET
Aerial Source: Woolpert 10/1/2015
Runway 3/21 8,999' x 150'
Aircraft Rescue and Firefighting Station (ARFF)
Airport Traffic Control Tower (ATCT)
Liberator Dr.
Terminal Building
Airport Housing
Airport Road
Landside Facilites
180
64

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AIRSIDE CONSIDERATIONS

- Evaluate improvements necessary for Runway 3-21 to meet the appropriate existing and ultimate Federal Aviation Administration (FAA) design standards.
- Examine a potential extension on Runway 3-21 to meet ultimate aircraft operational requirements.
- Analyze the taxiway system in meeting airfield safety, design, and geometry standards that includes mitigating the FAA identified "Hot Spot".
- Improve visual approach aids to include the installation of a precision approach path indicator (PAPI) and runway end identification lights (REILs) on Runway 3.
- Consider environmental sensitivities and incorporate sustainable initiatives as appropriate into airside improvements.

LANDSIDE CONSIDERATIONS

- Evaluate the circulation and efficiency of the terminal area in meeting existing and future demands.
- Provide options for terminal facility enhancements to meet existing and ultimate commercial passenger activity related to air tour and airline/air charter operations.
- Determine efficient land uses that allow the Airport to meet the needs of aviation and non-aviation demand while enhancing potential revenue support.
- Identify locations for additional hangar development to meet projected demand.
- Evaluate options to enhance support facilities needed for aviation activities.
- Consider environmental sensitivities and incorporate sustainable initiatives as appropriate into landside improvements.

ANALYSIS OF AIRSIDE DEVELOPMENT CONSIDERATIONS

This section identifies and evaluates various airside development factors at GCN to meet the requirements set forth in Chapter Four. Airside facilities are, by nature, the focal point of an airport complex. Because of their primary role and the fact that they physically dominate airport land use, airfield facility needs are often the most critical factor in the determination of viable development options.

AIRPORT DESIGN CRITERIA

Applicable standards for airport design are outlined in FAA Advisory Circular (AC) 150/5300-13A, Change 1, *Airport Design*. The design of airfield facilities is primarily based on the physical and operational characteristics of aircraft using the airport. As discussed in Chapter Four, a Runway Design Code (RDC) is applied to each runway at an airport in order to identify the appropriate design standards for the runway and associated taxiway system. The RDC is made up of the Aircraft Approach Category (AAC), the Airplane Design Group (ADG), and the approach visibility minimums expressed in runway visual range (RVR) values. It relates to the largest and fastest aircraft that regularly operates at the airport. The FAA has historically defined regular use as at least 500 annual operations at the airport. While this can, at times, be represented by one specific make and model of aircraft, most of the runways' RDC values are represented by several different aircraft, which collectively operate frequently at the airport.

Selection of the current and future critical aircraft must be realistic in nature and supported by current data and realistic projections. A detailed analysis was conducted in Chapter Four that identified the types and number of jet and turboprop operations that have historically occurred at GCN based upon the FAA's *Traffic Flow Management System Counts* (TFMSC). Based upon this analysis, the RDC for Runway 3-21 at the Airport is currently C-II-4000 and includes aircraft such as the Bombardier CRJ-200 regional jet, Challenger 300/600, and Gulfstream 200/400.

The airfield should continue to be planned for some of the most demanding regional commercial service and general aviation business jet aircraft on the market today. This would include general aviation aircraft such as the Gulfstream V and Bombardier Global Express and commercial service aircraft including the Bombardier CRJ-700 regional jet and Boeing 737-series. The alternative analysis will evaluate facility development that could meet ultimate RDC standards for C-III-4000 on Runway 3-21. **Table 5A** summarizes the existing and planned RDC for Runway 3-21 at GCN.

TABLE 5A
Runway Design Codes
Grand Canyon National Park Airport

Runway	Existing Runway Design Code	Planned Runway Design Code
3-21	C-II-4000	C-III-4000

SAFETY AREAS

The design of airfield facilities includes both the pavement areas to accommodate landing and ground operations of aircraft, as well as the required safety areas to protect aircraft operational areas and keep them free of obstructions that could affect the safe operation of aircraft at the airport. The safety areas include the runway safety area (RSA), runway object free area (ROFA), runway obstacle free zone (ROFZ), and runway protection zone (RPZ). The applicable design standards for the runway system were previously outlined in Chapter Four. As depicted on **Exhibit 5D**, there are areas on the airfield that do not conform to current safety design standards related to the RSA, ROFA, and RPZ. The ROFZ standards are currently met on Runway 3-21 at GCN.

Runway Safety Area

According to AC 150/5300-13A, *Airport Design*, the FAA calls for the RSA to be 400 feet wide and extend 1,000 feet beyond each runway end for existing RDC C-II design. For ultimate RDC C-III design, the RSA is widened to 500 feet and also extends 1,000 feet beyond each runway end. Under both existing and ultimate conditions, the RSA extending to the northeast of Runway 3-21 is penetrated by a portion of the perimeter access road. Although the road is restricted to authorized airport personnel and is not open to the public, the FAA still recommends it be clear of the RSA.

For RDC C-II standards, the RSA is penetrated by the perimeter access road beginning 954 feet beyond the runway end. For RDC C-III standards that require the application of a wider RSA, the road penetrates the RSA beginning 651 feet beyond the runway end. As detailed in Chapter Three, only 600 feet of RSA is needed prior to the landing threshold on each runway end under RDC C-II and C-III standards.

Future planning should consider meeting the full RSA for C-III standards beyond the departure end of Runway 3. Ideally, a portion of the perimeter access road could be relocated; however, this may be difficult given the existing terrain and features in this area, namely a retaining wall that has been constructed immediately adjacent to the northeastern-most portion of the RSA. In the event the Airport were to allow the existing penetrations to remain, an alternative would be to decrease runway length declared available for takeoff on Runway 3 to meet the 1,000 feet of RSA required beyond the runway end. The runway extension alternatives to follow later in this chapter will provide potential solutions to meeting RSA standards beyond the departure end of Runway 3.

In addition, certain portions of the airfield between the runway and parallel taxiway do not meet current RSA grading standards due to a series of culverts that aid in airfield drainage. These culverts are located adjacent to several of the entrance/exit taxiways serving the east side of Runway 3-21. In most instances, the culverts and associated drainage areas meet existing C-II design standards for RSA, but fall short of meeting the expanded C-III RSA area. The Airport is aware of this design issue and is working to ultimately correct it.

Runway Object Free Area

The FAA calls for the ROFA to be 800 feet wide, extending 1,000 feet beyond each runway end for existing RDC C-II and ultimate C-III design, which is applicable to Runway 3-21. Similar to the RSA, only 600 feet is needed prior to the landing threshold.

On the northeast side of the runway, a retaining wall and associated fencing as well as portions of Airport Road fall within the ROFA beginning 714 feet beyond the runway end. Similar to the RSA, it would be ideal for the Airport to clear the ROFA in order to meet design standards; however, relocating Airport Road and the retaining wall and associated fencing would prove costly and may not be practical given the amount of ROFA affected.

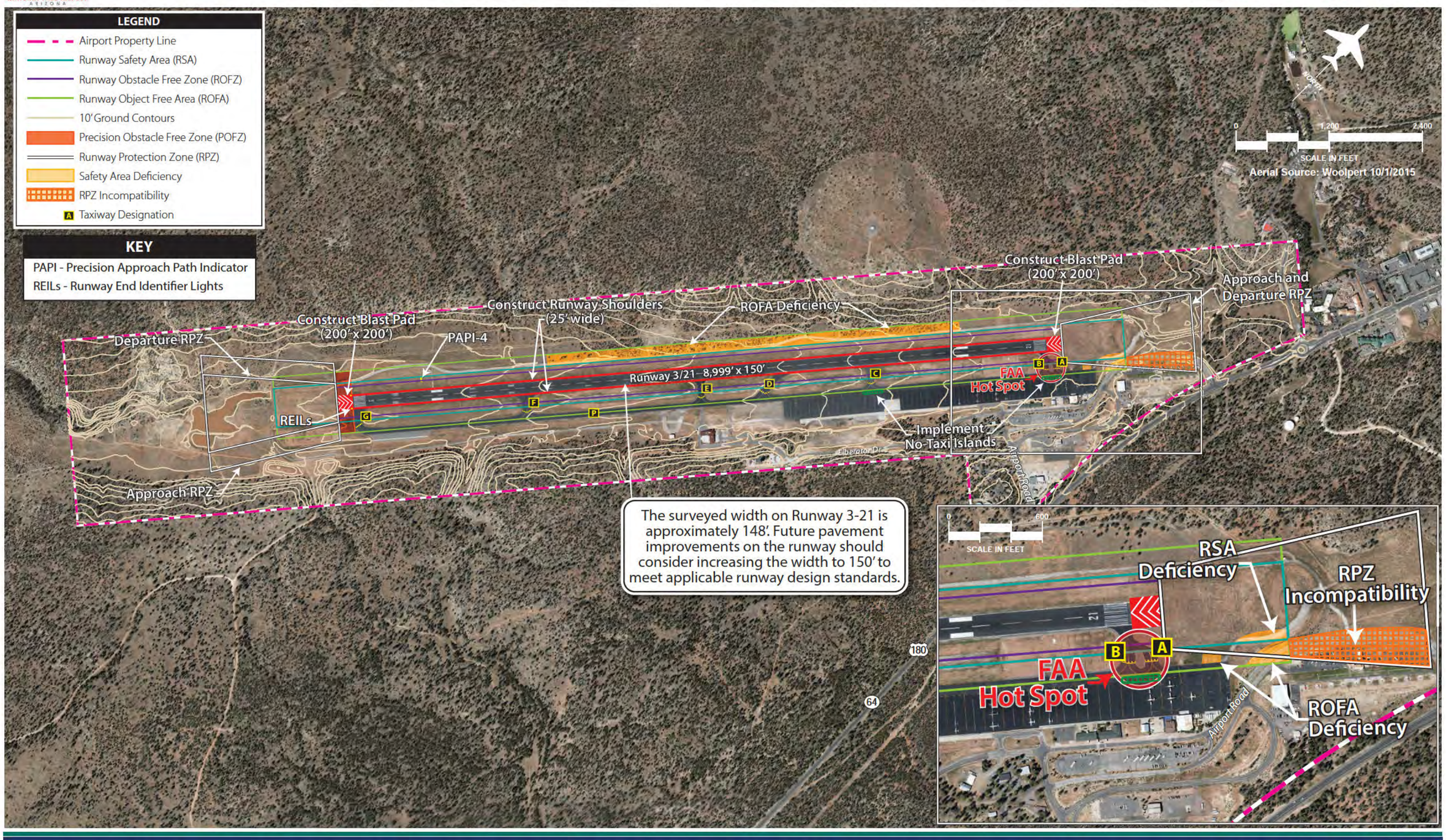
Also located north of the runway are two marked helicopter landing areas that fall within the ROFA. These are located approximately 600 feet beyond the northeast end of the Runway 21 landing threshold and are situated adjacent to the north aircraft parking apron. In addition, trees and shrubs obstruct the ROFA along portions of the west side of Runway 3-21. Future planning should include the removal and relocation of the two marked helicopter landing areas and the removal of vegetation on the west side of the runway to conform to ROFA standards.

It should be noted that under certain circumstances, the FAA may approve a Modification to Standard for non-standard conditions on the airfield related to certain safety areas such as the ROFA. A Modification to Standard cannot be approved for RSA deficiencies on an airport. The runway alternatives to follow provide potential solutions to meeting full ROFA standards.

Runway Protection Zone

FAA AC 150/5300-13A defines the RPZ as *"An area at ground level prior to the threshold or beyond the runway end to enhance the safety and protection of people and property on the ground."* The goal of the RPZ standard is to increase safety for both pilots and people on the ground by maintaining the RPZ free of items that attract groupings of people or property.

All runway ends have two RPZs: an approach RPZ and a departure RPZ. The size of each is dependent upon the type of aircraft or RDC for which the runway is being designed. The approach RPZ is also sized according to the lowest visibility minimums provided by the approved instrument approach procedure(s). For runways without a displaced threshold, it is common for the approach and departure RPZs to be in the same location. This is currently the case for the approach and departure RPZs beyond the north end of Runway 3-21. On the south end of Runway 3-21, the approach RPZ serving Runway 3 is larger than the departure RPZ associated with Runway 21 due to instrument approach procedures providing visibility minimums down to ¾-mile on Runway 3. FAA's RPZ criterion applies to both the approach and departure RPZ.


