

Chapter 5- Alternatives Analysis

The previous chapter of this master plan update, *Facility Requirements*, was completed to determine the airside, landside, and support facility needs of the Grand Canyon National Park Airport (GCN) throughout the 20-year planning horizon. This chapter is intended to identify those alternatives that will allow GCN to accommodate projected aircraft and aviation demand activity. In addition, the focus of this chapter is to evaluate the merits and deficiencies of potential capital development for landside and airside alternatives proposed for GCN. The airside development alternatives analysis will study four different runway length alternatives. The landside development alternatives to be analyzed in this phase of the master plan study include, in particular, a newly developed terminal building concept, public auto parking, and terminal building surface access.

The capital development alternatives proposed for GCN are intended to serve as the formulation of a development concept rather than the presentation of a final design recommendation. While the assessment of runway and terminal area development alternatives