LEGEND
Airport Property Line
Runway Safety Area (RSA)
Runway Obstacle Free Zone (ROFZ)
Runway Object Free Area (ROFA)
10' Ground Contours
Precision Obstacle Free Zone (POFZ)
Runway Protection Zone (RPZ)
Safety Area Deficiency
RPZ Incompatibility
A Taxiway Designation
KEY
PAPI - Precision Approach Path Indicator
REILs - Runway End Identifier Lights
NORTH
0
1,200
2,400
SCALE IN FEET
Aerial Source: Woolpert 10/1/2015
Construct Blast Pad (200' x 200')
Approach and Departure RPZ
Construct Runway Shoulders (25' wide)
ROFA Deficiency
Departure RPZ
PAPI-4
Runway 3/21 - 8,999' x 150'
FAA Hot Spot
REILs
Implement No-Taxi Islands
Liberator Dr
Airport Road
Approach RPZ
The surveyed width on Runway 3-21 is approximately 148'. Future pavement improvements on the runway should consider increasing the width to 150' to meet applicable runway design standards.
180
64
0
600
SCALE IN FEET
RSA Deficiency
RPZ Incompatibility
21
FAA Hot Spot
ROFA Deficiency
Airport Road

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In the past, FAA guidance did not clearly identify all objects which could be located inside the RPZ except to qualify that the object should not be an attractant to a congregation of people. In newer guidance, however, the FAA stipulates that certain land uses are permissible without further evaluation and other land uses will require further evaluation and ultimate FAA approval. Chapter Four outlined the updated guidance provided in AC 150/5300-13A, Change 1, and *Interim Guidance on Land Uses within a Runway Protection Zone* (September 27, 2012).

If an airport cannot fully control the entirety of the RPZ, the RPZ land use standards have recommendation status for that portion of the RPZ not controlled by the airport owner. In essence, this means that the FAA can require a change to the runway environment so as to properly secure the entirety of the RPZ. The FAA has always held that residences, businesses, and similar uses should be excluded from the RPZ, although this objective was not uniformly enforced. Objects such as public roads, however, have always been allowed under previous guidance unless it posed an airspace obstruction. FAA's current guidance does not readily allow for public roads in the RPZ, although existing conditions can be "grandfathered."

As shown on **Exhibit 5D**, portions of the approach and departure RPZs beyond the north end of Runway 3-21 have incompatibilities. Although under control of the Airport, a portion of the building and vehicle parking lot associated with Papillon Helicopters is contained within the RPZ as is a portion of Airport Road.

As previously discussed in Chapter Four, since the new RPZ guidance addresses new or modified RPZs, existing incompatibilities may be grandfathered under certain conditions. For example, roads that are in the current RPZ are typically allowed to remain as grandfathered unless the runway environment changes. The airport sponsor should take reasonable actions to meet RPZ design standards. The public roadway and Papillon Helicopters facility could be considered grandfathered since they are an existing condition. Any change to the RPZ could require full compliance, meaning the rerouting of Airport Road and relocation of other facilities outside the RPZ. Alternatives discussed later in this chapter will further evaluate the effects of mitigating these RPZ incompatibilities on the airfield system.

RUNWAY LENGTH

Runway 3-21 is currently 8,999 feet long. Analysis in the previous chapter recommended that the Master Plan consider a potential runway extension in the long term in order to support the needs of larger commercial service/air charter aircraft, such as the Boeing 737-series and MD-80-series, in the event that the Airport experiences a significant enhancement in commercial passenger service (particularly charter operations) in the future. These jets require additional runway length, especially during hot weather conditions and/or under heavy loads and longer trip lengths. Many of these aircraft are capable of operating at the Airport throughout most of the year, but will be weight-restricted during hot days as jet engines are less efficient during higher temperatures. Weight restrictions generally correlate with taking on less fuel and/or boarding fewer passengers.

The 2005 Airport Master Plan and subsequent ALP both call for a future runway length of 10,000 feet. An extension to the runway will not be an easy endeavor given the physical land constraints beyond the ends of the runway. As previously discussed, safety deficiencies already exist beyond the north end of the runway, and beyond the south end of the runway is a freshwater pond known as Rain Tank. Furthermore, existing infrastructure development associated with the Town of Tusayan is situated less than 3,000 feet beyond the north end of the runway. A northerly extension could shift aircraft activity closer to commercial and residential properties in the Town as well as interfere with special use airspace associated with the GCNP.

Given the complexities involved with a potential runway extension to the north, the alternatives analysis in this chapter will consider proposed extension scenarios to the south end of Runway 3-21. The alternatives will make distinctions from the extension as outlined on the currently approved FAA ALP and the proposed extension meeting FAA design standards.

RUNWAY WIDTH

The FAA design standard for runway width is based on the RDC and approach visibility minimums to the runway. Runway 3-21 at GCN is currently published at 150 feet wide, which meets the standard for RDC C-III design.

As noted in Chapter Four and on **Exhibit 5D**, a recent survey of the runway system indicates that the current width of Runway 3-21 is approximately 148 feet wide. Future improvements to the runway system should include increasing the width to 150 feet to meet proper runway design standards. It is recommended that this be programmed during a future pavement reconstruction project in order to incorporate the design of usable pavement for runway width.

RUNWAY SHOULDERS

Runway shoulders provide resistance to blast erosion and accommodate the passage of maintenance and emergency equipment and the occasional passage of an aircraft veering from the runway. Runway 3-21 at GCN currently does not have shoulders. Paved shoulders are required for runways accommodating ADG IV and higher aircraft and are recommended for runways accommodating ADG III aircraft.

The FAA design for runway shoulders associated with ADG III aircraft is 25 feet. Future planning considers providing a 25-foot shoulder on each side of Runway 3-21, as depicted on **Exhibit 5D**.

RUNWAY BLAST PADS

A runway blast pad is a surface adjacent to the end of the runway provided to reduce the erosive effect of jet blast and propeller wash. Currently, blast pads are not present at either end of Runway 3-21 at

GCN. Future planning considers constructing blast pads as shown on **Exhibit 5D**. A 200-foot by 200-foot blast pad is planned for each end of Runway 3-21 in order to adhere to ultimate design standards.

TAXIWAY DESIGN

Taxiway design has historically followed the critical aircraft utilizing the runway and taxiway system. Common design issues have included parallel taxiway separation from the runway, taxiway width, and overall system efficiency. FAA AC 150/5300-13A, Change 1, *Airport Design*, instituted new design standards for taxiways, some of which impact planning for GCN. Most of the new or updated standards were enacted to mitigate the potential for runway incursion events. Changes were also aimed at improving pilot situational awareness. The FAA has indicated that all airfields should be planned to meet these standards. Actual changes will be made over time as grant funding is made available.

GCN is served by a taxiway system which includes a full-length parallel taxiway and six entrance/exit taxiways serving Runway 3-21. While the existing taxiway system meets certain standards outlined in the AC, there are some issues that should be addressed. The following are the taxiway geometry concerns on the airfield:

- Taxiways A, B, and C provide direct access to the runway system from an aircraft parking apron.
- Taxiway D is not aligned at a 90-degree angle to the runway.

Indirect Access

A new taxiway design standard put into place under AC 150/5300-13A, Change 1, is the prohibition of direct access between an aircraft parking area and a runway. At GCN, Taxiways A, B, and C extend west of the aircraft parking apron and offer a direct pavement connection to Runway 3-21. Taxiway routing markings are not considered sufficient per FAA guidance. As such, the FAA recommends constructing "No Taxi Islands" or removing the taxiways and replacing them in a location that does not provide direct access.

"No Taxi Islands" can be developed using markings around the island, green paint to identify the island, and lighting around the island; or, the islands can be developed by removing the pavement altogether. Either option will present an obstruction which will require a pilot to navigate a turn prior to entering a runway environment. The FAA has found that requiring a turn prior to entering a runway can minimize runway incursion events. **Exhibit 5D** depicts the general location of the "No Taxi Islands" in order to prevent direct access from the parking apron to the runways.

Right-Angle Intersection

All taxiways connecting the runway and parallel taxiway system currently provide right-angle intersections on Runway 3-21 except for Taxiway D. Right-angle intersections are the standard runway/taxiway intersection, except when there is a need for a high-speed taxiway exit to accommodate airfield capacity demand. Right-angle taxiways provide the best visual perspective for a pilot to observe local aircraft traffic in both directions.

In the case of Taxiway D, it serves as a high-speed exit taxiway located approximately 3,500 feet from the Runway 21 landing threshold. According to airport traffic control tower (ATCT) personnel, Runway 21 is utilized approximately 70 percent of the time at GCN. As such, many of the aircraft associated with air tour operations are able to utilize Taxiway D as a high-speed exit, which further enhances the capacity of the airfield. As a result, it is recommended that Taxiway D remain in its current configuration.

Hot Spot

As detailed in Chapter Four, the FAA has identified a "hot spot" at the north end of the runway/taxiway system that is associated with the configuration of Taxiways A and B. It is further defined by the FAA as follows:

- Hot Spot 1: Pilots sometimes confuse Taxiway A and Taxiway B at the Runway 21 end because of the close proximity. Verify correct taxiway route.

The FAA puts emphasis on improving designated Hot Spots on airfields. The alternatives analysis to follow will identify opportunities to improve this Hot Spot solution.

VISUAL APPROACH AIDS

Certain approach aids provide information to pilots to indicate if they are on the correct glide path to the runway for landing. Visual approach aids are typically provided for instrument-capable runway ends that do not already have an approach lighting system.

A precision approach path indicator (PAPI) system is commonly installed to enhance safety by providing pilots with visual guidance information during landings to the runway. As depicted on **Exhibit 5D**, future planning considers the implementation of a four-box PAPI system on Runway 3. The PAPI must be sited and aimed so it defines an approach path with sufficient clearance over obstacles and minimum threshold crossing heights. A four-box visual approach slope indicator (VASI-4) that historically served Runway 21 has been replaced with a PAPI-4. VASI-4s are considered obsolete by the FAA and should be replaced by a PAPI system once it reaches the end of its useful life.

Runway end identification lights (REILs) should be considered for all lighted runway ends not planned for a more sophisticated approach lighting system. A REIL system currently exists at the Runway 21 threshold. In the past, a medium intensity approach lighting system (MALS) served Runway 3; however, the MALS was recently decommissioned and is no longer in use at GCN. As a result, facility planning considers the implementation of REILs on the end of Runway 3.

HOLD POSITION MARKINGS

The hold position markings associated with Taxiways A, B, C, D, E, F, and G have been recently relocated to 318 feet from the runway centerline, which meets RDC C-III standards when considering the elevation of the airfield. The relocated hold lines have been depicted on **Exhibit 5D**.

AIRSIDE ALTERNATIVES

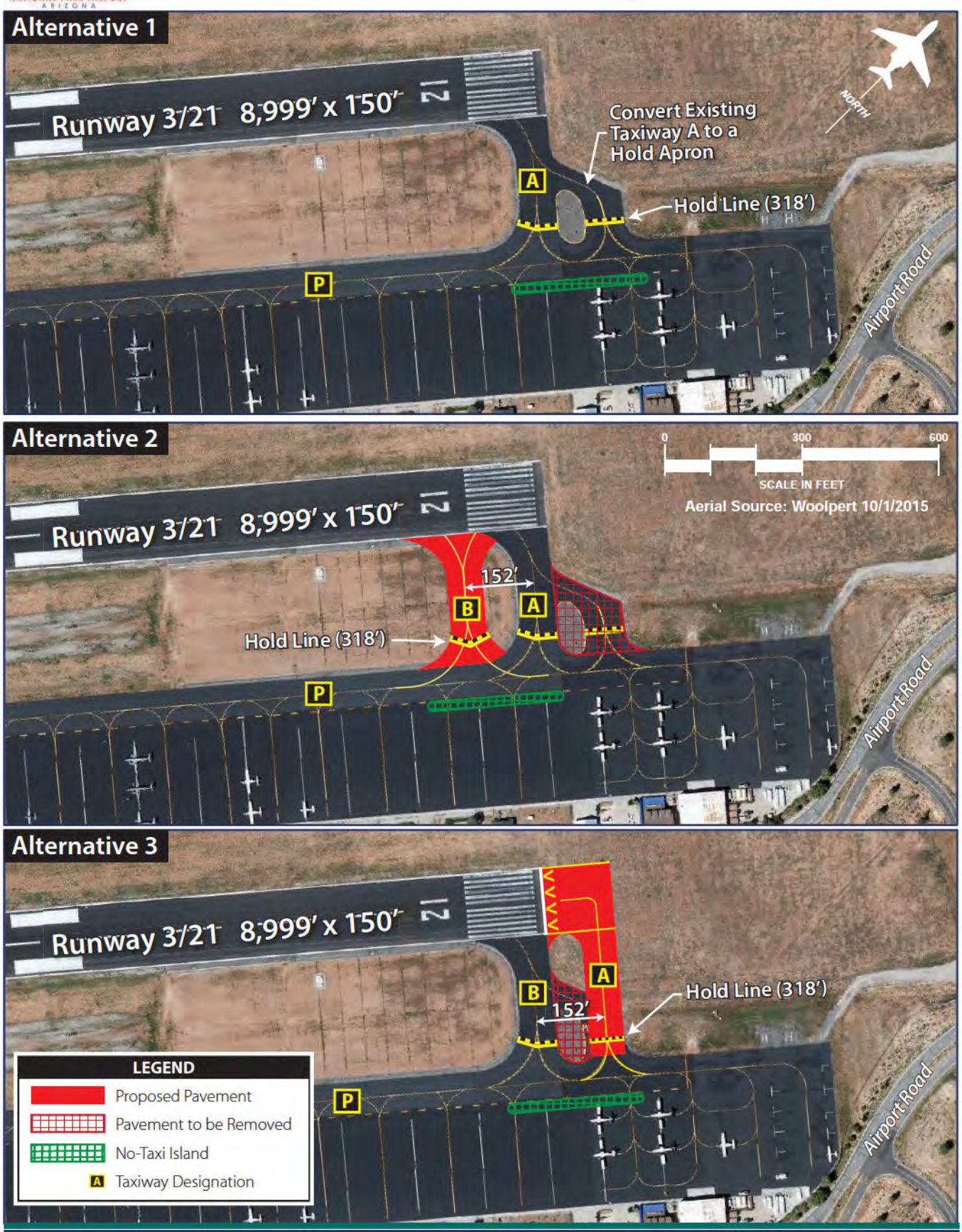
The following section describes alternatives as they relate to airside considerations previously discussed. The first set of alternatives relates to the FAA-identified Hot Spot on the airfield. The second set of alternatives deals with the approach and departure RPZs beyond the north end of the runway and details the impacts that would result from removing the RPZs from incompatible land uses. The final set of airside alternatives analyze a proposed runway extension as called for on Runway 3-21. Also considered with this set of alternatives are options for addressing the safety area issues beyond the north end of the runway.

HOT SPOT MITIGATION ANALYSIS

As previously discussed, there is a Hot Spot location on the airfield associated with the close proximity of Taxiways A and B. The objective of this analysis is to identify opportunities to improve the Hot Spot if a viable solution is available.

Hot Spot Mitigation – Alternative 1

Alternative 1 at the top of **Exhibit 5E** converts existing Taxiway A into a hold apron. In doing so, existing Taxiway B could be re-designated as Taxiway A. Traditional hold aprons would require filling in the pavement between the existing taxiways; however, the FAA now dictates distinct taxiway lanes be implemented for hold aprons. As depicted, the hold lines which have recently been relocated to 318 feet from the runway centerline limit the functionality of the proposed hold apron due to the amount of space available for aircraft between the hold line and parallel Taxiway P.


Alternative 1
Runway 3/21 8,999′ x 150′
21
Convert Existing Taxiway A to a Hold Apron
NORTH
A
Hold Line (318′)
P
Airport Road
Alternative 2
0
300
600
SCALE IN FEET
Aerial Source: Woolpert 10/1/2015
Runway 3/21 8,999′ x 150′
21
152′
B
A
Hold Line (318′)
P
Airport Road
Alternative 3
Runway 3/21 8,999′ x 150′
21
A
B
152′
Hold Line (318′)
P
Airport Road
LEGEND
Proposed Pavement
Pavement to be Removed
No-Taxi Island
A Taxiway Designation

Hot Spot Mitigation – Alternative 2

Exhibit 5E also presents Alternative 2, which calls for the removal of existing Taxiway A and replacing it with a by-pass taxiway adjacent to the south side of existing Taxiway B. As a result, it is recommended that the taxiways be re-designated as Taxiway A and Taxiway B as one moves from north to south.

The new taxiway would serve as a separate entrance/exit taxiway to Runway 3-21. As proposed, the taxiways would be separated by 152 feet (centerline to centerline), which meets taxiway separation standards for ADG III design.

Hot Spot Mitigation – Alternative 3

Alternative 3 depicted at the bottom of **Exhibit 5E** calls for the separation of the two taxiways by extending Taxiway A to Runway 3-21. In doing so, 150 feet of additional taxiway pavement would be needed leading to the Runway 21 threshold to allow for proper separation of Taxiways A and B. Under this scenario, Taxiway A would be considered a lead-in taxiway, which the FAA typically does not support.

Hot Spot Mitigation Summary

It is evident that there is no one alternative that best alleviates the Hot Spot issue associated with the close proximity of Taxiways A and B in the north area of the airfield. While each of the three alternatives presented have certain advantages to being implemented, each one also creates new challenges related to overall airfield design and implementation.

Alternative 1 would eliminate the confusion of the close proximity of Taxiway A and B by converting Taxiway A into a hold apron. In doing so, aircraft could utilize the hold apron as an area to prepare for departure and/or by-pass other aircraft that are ready to enter the runway system. This is similar to the current functionality of existing Taxiway A. This alternative does not, however, provide a designated hold apron configuration that is preferred by the FAA as it would be located within the ROFA. A preferred configuration would be to locate the hold apron adjacent to the east side of parallel Taxiway P, similar to the existing hold apron located on the south side of the airfield. This is not feasible due to the main aircraft parking apron being situated adjacent to the east side of the parallel taxiway in this area. Furthermore, the location of the hold line markings limit a large portion of the proposed hold apron from being used for anything other than aircraft transitioning to Taxiway A in order to enter the runway system.

The removal of one taxiway in Alternative 1 could necessitate the re-designation of entrance/exit taxiways farther south in order to maintain continuity with preferred airfield signage standards. Although this would incur additional costs, the overall cost of this alternative would be less expensive when compared to the amount of additional pavement needed in Alternatives 2 and 3.

Alternative 2 would allow for two separate entrance/exit taxiways serving Runway 3-21 by removing existing Taxiway A and replacing it with a new taxiway immediately south of existing Taxiway B. In still having two designated taxiways, the existing entrance/exit taxiways farther south would not need to be re-designated. The disadvantage of this alternative is that the entrance of Taxiways A and B from parallel Taxiway P are still in close proximity to one another and could continue to cause confusion for pilots desiring to enter the runway system from the parallel taxiway. In addition, the cost of this alternative would be greater than Alternative 1 due to the construction of an entirely new taxiway, plus the removal of existing Taxiway A.

Alternative 3 is similar to Alternative 2 in that it provides two separate entrance/exit taxiways connecting the runway and parallel taxiway. Under this alternative; however, Taxiway A would be extended to Runway 3-21, requiring a need for 150 feet of additional taxiway pavement leading to the Runway 21 threshold. As previously discussed, this lead-in taxiway scenario is not preferred by the FAA. This alternative would also be the most expensive due to the construction costs associated with site preparation and pavement for the new taxiway leading to the Runway 21 threshold.

It is important to note that the Hot Spot issue has been discussed with GCN ATCT personnel during the preparation of the Master Plan in order to gain further insight as to the importance of Taxiway A and B serving the runway system. According to ATCT personnel, the existence of the two taxiways is important to the overall capacity and efficiency of the airfield network. At any given time, multiple aircraft associated with air tour operations needing to utilize Runway 21 for departure benefit from being able to stage themselves and prepare for takeoff on separate taxiways at the departure end of Runway 21. As such, it is important to maintain an area to accommodate the staging and takeoff preparation of multiple aircraft. ATCT personnel went on to indicate a preference to maintain the layout of Taxiways A and B as they currently exist.

No-Development Alternative

The potential Hot Spot mitigation should also consider the no-development alternative. Based on discussions with the ATCT, the existing layout of Taxiways A and B should be maintained and personnel will continue to carefully advise aircraft taxiing in this area. While proper planning considers the mitigation alternatives discussed previously, the actual reconfiguration of the taxiways should be undertaken only if directed by the FAA.

APPROACH AND DEPARTURE RPZ ANALYSIS

As previously discussed, all runway ends have two RPZs: an approach RPZ and a departure RPZ. At GCN, the approach and departure RPZs serving the north end of Runway 3-21 are co-located. Current FAA design standards call for an airport to provide positive land use control over the land within the RPZ. This is currently the case at GCN, as the RPZs on each end of Runway 3-21 are fully contained on airport

property. Furthermore, the FAA provides guidance on minimizing incompatible land uses within the RPZs, to include residences, businesses, and public roadways.

As previously detailed, the approach and departure RPZs beyond the north end of Runway 3-21 contain incompatibilities that include a portion of the building and vehicle parking lot associated with Papillon Helicopters as well as a portion of Airport Road. In order to completely clear the RPZs of these incompatibilities, the recommended option would be to relocate the incompatible land uses outside the RPZs. While an option, the cost of relocating portions of Airport Road as well as the Papillon Helicopter air tour facility would be substantial. Furthermore, the logistics of relocating the road and landside infrastructure would be practically impossible given the limited amount of accommodating airport property in the vicinity. While this remains an option, it is very likely that the FAA would not support the costs to do so, and the costs would likely exceed the ability of ADOT to undertake these projects without federal funding assistance.

Another option to meeting RPZ standards beyond the north end of Runway 3-21 would be to modify the existing runway environment so as to move the RPZs off the incompatible land uses. This can be done in two ways. The first would be to simply reduce the runway length. This option would then shift the RPZs in relation to the amount of runway reduced. As previously noted, the Airport should at least maintain and possibly achieve greater runway length in the future, not less. Reducing the runway pavement would impact both landings in one direction and takeoffs in the other. As a result, this option is not preferred and should be avoided if possible. A second option is to allow the runway pavement to remain intact but instead limit operational runway length through the displacement of the landing threshold. The following alternatives further detail these options.

It is important to reiterate that the FAA can allow for RPZ conditions to be grandfathered as long as there are no actions or events being proposed to the runway environment that would alter the RPZs. These actions or events could include a runway extension, a change in the critical design aircraft that increases the RPZ dimensions, a new or revised instrument approach procedure that increases the size of the RPZ, and/or a local development proposal in the RPZ. This Master Plan is not proposing any of these actions or events beyond the north end of Runway 3-21 that would alter the approach or departure RPZ. While no further action may be needed regarding the RPZ issue beyond the north end of the runway, a planning study such as this is still tasked with examining options to improve safety areas when practicable.

Approach and Departure RPZ – Alternative 1

Alternative 1 on **Exhibit 5F** shifts the approach and departure RPZs to the south in order to be clear of Airport Road. In doing so, the facilities associated with Papillon Helicopters would also be removed from within the RPZs. Since the existing approach and departure RPZs begin 200 feet from the physical end of the runway pavement, this alternative would require displacing the Runway 21 threshold by 1,210 feet. According to AC 150/5300-13A, Change 1, a runway's threshold is located to provide proper clearance for landing aircraft over existing obstacles while on approach to landing. Runway thresholds can be displaced to provide:

1) A means for obtaining RSA prior to the threshold;
2) A means for obtaining additional ROFA prior to the threshold;
3) A means for locating the RPZ to mitigate unacceptable incompatible land uses; and
4) Mitigation of environmental impacts.

With this proposed displaced threshold, only 7,789 feet of runway length would be available for aircraft landing on Runway 21. For aircraft departing on Runway 3, the amount of length declared available for takeoff run would also be decreased to 7,789 feet to account for the relocated departure RPZ. Further discussion related to these distances declared available for takeoff and landing will be addressed in the runway extension alternatives analysis.

While Alternative 1 would remove the approach and departure RPZs from incompatibilities as previously discussed, it would introduce new incompatibilities on the east side of the Airport to include the two designated helicopter landing areas and a portion of the main aircraft parking apron. The FAA also discourages these facilities from being located within the RPZs.

Approach and Departure RPZ – Alternative 2

Exhibit 5F also presents Alternative 2 in dealing with the approach and departure RPZs beyond the north end of Runway 3-21. The goal of this alternative would be to relocate the RPZ off the development associated with the Papillon Helicopters air tour facility. As depicted, the RPZs would need to be shifted a minimum of 910 feet south so as to remain clear of the Papillon Helicopters parking lot farther north. In doing so, the Runway 21 threshold would be displaced 910 feet, providing for a landing distance of 8,089 feet. Likewise, certain aspects of takeoff distance declared available for departures on Runway 3 would similarly be affected as the takeoff runway would be limited to 8,089 feet in order to account for the departure RPZ.

In this alternative, Airport Road would still remain within the approach and departure RPZs. Alternative 2 would also introduce the helicopter landing areas and a portion of the main aircraft parking apron into the relocated RPZs, but not to the extent as in Alternative 1.

Approach and Departure RPZ Summary

It is evident from this evaluation that GCN cannot fully meet the approach and departure RPZ standards beyond the north end of Runway 3-21 without substantial and costly improvements. In Alternative 1, the relocation of the RPZs would not be feasible as the decrease in effective runway distance would significantly impact certain segments of aviation demand, particularly larger turbine aircraft. Furthermore, this alternative does not fully mitigate the incompatibilities within the RPZs since shifting them to the south would introduce aircraft and helicopter parking areas associated with the main parking apron at the Airport.

Alternative 1

Alternative 2

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Alternative 2 helps to decrease the incompatibilities within the approach and departure RPZs by removing them from the development associated with Papillon Helicopters. This would require a 910-foot displacement on Runway 21. While this would also decrease the amount of runway length available, it still does not fully mitigate the RPZ deficiencies, as a portion of Airport Road would still remain in the outer portion of the RPZ. The FAA may allow the roadway to remain within the RPZ since it is an existing condition. In addition, a portion of the aircraft parking apron and helicopter landing areas would be included in the shifted RPZs.

It should be noted that since these alternatives call for a change to the runway environment (i.e., displaced threshold as a result of the relocated approach RPZ), the Airport would need to coordinate this modification with the FAA's proper lines of business (including APP-400) to get an official approval on the relocation of the RPZ as proposed.

No-Development Alternative

It is also important to consider the no-development alternative when dealing with the RPZ analysis. Under this alternative, the approach and departure RPZs would remain in their current location. As detailed earlier in the Master Plan, existing incompatibilities may be grandfathered under certain conditions as long as there are no proposed changes to the runway and/or RPZ environment. Similar to the Hot Spot mitigation, the future disposition of the approach and departure RPZs beyond the north end of Runway 3-21 at GCN will need further coordination with the FAA prior to any implementation measures.

RUNWAY 3-21 EXTENSION ANALYSIS

As previously discussed, the 2005 Master Plan and currently approved ALP propose a 1,001-foot southerly extension on Runway 3-21. Since that time, updated FAA design standards have provided additional guidance that can affect the future implementation of a potential runway extension at GCN.

The exhibits to follow analyze two separate runway extension alternatives. The first alternative depicts the extension as called for in the previous Master Plan and on the existing ALP. The second alternative applies FAA guidance to properly meet safety design standards associated with the proposed extension.

Runway 3-21 Extension – Alternative 1

Alternative 1, depicted on **Exhibit 5G**, considers the 1,001-foot southerly extension on Runway 3-21, achieving an overall usable pavement length of 10,000 feet. The proposed RSA and ROFA would extend farther south and encompass the majority of the existing freshwater pond beyond the south end of the runway known as Rain Tank. In order to satisfy these safety standards, Rain Tank would need to be properly filled and graded.

The extension would necessitate the relocation of the glideslope antenna associated with the instrument landing system (ILS) approach to Runway 3. According to the FAA, glideslope antennas can be sited between 750 feet and 1,250 feet from a runway threshold. The proposed 1,001-foot extension in this alternative would shift the runway threshold approximately 2,000 feet from the existing glideslope antenna, thus necessitating its relocation. The perimeter access road would need to be re-routed around the shifted RSA on the south side of the runway. As a result of the proposed extension, the approach and departure RPZs would extend farther south but still remain on airport property. Finally, Alternative 1 includes the construction of blast pads serving each runway end as previously recommended.

The RSA and ROFA design issues at the north end of the runway are not fully mitigated in this alternative. Under this scenario, it is assumed that the FAA would allow the perimeter access road to remain in the RSA since it is internal to airport personnel and can only be accessed by permission from the ATCT. A Modification to Standard could be approved by the FAA for the non-standard conditions associated with the ROFA, including the existence of Airport Road as well as a retaining wall and associated fencing. Although not depicted, it is recommended that the helicopter landing areas located adjacent to the west edge of the main aircraft parking be relocated outside the ROFA.

Runway 3-21 Extension – Alternative 2

As presented on **Exhibit 5H**, Alternative 2 includes a 1,001-foot southerly extension to Runway 3-21 and proposes the use of declared distances in order to mitigate RSA and ROFA deficiencies. Declared distances are the effective runway length the airport operator declares available for takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements. Pilots utilize these measurements in their runway length calculations. The four declared distances are defined as the following:

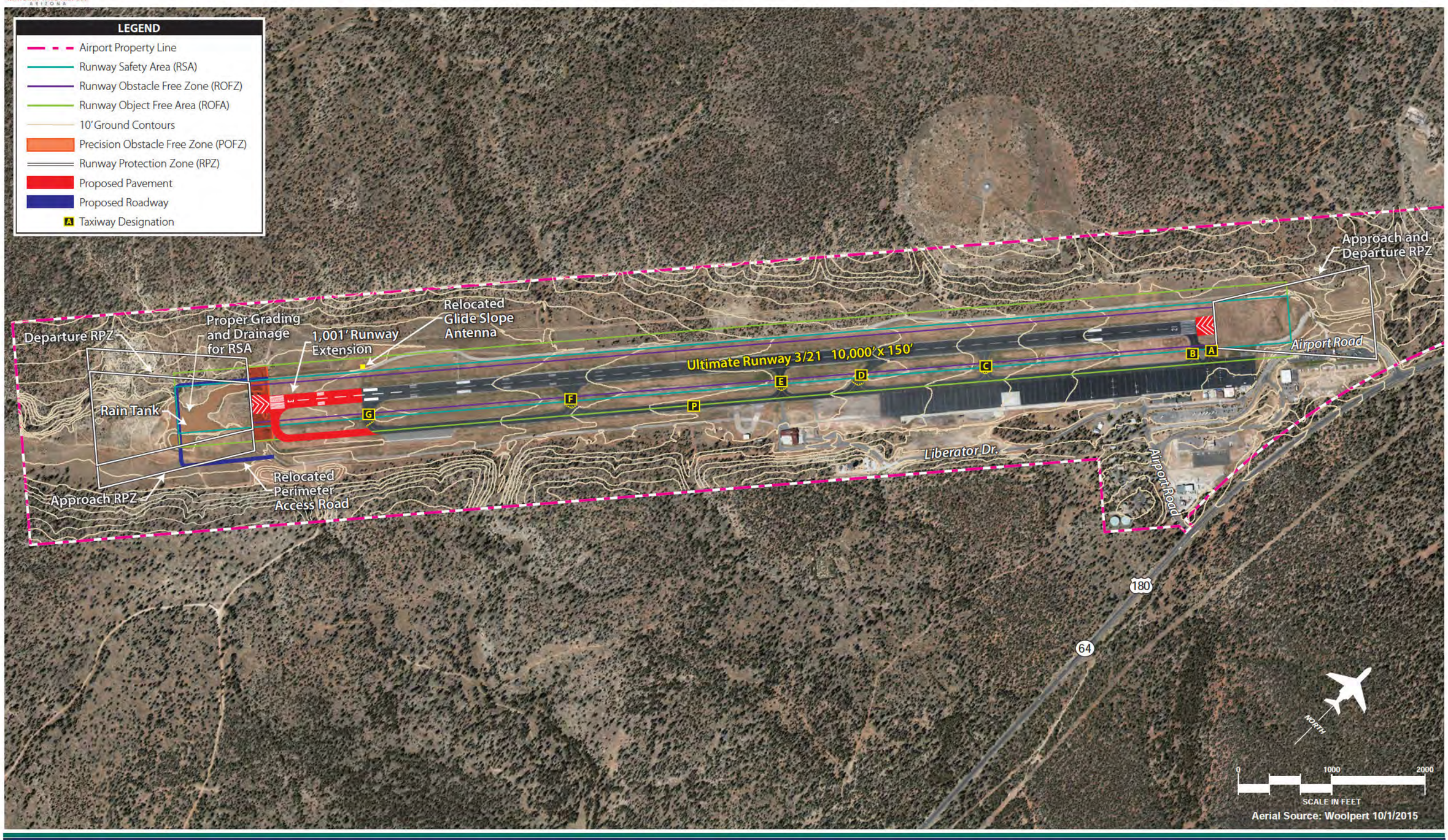
Takeoff run available (TORA) - The length of the runway declared available and suitable to accelerate from brake release to lift-off, plus safety factors.

Takeoff distance available (TODA) - The TORA plus the length of any remaining runway or clearway beyond the far end of the TORA available to accelerate from brake release past lift-off, to start of takeoff climb, plus safety factors.

Accelerate-stop distance available (ASDA) - The length of the runway plus stopway declared available and suitable to accelerate from brake release to take-off decision speed, and then decelerate to a stop, plus safety factors.

Landing distance available (LDA) - The distance from the threshold to complete the approach, touchdown, and decelerate to a stop, plus safety factors.

The TORA and TODA apply to takeoff, the ASDA applies to a rejected takeoff, and LDA applies to landing. Declared distances may be used to obtain additional RSA and/or ROFA prior to a runway's threshold and/or beyond the stop end of the runway, to mitigate unacceptable incompatible land uses in the RPZ,


LEGEND
Airport Property Line
Runway Safety Area (RSA)
Runway Obstacle Free Zone (ROFZ)
Runway Object Free Area (ROFA)
10' Ground Contours
Precision Obstacle Free Zone (POFZ)
Runway Protection Zone (RPZ)
Proposed Pavement
Proposed Roadway
A Taxiway Designation
Departure RPZ
Proper Grading and Drainage for RSA
1,001' Runway Extension
Relocated Glide Slope Antenna
Ultimate Runway 3/21 10,000' x 150'
Approach and Departure RPZ
Airport Road
Rain Tank
Approach RPZ
Relocated Perimeter Access Road
Liberator Dr.
Airport Road
180
64
NORTH
0
1000
2000
SCALE IN FEET
Aerial Source: Woolpert 10/1/2015

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- Airport Property Line
- Runway Safety Area (RSA)
- Runway Obstacle Free Zone (ROFZ)
- Runway Object Free Area (ROFA)
- 10' Ground Contours
- Precision Obstacle Free Zone (POFZ)
- Runway Protection Zone (RPZ)
- Proposed Pavement
- Proposed Roadway
- Pavement to be Removed
- A Taxiway Designation

NORTH

0 1000 2000
SCALE IN FEET

Aerial Source: Woolpert 10/1/2015

TORA/TODA - 10,000'
ASDA/LDA - 9,714'

Departure RPZ
Proper Grading and Drainage for RSA
1,001' Runway Extension
Rain Tank
Approach RPZ
Relocated Perimeter Access Road
Ultimate Runway 3/21 10,000' x 150'
TORA/TODA/ASDA/LDA – 10,000'
Approach and Departure RPZ
Airport Road
Lakeview Dr

DECLARED DISTANCES		
Category	Runway 3	Runway 21
TORA	10,000'	10,000'
TODA	10,000'	10,000'
ASDA	9,714'	10,000'
LDA	9,714'	10,000'

KEY
ASDA - Accelarate-Stop Distance Available
LDA - Landing Distance Available
TODA - Takeoff Distance Available
TORA - Take Off Run Available

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to meet runway approach and/or departure surface clearance requirements, or to mitigate environmental impacts. Declared distances may also be used as an incremental improvement technique when it is not practical to fully meet these requirements. Declared distances may only be used for these purposes when it is impracticable to meet the airport design standards or to mitigate environmental impacts by other means, and the use of declared distances is practicable.

The TORA and TODA are often equal to the actual runway length. The TORA may be reduced in order to resolve incompatible land uses in the departure RPZ and/or to mitigate environmental effects. The TORA can never be longer than the TODA. The TODA may be limited from extending to the runway end in order to mitigate penetrations to the 40:1 instrument departure surface (when applicable). The TODA may also extend beyond the runway end through the use of a published clearway. A clearway is a defined area beyond the end of a runway that is cleared and suitable for use in lieu of runway to satisfy takeoff distance requirements. There is no clearway designated beyond either end of the runway at GCN.

The ASDA and the LDA are the primary considerations in determining the runway length available for use by aircraft, as these calculations must consider providing the full RSA and ROFA to standard in operational calculations. The ASDA and LDA can be figured as the usable portions of the runway length less the distance required to maintain adequate safety areas beyond the ends of the runway or prior to the landing threshold. By regulation, a full 1,000 feet of RSA and ROFA must be available at the far end of a departure operation in the ASDA calculation. For LDA calculations, 600 feet of RSA and ROFA is required prior to the landing threshold, and 1,000 feet of RSA and ROFA is required beyond the far end of the landing operation.

With the 1,001-foot extension proposed in Alternative 2, the TORA and TODA would increase to 10,000 feet for Runway 3. In order to gain the full use of runway pavement in the TORA calculation, the assumption made is that Airport Road and the development associated with Papillon Helicopters are allowed to remain in the departure RPZ beyond the north end of the runway. The ASDA and LDA would decrease to 9,714 feet to account for the overriding ROFA deficiency that exists beyond the north end of the runway. In order to fully mitigate the safety area deficiencies, this alternative does include relocating the helicopter landing areas outside the ROFA and realigning a portion of the perimeter access road outside the RSA.

For Runway 21, the TORA, TODA, ASDA, and LDA are all calculated at 10,000 feet. Under this scenario, the assumption is made that Airport Road and the Papillon Helicopter air tour facility are allowed to remain within the approach RPZ serving Runway 21. Similar to Alternative 1, this alternative considers fully meeting safety area standards beyond the south end of the proposed runway extension, to include proper grading and drainage of the RSA. Also included is the relocation of the glideslope antenna associated with the ILS approach serving Runway 3 as well as the implementation of blast pads serving each runway end.

Runway 3-21 Extension Summary

The previous runway extension alternatives considered methods which attempt to provide additional runway length, while also attempting to meet FAA airport safety design criteria to the extent practicable. **Table 5B** further outlines the runway lengths declared available with the two separate runway extension alternatives being proposed.

TABLE 5B
Proposed Runway Length Scenarios
Grand Canyon National Park Airport

	Runway	
Alternative 1 (as shown on Exhibit 5G)	**3**	**21**
Takeoff Run Available (TORA)	10,000	10,000
Takeoff Distance Available (TODA)	10,000	10,000
Accelerate-Stop Distance Available (ASDA)	10,000	10,000
Landing Distance Available (LDA)	10,000	10,000
Alternative 2 (as shown on Exhibit 5H)	**3**	**21**
Takeoff Run Available (TORA)	10,000	10,000
Takeoff Distance Available (TODA)	10,000	10,000
Accelerate-Stop Distance Available (ASDA)	9,714	10,000
Landing Distance Available (LDA)	9,714	10,000

Source: Coffman Associates analysis

Any capital expenditures required to meet the needs of aircraft utilizing GCN will require specific justification. The FAA typically stipulates that if a runway extension is planned, documentation of 500 annual itinerant operations of the design aircraft will be required.

There are several methods to track aircraft activity. The FAA has made available a comprehensive database called the Traffic Flow Management System Counts (TFMSC). There are also several user subscription services, such as *Airport IQ* and *Flight Aware*, which offer similar services. The Airport's fixed base operator (FBO) can also track individual activity by business jets. This would be recommended as some aircraft operating under visual flight rules (VFR) may not be documented in the FAA database. Finally, letters from operators addressing their runway needs can provide documentation for justification of FAA support.

Environmental Factors

Implementation of the runway extension alternatives could result in significant environmental impacts. Rain Tank, located south of the runway, would need to be filled in and the area graded to FAA standards for RSA and ROFA. Rain Tank is an identified Freshwater Pond on the National Wetland Inventory. It may also be a ground water recharge area. It has the potential to provide habitat for aquatic-dependent species, including the northern Mexican gartersnake, which is listed as Threatened in the federal *Endangered Species Act*. As a jurisdictional "water of the U.S.," it and its associated wetlands are protected by

the *Clean Water Act* (Section 404), Executive Order 11990, *Protection of Wetlands*, and Department of Transportation (DOT) Order 5660.1A, *Preservation of the Nation's Wetlands.*

Grading and the placement of fill within Rain Tank and associated wetland habitat would not only require a permit from the United States Army Corps of Engineers, but mitigation would include the creation of wetlands elsewhere to ensure that "no net loss" of wetland habitat occurs. Consultation with the Arizona Game and Fish Department under the *Fish and Wildlife Coordination Act* is also likely to be needed. Measures to ensure that water quality impacts to downstream water resources would also be required (*Clean Water Act*, Section 401). Other potential biological impacts that could occur as a result of the conversion of Rain Tank are impacts to birds protected under the *Migratory Bird Treaty Act*.

In addition to the biological and water-related impacts of converting Rain Tank, there are also cultural and historical considerations. The use of Rain Tank has been documented in several ethnohistories of the Havasupai Tribe as a natural perennial (or possibly man-made) water source that has been used for generations by various Native American peoples. Trails led from Rain Tank in several directions connecting to such destinations as Red Butte, Long Jim Canyon, and the south rim of the Grand Canyon. As such, evaluation of the implications of changing the traditional use of the Rain Tank area would likely be necessary.

Preliminary Cost Estimates

Undertaking either of the proposed runway extension alternatives would also incur significant development costs. **Table 5C** provides a breakdown of preliminary costs associated with the runway extensions as previously discussed. These preliminary cost estimates take into account site preparation requirements for the runway and taxiway extensions; runway and taxiway construction; relocation of navigational aids (glideslope antenna); additional lighting, marking, and signage; the ability to meet safety design standards; environmental clearance requirements; and design, construction and contingency costs. It is important to note that costs presented here should be viewed only as estimates subject to further refinement during actual design and construction.

TABLE 5C
Runway Extension Alternatives Probable Construction Cost Range
Grand Canyon National Park Airport

Project Description	Cost Estimate Range
Site Preparation	$5.0 million - $5.5 million
Runway/Taxiway Construction	$1.5 million - $2.0 million
Relocate Navigational Aids (Glideslope Antenna)	$750,000 - $1.0 million
Airfield Safety Standards	$75,000 - $100,000
Lighting, Marking, and Signage	$175,000 - $200,000
Environmental Documentation	$500,000 - $1.0 million
Design, Engineering, Contingencies	$2.5 million - $3.0 million
Total Project Cost Estimate	**$10.5 million - $12.8 million**

Source: Coffman Associates analysis

No-Development Alternative

As with previous alternatives analyses, the no-development alternative can also be considered as it relates to a potential runway extension at GCN. Under this scenario, the existing runway length would be maintained regardless of whether or not a justified need warrants the potential extension on Runway 3-21 in the future. ADOT and Airport staff should continue to monitor aircraft activity in order to make sure the facility is meeting the needs of aviation demand both now and in the future. It is important to note that if the FAA directs the Airport to address safety area issues as previously discussed in this chapter, doing so could decrease the utilization of Runway 3-21 associated with the no-development alternative.

PRELIMINARY OBSTRUCTION ANALYSIS

A key priority which needs to be considered is protecting the Airport from the potential for flight obstructions. The FAA has established criteria aimed at protecting airports from these flight obstructions. First, FAA criterion stipulates that obstructions not be placed too near the runway ends or parallel to the runway. The obstruction clearance requirements are based on the critical aircraft, as well as the type of approaches established or planned for an airport. For visual approaches and/or approaches not lower than one-mile visibility, minimum obstruction clearance is required. For RDC C-II/III aircraft with approach minimums lower than one-mile visibility, however, the obstruction criterion is more protective.

The two primary resources for determining airspace obstructions are Title 14 Code of Federal Regulations (CFR) Part 77, *Objects Affecting Navigable Airspace* and *Terminal Instrument Procedures* (TERPS). Part 77 is more of a filter which identifies potential obstructions, whereas TERPS is the critical tool in determining actual flight obstructions and is used to evaluate and develop instrument approach procedures including visibility minimums and cloud heights associated with approved approaches.

The first step in identifying potential airspace obstructions is the evaluation of the appropriate Part 77 and threshold siting surfaces (TSS). TSS is an imaginary surface which represents the most critical approach area nearest the runway end. The associated TSS size and slope angle is defined by the visibility minimums of the approach and aircraft type utilizing the approach. The departure surface is another consideration which should be analyzed. In some cases, the departure surface beyond the far end of the runway can be the critical factor in establishing the minimums for the approach end of the runway. This is due to the need to have a cleared area for the missed approach procedure.

Exhibit 5J presents the preliminary obstruction analysis that examines the Part 77 approach and transitional surfaces, TSS, and departure surfaces based upon the existing approaches serving each end of Runway 3-21 at GCN. As detailed, the majority of airport property is currently clear of these surfaces except for an area on the west side of the Airport between Runway 3-21 and the Grand Canyon VOR/DME. This area serves as a penetration to the Part 77 transitional surface due to the rise in terrain.

LEGEND

- Property Line
- **Clearance to Surface**
  - Penetrates more than 10 ft
  - Penetrates less than 10 ft
  - Clear 0 - 25 ft
  - Clear 26 - 50 ft
  - Clear 51 - 75 ft
  - Clear 76 - 100 ft
  - Clear 100 - 125 ft
  - Clear 126 - 144 ft
- Primary Surface

Height Clearance Between the Ground and the Controlling Airspace Surface

Runway 3/21 8,999' x 150'

Shaded areas represent clearance between the ground and the controlling surface. Blue shaded areas are clear while red and orange areas penetrate the surface.

NORTH

0 1,200 2,400

SCALE IN FEET

Source: Woolpert 10/1/2015

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Property beyond the approach and departure ends of Runway 3-21 as well as property that currently accommodates landside development on the east side of the Airport remains clear of the Part 77 and TERPS surfaces being analyzed. This is important not only from the standpoint of approach protection, but also in evaluating future landside development potential that could occur in different areas on the Airport, which is analyzed in the next section of this chapter.

ANALYSIS OF LANDSIDE DEVELOPMENT CONSIDERATIONS

Generally, landside issues are related to those facilities necessary, or desired, for the safe and efficient parking and storage of aircraft, movement of pilots and passengers to and from aircraft, airport support facilities, and overall revenue support functions. Landside planning considerations, summarized previously on **Exhibit 5C**, will focus on strategies following a philosophy of separating activity levels. To maximize airport efficiency, it is important to locate facilities together that are intended to serve similar functions. The best approach to landside facility planning is to consider the development to be like that of a community where land use planning is the guide. For airports, the land use guide in the terminal area should generally be dictated by aviation activity levels. Due to the layout and availability of land available at GCN, consideration will also be given to non-aviation uses that can provide additional revenue support to the Airport.

AVIATION ACTIVITY LEVELS

The aviation development areas should be divided into high, medium, and low activity levels at an airport. The high activity area should be planned and developed to provide aviation services on the airport. An example of the high activity areas is the terminal building and adjoining aircraft parking apron, which provides tiedown locations and circulation for aircraft. In addition, hangars used for FBOs, flight departments, or storing a large number of aircraft would be considered a high activity use area. The best location for high activity areas is along the flight line near midfield, for ease of access to all areas on the airfield. All major utility infrastructure would need to be provided to these areas.

The medium activity use category defines the next level of airport use and primarily includes smaller aircraft that may desire their own executive hangar storage on the airport. The best location for medium activity use is off the immediate flight line, but still readily accessible to aircraft. Due to an airport's layout and other existing conditions, if this area is to be located along the flight line, it is best to keep it out of the midfield area of the airport, so as to not cause congestion with transient aircraft utilizing the airport. Parking and utilities, such as water and sewer, should also be provided in this area.

The low activity use category defines the area for storage of smaller single and multi-engine aircraft. Low activity users are personal or small business aircraft owners who prefer individual space in linear box hangars or T-hangars. Low activity areas should be located in less conspicuous areas. This use category will require electricity, but generally does not require water or sewer utilities.

In addition to the functional compatibility of the aviation development areas, the proposed development concept should provide a first-class appearance for GCN. As previously mentioned, the Airport serves as a very important link to the entire region. Consideration to aesthetics should be given high priority in all public areas, as the Airport can serve as the first impression a visitor may have of the community.

In order to allow for maximum development of the airport while keeping with mandated safety design standards, it is very important to devise a plan that allows for the orderly development of airport facilities. Typically, airports will reserve property adjacent to the runway system for aviation related activity exclusively. This will allow for the location of taxiways, aprons, and hangars.

PASSENGER TERMINAL BUILDING

A terminal building is often the first impression air travelers have of the area. A functional and attractive terminal facility can be needed to secure and build air travelers' favorable opinion of the surrounding area. Currently, a dedicated terminal building is offered at GCN as outlined in previous chapters. The facility encompasses approximately 8,500 square feet and is located adjacent to the east side of the main aircraft parking apron towards the north end of the airfield. It should be noted that the building also includes 3,500 square feet of enclosed tank and piping infrastructure attached to the north side of the building, bringing the total building footprint to 12,000 square feet.

As previously detailed, the existing terminal building at GCN was initially constructed in 1968 and expanded to its current footprint in 1972. At a minimum, the terminal building should be maintained and improved in the short term to meet the basic needs of air travelers utilizing the Airport. In order to meet projected passenger demands outlined in Chapter Two, a more aggressive approach would be to plan for a new and modern terminal building that can serve airline/air charter demands and a component of air tour operator activities while also serving the needs of airport administration and other support functions. As such, this planning effort should, at a minimum, identify opportunities for enhancing and/or constructing a new terminal building.

Existing Terminal Building

In order to accommodate the needs of existing and potential enhanced passenger service demands at GCN, an evaluation of the existing terminal building has been undertaken. Previous analysis in Chapter Four indicated that the existing layout of the facility does not provide adequate space and functionality to serve certain passenger service components. Furthermore, when the existing terminal building was built in 1968, less restrictive building codes were in place when compared to current code standards. It has been determined that major renovations would be required to the facility related to significant design and construction efforts in order to better meet the needs of existing and future demand as well as meeting updated International Building Code (IBC) risk category standards. These include heating, ven-

tilation, and air conditioning (HVAC) and electrical upgrades, windows, roof and wall insulation, and numerous Americans with Disabilities Act (ADA) upgrades. Partial asbestos abatement and hazardous material work has been undertaken in the past with more work potentially needed.

Detailed record drawings of the terminal building have not been located at this time, so additional information is needed to in order to determine what type of renovations would be needed to meet the IBC risk categories now in effect. It is important to note that new IBC updates that will be introduced in 2017 will require even more "whole structure upgrade elements" to bring the entire building up to applicable codes.

The following projects would need to be considered and possibly completed in order to meet the designated IBC risk category code updates for the existing terminal building to accommodate commercial passenger service functions or for the possible repurposing of the facility with less occupant load. The list includes:

- ADA upgrades to include restroom facilities and ramps to airfield/apron
- Door clearances and door hardware (lever sets/closers)
- Possible ADA ramp enclosure for ice buildup on ADA ramps at ramp side
- Bring ADA ramps into full code and ADA compliance at all grade changes inside and outside
- Seismic upgrades (primarily will include increased wall/roof bracing throughout the entire structure)
- Increased seismic zone criteria from original design and construction in mid 1960s
- Requirements for IBC Risk Category III or IV which will increase structural importance factor (engineering/architectural studies will need to be made of critical structural frame elements)
- Complete upgrade will be required for the roof diaphragm and ceiling upgrade repairs for wall/roof straps and metal connections for seismic resistance upgrades to the entire structural frame
- IECC Upgrades (International Energy Conservation Code)
- Electrical Lighting (LED)
- Increased wall/roof insulation
- Increased window/performance
- HVAC equipment inspections - possible replacement of certain HVAC equipment
- Extensive pump room and water storage tanks exist inside and outside this structure (need to determine electrical and mechanical plumbing electrical status in an emergency)
- Verify sound mitigation of pump room and large water storage tanks
- Consider water harvest elements and water storage
- Hazardous materials abatement
- Asbestos floor tile removal (follow-up report in all related details for compliance)
- Wood siding may have dry rot (inspections recommended)
- Asphalt shingle roof should be considered to be replaced with standing seam metal roof
- Fire sprinkler and fire alarm upgrades investigation for code compliance

It should also be noted that the existing terminal building has not been evaluated to determine if it has eligibility for protection under the National Historic Preservation Act. A detailed cost analysis and risk

matrix should be completed for items that are being considered to repurpose the existing terminal building at GCN. **Table 5D** provides a breakdown of preliminary costs associated with renovating the existing terminal building.

TABLE 5D
Probable Construction Cost Range to Renovate Existing Terminal Building and Support Infrastructure
Grand Canyon National Park Airport

Project Description	Cost Estimate Range
Extensive Renovations to Meet Code Requirements and Upgrade Facilities	$2.0 million - $4.0 million
Improve Parking, Bus Staging, and Rental Car Opportunities	$250,000 - $500,000
Investigations - Create Building and Site Engineering As-Built Drawings	$300,000 - $500,000
Water Harvesting Features on Existing Building	$300,000 - $500,000
Total Project Cost Estimate	**$2.85 million - $5.5 million**

Source: LEA Architects analysis

It is evident from the preliminary cost analysis that considerable expenses would be associated with renovating the existing terminal facility to meet updated building code requirements, as well as existing and projected aviation demand. Given the extensive interior and exterior functional and aesthetic improvements that would be needed, the landside alternatives to follow examine options for a new replacement terminal building at GCN.

Terminal Siting Considerations

FAA AC 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*, identifies a number of basic considerations that affect the location of a terminal building. The primary considerations include the following:

1. **Runway Configuration:** The terminal site should be located to minimize aircraft taxiing distances and active runway crossings.

2. **Airfield Access:** The terminal site should consider the layout of terminal aprons and access taxilanes or taxiways and apply recommended airfield design standards to reduce the probability of runway incursions.

3. **FAA Geometric Design Standards and Airspace:** The terminal location needs to assure adequate distance from present and future aircraft operational areas and remain clear of imaginary airspace surfaces.

4. **Access to Highway Network:** The terminal should be located to provide the most direct/shortest routing to the access transportation system.

5. **Expansion Potential:** The long term viability of the terminal is dependent upon the ability of the site to accommodate expansion of the terminal beyond forecast requirements.

6. **Existing and Planned Facilities:** The terminal site should consider the existing and planned locations of other airport facilities and equipment so as to not interfere with line-of-sight or other operational restrictions associated with these facilities.

7. **Terrain:** Topographical conditions and the site's relation to the areas prone to flooding should be considered in the selection of a terminal site.

The alternatives to follow consider constructing a new replacement terminal building that could meet the functionality needs in the event that enhanced scheduled airline/air charter service would take place at GCN in the future. Consideration in the alternatives analysis is given to a potential terminal location that best meets the criteria listed above while taking into account existing airport infrastructure investment and future development potential.

HANGAR DEVELOPMENT

Analysis in Chapter Four indicated that the Airport should plan for the construction of additional aircraft hangars over the next 20 years as demand dictates. Hangar development takes on a variety of sizes corresponding with several different intended uses.

Commercial general aviation activities are essential to providing the necessary services on an airport. This includes privately owned businesses involved with, but not limited to, aircraft rental and flight training, aircraft charters, aircraft maintenance, line service, and aircraft fueling. These types of operations are commonly referred to as FBOs or specialized aviation service operators (SASOs). The facilities associated with businesses such as these include conventional type hangars that hold several aircraft. High levels of activity often characterize these operations, with a need for apron space for the storage and circulation of aircraft. These facilities are best placed along ample apron frontage with good visibility from the runway system for transient aircraft. Utility services are needed for these types of facilities, as well as vehicle parking areas.

Aircraft hangars used for the storage of smaller aircraft primarily involve T-hangars or linear box hangars. Since storage hangars often have lower levels of activity, these types of facilities can be located away from the primary apron areas in more remote locations of an airport. Limited utility services are needed for these areas.

Other types of hangar development can include executive hangars for accommodating either one larger aircraft or multiple smaller aircraft. These types of hangars can be used by corporations with company-owned aircraft or by an individual or group of individuals with multiple aircraft. These hangar areas typically require all utilities and segregated roadway access. **Table 5E** summarizes the aircraft hangar types and corresponding size and aviation uses that are typically associated with each facility.

TABLE 5E
Aircraft Hangar Types

Hangar Type	Typical Size	Aviation Uses
Conventional	Clear span hangars greater than 10,000 square feet	FBOs, SASOs, and other commercial aviation activities resulting in high activity uses
Executive	Clear span hangars less than 10,000 square feet	SASOs, flight departments, and private aircraft storage resulting in medium-to-high activity uses
T-Hangar/Linear Box	Individual storage spaces offering 1,200 - 1,500 square feet	Private aircraft storage resulting in low activity uses

FBO – Fixed Base Operator
SASO – Specialized Aviation Service Operator

BUILDING RESTRICTION LINE

The building restriction line (BRL) identifies suitable building area locations on the airport. The BRL encompasses the RPZs, the ROFA, navigational aid critical areas, areas required for terminal instrument procedures, and other areas necessary for meeting airport line-of-sight criteria.

Two primary factors contribute to the determination of the BRL: type of runway (utility or other-than-utility) and the capability of the instrument approaches. Runway 3-21 is considered an "other-than-utility" runway.

The BRL is the product of Title 14 CFR Part 77 transitional surface clearance requirements. These requirements stipulate that no object be located in the primary surface, defined as being no closer than 250 feet from a non-precision instrument runway centerline and not closer than 500 feet to a runway served by a precision instrument approach. For GCN, the primary surface is 1,000 feet wide (500 feet either side of the runway centerline). From the primary surface, the transitional surface extends outward at a slope of one vertical foot to every seven horizontal feet.

The location of the BRL is dependent upon the selected allowable structure height. Traditionally, the BRL is set at a point where the transitional surface is 20 feet or 35 feet above runway elevation. The alternatives to follow consider a 35-foot BRL in relationship to the runway system and existing and proposed land uses. Due to the relatively limited amount of space between the runway system and existing landside facilities on the east side of the Airport, the BRL will be a factor in future landside development within these areas.

HELICOPTER OPERATIONS

GCN accommodates a significant number of helicopter operations, a majority of which are related to air tour activities associated with Maverick Helicopters, Grand Canyon Helicopters, and Papillon Helicopters. These tour operators conduct activities from their private leaseholds in the northeast area of the Airport separate from the main aircraft parking apron.

There are currently two marked helicopter landing areas adjacent to the north aircraft parking apron that can be utilized by transient helicopter activity. These landing areas are in poor condition, and more importantly, are located within the ROFA associated with Runway 3-21.

The landside alternatives to follow will consider relocating the transient helicopter landing areas outside the ROFA. These areas could benefit military training and on-demand medical emergency functions in addition to general aviation activities.

AIRPORT MAINTENANCE FACILITY

Presently, GCN maintenance facilities are located immediately south of the Tusayan Town Hall and Airport management office. Consideration should be given to constructing a dedicated maintenance facility elsewhere on airport property in the event its current location could be better utilized for aviation or non-aviation activities. The landside alternatives presented later in this chapter will depict locations farther south, adjacent to the Aircraft Rescue and Firefighting (ARFF) facility.

AIRPORT HOUSING

GCN has on-site housing that includes 23 separate residential units located adjacent to the south side of the south airport entrance along Airport Road. Due to limited housing options in the Town of Tusayan and surrounding area, the on-site housing provides space for many Airport employees and employees of Airport businesses.

The FAA discourages residential land uses on airport property and has been consulted in the past in regard to the airport housing at GCN. Given the unique location and operation of the Airport, the FAA understands it is a necessity for employees who administer and operate the Airport on a full-time basis. While not ideal, additional airport housing should ultimately be considered on airport property.

The alternatives to follow consider other potential sites on airport property that could accommodate future housing. In doing so, the existing housing area adjacent to the main entrance to the Airport could be reconsidered for other uses that benefit the facility's revenue generating potential.

NON-AVIATION DEVELOPMENT POTENTIAL

As previously detailed in Chapter Four, this Master Plan should consider portions of airport property to be utilized for non-aviation purposes. GCN does not currently have approval to use property for non-aviation purposes at this time other than the airport housing to accommodate Airport employees and employees of Airport businesses. Specific approval from the FAA is required to utilize property for non-aviation uses. Chapter Four detailed the process that is involved with releasing airport property for non-aviation use.

Non-aviation related uses can be allowed on airports for areas not required for aviation purposes. In some cases, airport land inventories allow for non-aviation uses as long as the areas are not accessible to the airfield. This could pertain to GCN as many areas on airport property are not conducive to aircraft access due to physical land constraints. Non-aviation use could support commercial, industrial, or business development and would provide the Airport with an opportunity to improve revenue streams on land that would otherwise remain vacant. The alternatives to follow will further outline areas on airport property that could potentially accommodate non-aviation development potential.

LANDSIDE ALTERNATIVES

The following section describes a series of landside alternatives as they relate to considerations detailed above. Aviation activity at GCN is well established on the east side of the Airport. This area can continue to accommodate the forecast demand for commercial service and general aviation activity through the long term planning period of this Master Plan and is the most readily available for development given existing roadway access and utility infrastructure.

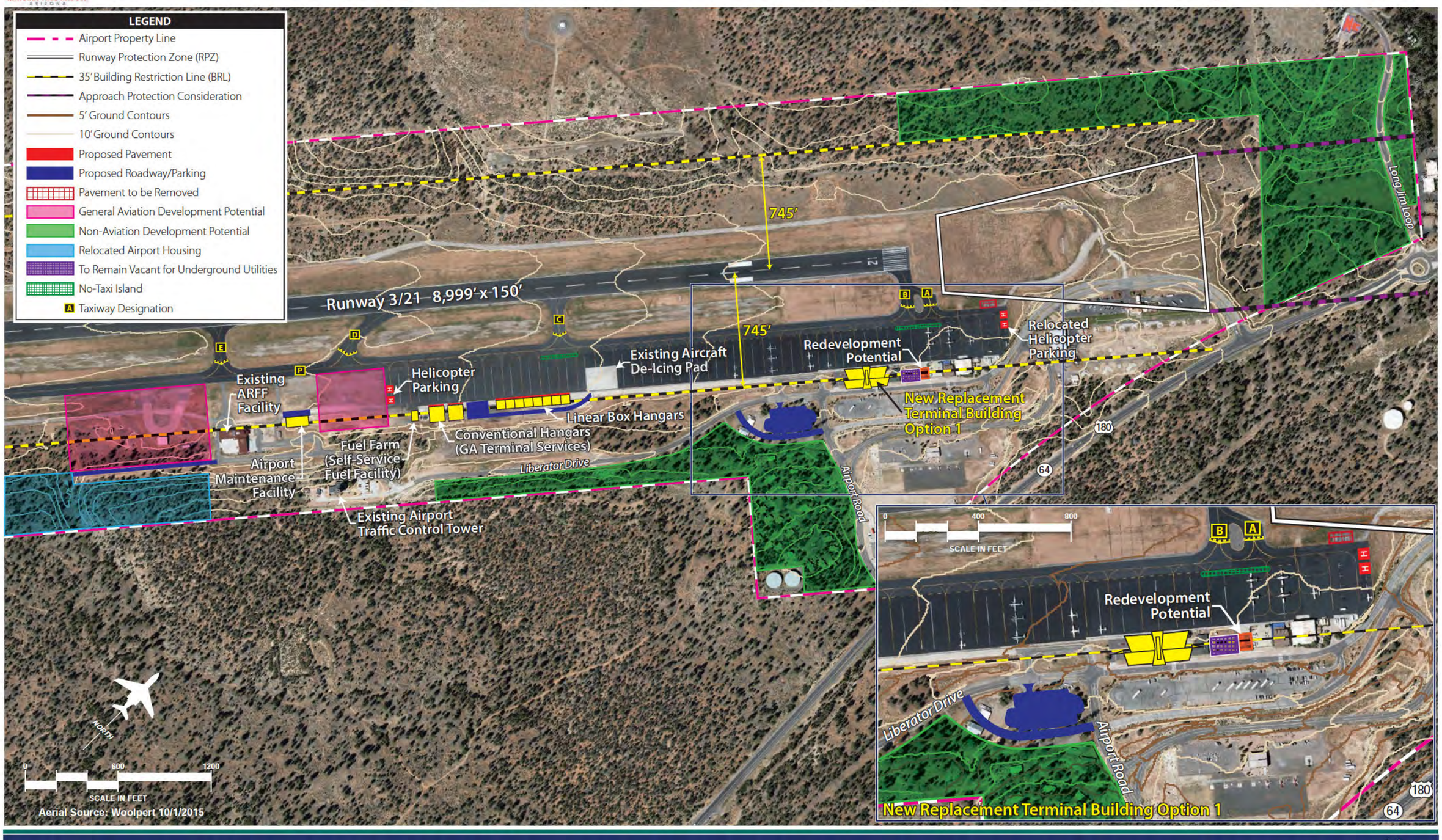
LANDSIDE PLAN ANALYSIS

The intent of this analysis is to present three landside alternatives. The alternatives are straightforward development plans aimed at meeting the needs of several service levels including commercial service, air tour operators, general aviation, and additional support functions. One of the main considerations in each alternative is the ultimate site for a new replacement terminal building. Each alternative proposes the relocation of the existing passenger terminal building and, as a result, the infrastructure and support (i.e., vehicle access and parking) associated with it which can have an impact on the location and layout of other airport components. Each landside alternative provides further narrative on the terminal building and its associated infrastructure and support being proposed.

The alternatives to be presented are not the only options for development. In some cases, a portion of one alternative could be intermixed with another. Also, some development concepts could be replaced with others. The final recommended plan only serves as a guide for the Airport which will aid ADOT in the strategic planning of available properties. Many times, airport operators change their plan to meet the need of specific users. The goal in analyzing landside development alternatives is to focus future development so that airport property can be maximized.

Landside Plan – Alternative 1

Landside Alternative 1 is depicted on **Exhibit 5K**. As presented, the primary development items include:


LEGEND
Airport Property Line
Runway Protection Zone (RPZ)
35' Building Restriction Line (BRL)
Approach Protection Consideration
5' Ground Contours
10' Ground Contours
Proposed Pavement
Proposed Roadway/Parking
Pavement to be Removed
General Aviation Development Potential
Non-Aviation Development Potential
Relocated Airport Housing
To Remain Vacant for Underground Utilities
No-Taxi Island
A Taxiway Designation
Runway 3/21 8,999'x 150'
745'
745'
Long Jim Loop
Relocated Helicopter Parking
Redevelopment Potential
Existing Aircraft De-Icing Pad
Helicopter Parking
Existing ARFF Facility
New Replacement Terminal Building Option 1
Linear Box Hangars
Conventional Hangars (GA Terminal Services)
Fuel Farm (Self-Service Fuel Facility)
Liberator Drive
Airport Maintenance Facility
Existing Airport Traffic Control Tower
Airport Road
180
64
NORTH
0
800
1200
SCALE IN FEET
Aerial Source: Woolpert 10/1/2015
0
400
800
SCALE IN FEET
Redevelopment Potential
Liberator Drive
Airport Road
New Replacement Terminal Building Option 1
180
64

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- A new replacement terminal building in the same approximate location as the existing terminal;
- Additional parking and access to accommodate vehicle and bus staging south of Airport Road;
- Redevelopment potential associated with the retired ARFF facility;
- Hangar development adjacent to the south parking apron that includes two conventional-style hangars that could support general aviation terminal services;
- A row of linear box hangars facing the aircraft parking apron;
- A new fuel farm with the ability to accommodate self-service aircraft fueling;
- Helicopter parking at the edge of the south parking apron;
- A new airport maintenance facility north of the existing ARFF facility;
- Two parcels that could accommodate future general aviation development potential;
- Relocated airport housing south of the existing ARFF facility; and
- Non-aviation related development potential in the area of existing airport housing as well as in the north area of the Airport adjacent to Long Jim Loop and Highway 64/180.

As proposed, this alternative would make use of the existing terminal location for a new replacement terminal building. This proposed facility and associated infrastructure and support will be further detailed in the next section.

Alternative 1 considers the future general aviation functions to be met toward the south side of the main aircraft parking apron. A series of conventional hangars and a linear box hangar complex would be provided access directly from the parking apron. These facilities could be granted vehicle access from the existing roadway that runs adjacent to the east side of the parking apron.

This alternative also proposes a new fuel farm immediately south of the proposed hangar facilities. This location could provide self-service fueling capabilities, as it is planned adjacent to the apron that would allow for efficient movement of aircraft. At the south edge of the apron are two helicopter parking areas that could accommodate general aviation, military, or on-demand medical emergency activities.

Additional aviation development potential is offered on vacant land farther south. In addition, a dedicated airport maintenance facility is proposed directly north of the existing ARFF facility. It is beneficial for a maintenance facility to be located in close proximity to the ARFF facility since there is overlap of services provided by each. Furthermore, the area that currently accommodates airport maintenance may be needed for enhanced terminal activities in the event that a new terminal building is constructed in the future.

Finally, Alternative 1 considers the relocation of airport housing south of the existing ARFF facility in an area that would be difficult to accommodate future aviation development given physical land constraints. As a result, the property that currently encompasses airport housing could be further analyzed for compatible non-aviation development potential. Other non-aviation development could occur at the north end of airport property. It would be important to consider the height of structures in this area so as not to penetrate approach and departure surfaces associated with Runway 3-21.

Terminal Building Option 1

The proposed new replacement terminal building, as shown on **Exhibit 5K**, is located on the same site as the existing 12,000 square-foot facility footprint. For cost avoidance, selective demolition of the existing terminal would allow the equipment portion of the building to be retained and renovated as a standalone infrastructure support building after the existing terminal is demolished in order to make room for a new replacement terminal that could be brought online in the same year as the demolition. Temporary facilities would be needed for the replacement terminal during an approximate one-year construction period. Additional vehicle parking and potential rental car operations could be built adjacent to the south side of Airport Road and still be within walking distance of the replacement terminal location.

A new sustainable terminal building is envisioned to contain approximately 30,000 square feet in the initial build and could be further enhanced up to 40,000 square feet in later years as demand would dictate. Needed infrastructure to support the new replacement terminal, such as parking, water, sewer, and electrical, would have the majority of those needed utilities onsite for cost avoidance. The terminal would provide a split level design that addresses the site grade differential and would address all ADA requirements on the interior and exterior.

The sustainable ARFF facility completed in 2010 is a certified LEED Gold Building and the new replacement terminal would contain similar sustainable design strategies and natural materials for LEED Gold USGBC certification. Sustainable solutions for the replacement terminal would include passive and active solar systems, including solar hot water, solar photovoltaics, added insulation, upgraded windows, water harvesting, low flow fixtures, and many other sustainable features. **Table 5F** provides a breakdown of preliminary costs associated with a replacement terminal and support infrastructure associated with Option 1.

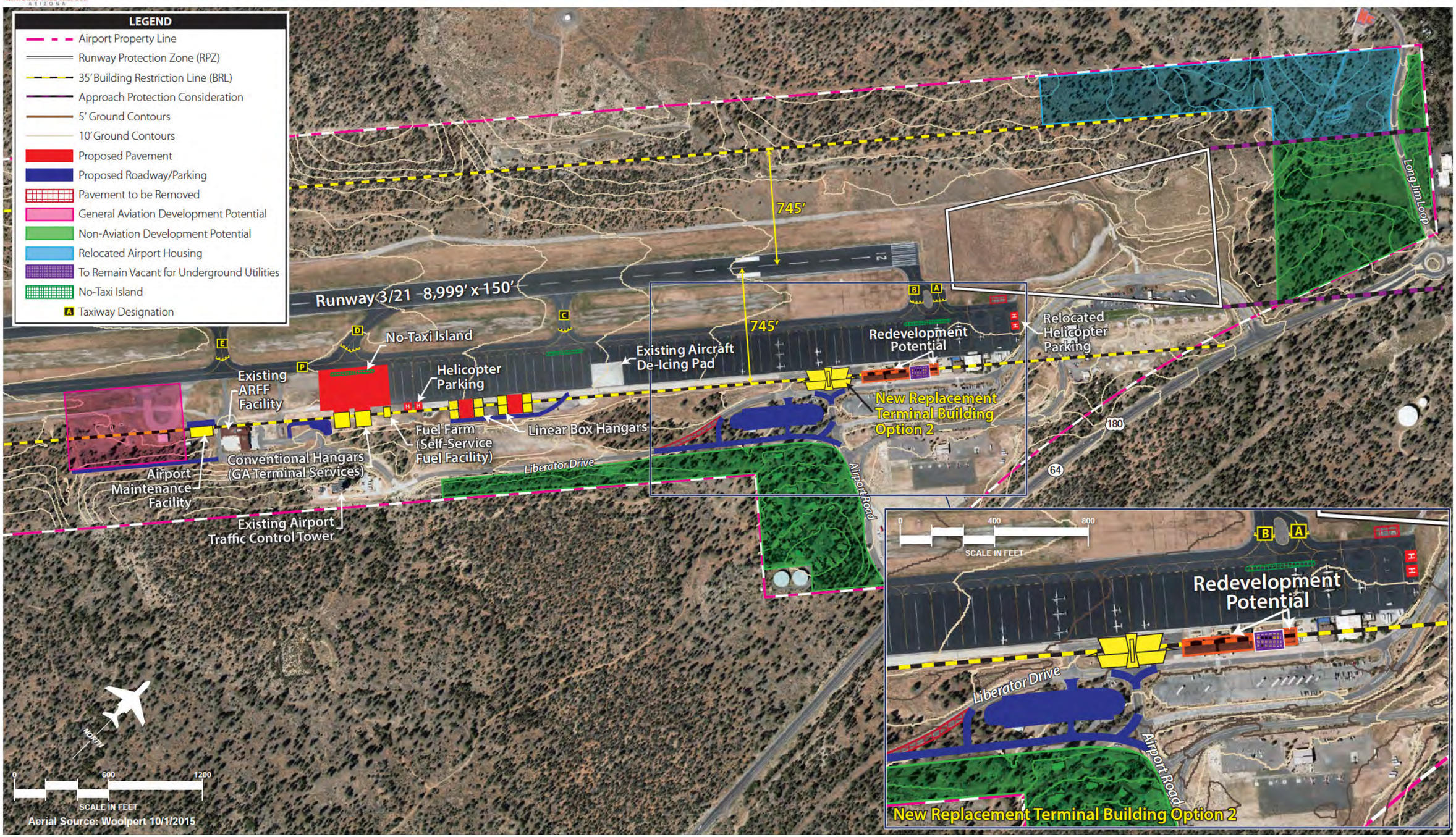
TABLE 5F
Probable Construction Cost Range - Terminal Building Option 1
Grand Canyon National Park Airport

Project Description	Cost Estimate Range
New Replacement Terminal Building	$7.0 million - $12.0 million
Additional Parking and Rental Car Opportunities	$500,000 - $750,000
Existing Building Demolition and Infrastructure Building Construction	$300,000 - $500,000
Total Project Cost Estimate	**$7.8 million - $13.25 million**

Source: LEA Architects analysis

Landside Plan – Alternative 2

Landside Alternative 2, as shown on **Exhibit 5L**, presents a second landside development concept. The proposed items considered in this alternative include the following:


LEGEND
Airport Property Line
Runway Protection Zone (RPZ)
35' Building Restriction Line (BRL)
Approach Protection Consideration
5' Ground Contours
10' Ground Contours
Proposed Pavement
Proposed Roadway/Parking
Pavement to be Removed
General Aviation Development Potential
Non-Aviation Development Potential
Relocated Airport Housing
To Remain Vacant for Underground Utilities
No-Taxi Island
A Taxiway Designation
Runway 3/21 8,999' x 150'
745'
745'
No-Taxi Island
Helicopter Parking
Existing ARFF Facility
Existing Aircraft De-Icing Pad
Redevelopment Potential
Relocated Helicopter Parking
New Replacement Terminal Building Option 2
Fuel Farm (Self-Service Fuel Facility)
Linear Box Hangars
Conventional Hangars (GA Terminal Services)
Airport Maintenance Facility
Existing Airport Traffic Control Tower
Liberator Drive
Airport Road
Long Jim Loop
180
64
NORTH
0 600 1200
SCALE IN FEET
Aerial Source: Woolpert 10/1/2015
0 400 800
SCALE IN FEET
Redevelopment Potential
Liberator Drive
Airport Road
New Replacement Terminal Building Option 2

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- A new replacement terminal building located at the convergence of Airport Road south of the existing terminal;
- Additional parking and access to accommodate vehicle and bus staging south of Airport Road;
- Redevelopment potential associated with the existing terminal location and retired ARFF facility;
- Separate linear box hangar facilities towards the south parking apron;
- Helicopter parking adjacent to the east side of the south parking apron;
- A new fuel farm with the ability to accommodate self-service aircraft fueling;
- Two conventional hangars served by additional aircraft parking apron space that could support general aviation terminal services;
- A new airport maintenance facility south of the existing ARFF facility;
- A parcel that could accommodate future general aviation development potential south of the existing ARFF facility;
- Relocated airport housing in the northwest quadrant of airport property; and
- Non-aviation related development potential in the area of existing airport housing, as well as in the north area of the Airport, adjacent to Long Jim Loop and Highway 64/180.

In this alternative, a replacement terminal building is proposed beginning approximately 100 feet south of the existing terminal location. The next section further details this proposed configuration.

Similar to Alternative 1, this alternative considers accommodating general aviation activities farther south along the main aircraft parking apron. A series of conventional and linear box hangars are proposed in this area with different configurations when compared to the previous alternative. Vehicle access to the linear box hangars could be obtained from an existing roadway traversing the east side of the main aircraft parking apron, while access to the conventional hangars could be obtained by extending access from the roadway serving the ARFF facility. It should be noted that in order to accommodate the proposed conventional hangars, additional parking apron space would need to be constructed.

Other support facilities in this area include helicopter parking and a new fuel farm with the ability to accommodate self-service fueling. An airport maintenance facility is proposed on the south side of the existing ARFF facility and still farther south is an area that could accommodate additional aviation development in proximity to the National Park Service hangar.

Alternative 2 also proposes potential non-aviation development in two separate areas of existing airport property. One is where airport housing is currently located. As a result, this alternative calls for the relocation of airport housing to the northwest side of the Airport. Access to this area could be obtained by extending a roadway south from Long Jim Loop. A second area for non-aviation development potential is located east of the proposed airport housing with desirable access to Highway 64/180 and Long Jim Loop.

Terminal Building Option 2

The proposed new replacement terminal building, as depicted on **Exhibit 5L**, is located at the center of Airport Road along the existing aircraft parking apron, just south of the current terminal facility. Portions of Airport Road would need to be reconfigured in order to allow for this location. The center of the new sustainable passenger terminal and main entrance of this important building would be centered on Airport Road to become a focused architectural attraction as passengers continue the journey coming into the Airport entrance. The facility would serve as an ideal first impression for arriving destination airline passengers and first time visitors to the Airport and GCNP.

The new sustainable terminal facility is envisioned to contain approximately 30,000 square feet in the initial build and could be expandable up to 40,000 square feet in later years, if required. The replacement terminal would continue to use the existing terminal parking lot with tour bus staging. Additional parking and potential rental car operations associated with the new replacement terminal could be accommodated on the south side of Airport Road. As previously detailed in Option 1, this terminal would also incorporate sustainability initiatives that would include passive and active solar systems, including solar hot water, solar photovoltaics, added insulation, upgraded windows, water harvesting, low flow fixtures, and many other sustainable features.

As a result of the new replacement terminal building, the existing facility could be demolished for newer facilities or repurposed for other aviation-related practical uses. Consideration should be given to preserve the utility infrastructure associated with the north portion of the existing facility. **Table 5G** provides a breakdown of preliminary costs associated with a replacement terminal and support infrastructure associated with Option 2.

TABLE 5G
Probable Construction Cost Range - Terminal Building Option 2
Grand Canyon National Park Airport

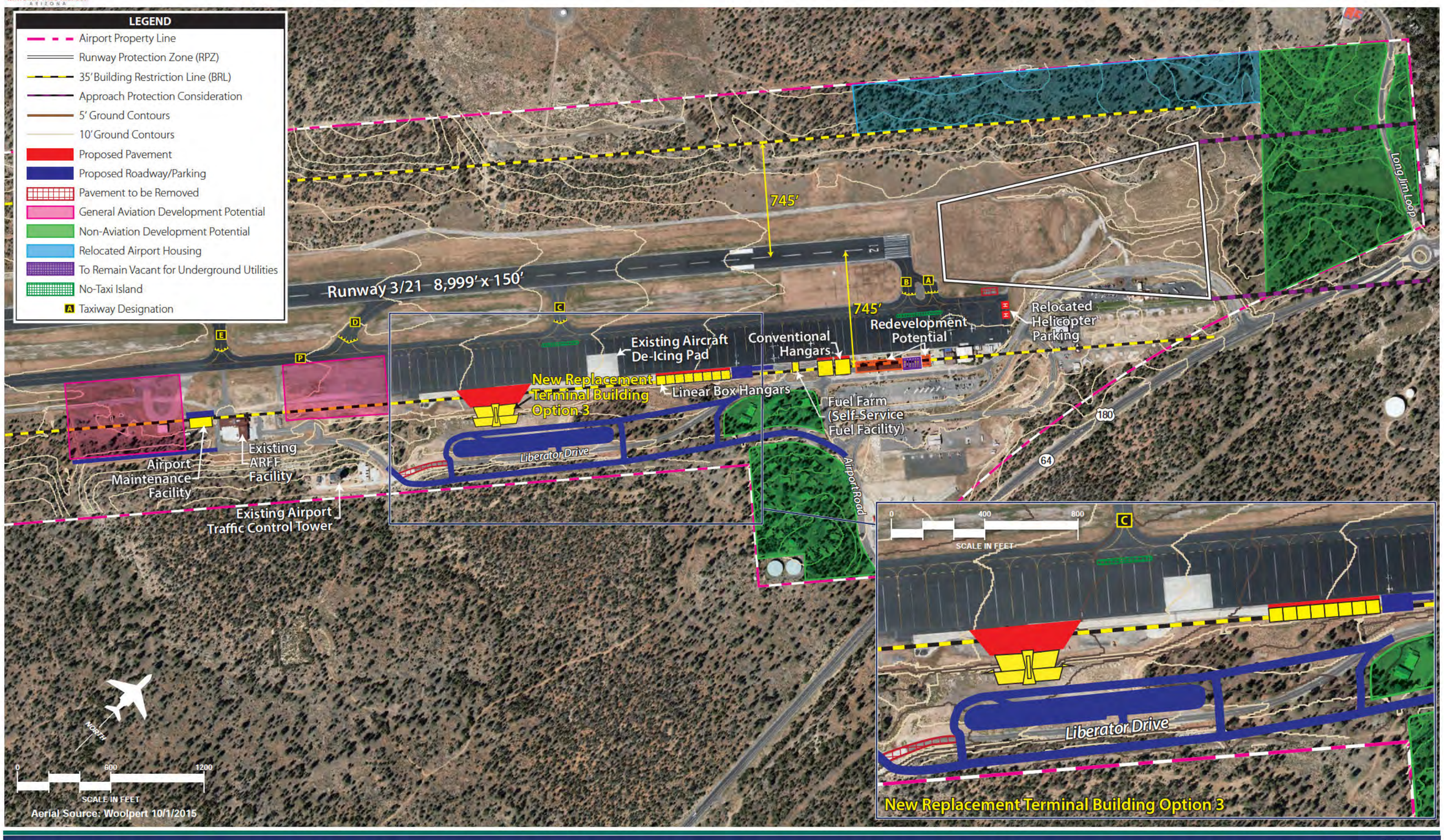
Project Description	Cost Estimate Range
New Replacement Terminal Building	$7.0 million - $12.0 million
Additional Parking and Rental Car Opportunities	$500,000 - $750,000
Existing Building Demolition and Infrastructure Building Construction	$300,000 - $500,000
Potential Upgrades to Existing Terminal for Other Uses	$300,000 - $500,000
Total Project Cost Estimate	**$8.1 million - $13.75 million**

Source: LEA Architects analysis

Landside Plan – Alternative 3

Exhibit 5M depicts the final alternative for this landside analysis. This alternative is significantly different from the previous landside alternatives and includes the following:

- A new replacement terminal building located farther south in an area adjacent to the south parking apron;


LEGEND
Airport Property Line
Runway Protection Zone (RPZ)
35' Building Restriction Line (BRL)
Approach Protection Consideration
5' Ground Contours
10' Ground Contours
Proposed Pavement
Proposed Roadway/Parking
Pavement to be Removed
General Aviation Development Potential
Non-Aviation Development Potential
Relocated Airport Housing
To Remain Vacant for Underground Utilities
No-Taxi Island
A Taxiway Designation
Runway 3/21 8,999' x 150'
745'
745'
Long Jim Loop
Relocated Helicopter Parking
Redevelopment Potential
Conventional Hangars
Existing Aircraft De-Icing Pad
New Replacement Terminal Building Option 3
Linear Box Hangars
Fuel Farm (Self-Service Fuel Facility)
Liberator Drive
Airport Road
Airport Maintenance Facility
Existing ARFF Facility
Existing Airport Traffic Control Tower
180
64
NORTH
0
600
1200
SCALE IN FEET
Aerial Source: Woolpert 10/1/2015
0
400
800
SCALE IN FEET
New Replacement Terminal Building Option 3

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- A new parking and access route to accommodate vehicle and bus staging adjacent to the east side of the proposed terminal location;
- Redevelopment potential associated with the existing terminal location and retired ARFF facility;
- Two conventional hangars immediately south of the existing terminal location that could complement the redevelopment potential to the north;
- A new fuel farm with the ability to accommodate self-service aircraft fueling;
- A row of linear box hangars facing the aircraft parking apron;
- Helicopter parking at the edge of the north parking apron;
- Two parcels south of the proposed terminal building that could accommodate future general aviation development potential;
- A new airport maintenance building south of the existing ARFF facility;
- Relocated airport housing towards the northwest quadrant of the Airport; and
- Non-aviation related development potential in the areas of existing airport housing and Airport management office, as well as in the north area of the Airport adjacent to Long Jim Loop and Highway 64/180.

As proposed, the relocated terminal building would require substantial improvements farther south on the airfield to include a new vehicle access road and parking alignment. It should be noted that this terminal location is closely aligned to the recommended development concept associated with the 2009 Terminal Area Plan. The next section will further detail this replacement terminal location and support network.

Alternative 3 would allow for significant development and redevelopment potential in the north area of the airfield that could accommodate general aviation and air tour operator functions. Similar to the previous alternatives, a series of conventional hangars and linear box hangars are proposed, but this time utilizing the northern half of the main aircraft parking apron. A new fuel farm is proposed in an area between the hangar facilities that could accommodate self-service fueling. Helicopter parking is incorporated at the north edge of the parking apron, as called for in airside alternatives earlier on.

South of the proposed terminal building, this alternative dedicates two separate parcels for aviation development as demand would dictate. The relocation of airport maintenance is proposed in a facility adjacent to the south side of the existing ARFF facility.

In keeping with the concept of utilizing portions of airport property for uses other than aviation related, Alternative 3 highlights three separate areas for non-aviation development potential. Two of those areas are in the existing location of airport housing and the Airport management office. Airport housing could be relocated in the northwest area of the Airport and Airport management could be accommodated in a variety of places, including the proposed terminal building or redevelopment area where the existing terminal is located.

Terminal Building Option 3

The proposed new replacement terminal building, as presented on **Exhibit 5M**, is located farther south along the main aircraft parking apron in a midfield location with relationship to the runway system. This site offers a more secure passenger terminal area as the building is not in a congested area and provides additional space for aircraft movement and circulation adjacent to the aircraft parking apron. This site does need to consider significant grade changes which could allow for the creation of a two-story or a split level concept; a single level concept would require some challenges because of the abrupt rise of the topography farther east. The site offers a large, relatively flat area on the east side of the replacement terminal location for automobile parking, potential rental car operations, and bus staging areas. Portions of the existing roadway network serving the Airport could complement the new vehicle/bus roadway system needed to serve this replacement terminal option. Additional infrastructure would also be required for this site since there is no significant development in close proximity that currently provides for utilities, access, etc.

Similar to the previous options, sustainable solutions for the new replacement terminal would include passive and active solar systems, including solar hot water, solar photovoltaics, upgraded windows, added insulation, water harvesting, low flow fixtures, and many other sustainable features. **Table 5H** provides a breakdown of preliminary costs associated with a replacement terminal and support infrastructure associated with Option 3. As can be expected, this option would be more expensive that Options 1 and 2, given the new infrastructure associated with a replacement terminal being proposed in this location.

TABLE 5H
Probable Construction Cost Range - Terminal Building Option 3
Grand Canyon National Park Airport

Project Description	Cost Estimate Range
New Replacement Terminal Building	$7.0 million - $12.0 million
Vehicle/Bus Access, Parking, Staging, and Rental Car Opportunities	$2.0 million - $3.0 million
Building and Site Infrastructure	$1.0 million - $2.0 million
Potential Upgrades to Existing Terminal for Other Uses	$300,000 - $500,000
Total Project Cost Estimate	**$10.3 million - $17.5 million**

Source: LEA Architects analysis

Landside Plan Summary

The landside alternatives previously detailed look to accommodate an array of activities that either currently occur or could be expected to occur at GCN in the future. As previously detailed, the main point of emphasis in this analysis relates to the ultimate disposition of a commercial passenger terminal facility at the Airport. In the event that a new replacement terminal building is constructed, the location of this facility and its infrastructure and support will dictate the locations of general aviation and other ancillary support functions on the airfield.

Alternatives 1 and 2 would allow the future terminal locations to make better use of the existing vehicle access and parking infrastructure at the Airport. With these alternatives, however, the proposed terminal locations would bring increased activities to the already high activity area on the airfield. A location farther south, as in Alternative 3, would better segregate the specialized commercial passenger service activity from other portions of the airfield. This alternative would be the most expensive, however, given the amount of improvements (i.e., vehicle access and parking) needed to accommodate such a site. It is important to consider the needs of other aviation functions on the Airport, including general aviation and air tour activities. The landside alternatives highlight adequate space to help meet the needs of these functions through the long term planning horizon.

As with many of the alternatives detailed in this chapter, Airport staff and ADOT should continually monitor the demand that is occurring on the airfield and in the region to help determine the potential need for enhanced landside facilities, both aviation and non-aviation related. Each of the development options considers a long term vision that would, in some cases, extend beyond the 20-year scope of this Master Plan. Nonetheless, it is beneficial to provide a long term vision for the Airport for future generations.

ALTERNATIVES SUMMARY

Planning future development of both the airside and landside is important because individual actions taken in one area can impact the potential for other options in the future. Therefore, it is important to examine the alternative development options in order to maximize the opportunities of GCN. Sustainability planning should also be considered by such means as maximizing available land area and limiting the need to extend utilities.

The process utilized in assessing airside and landside development alternatives involved a detailed analysis of facility requirements through the long term planning horizon. Airport design standards were considered at every stage of the analysis. Safety, both in the air and on the ground, was given a high priority in the analysis of alternatives.

After review and input from the PAC, airport management, ADOT, FAA, and interested citizens, a recommended development concept to include a detailed capital improvement program and environmental overview will be presented in the next phase of the study. The resultant plan will represent an airside facility that fulfills safety design standards to the extent practicable and a landside complex that can be developed as demand dictates. The development plan for GCN must represent a means by which the Airport can evolve in a balanced manner, both on the airside and landside, to accommodate the forecast demand. In addition, the plan must provide flexibility to meet activity growth beyond the long range planning horizon.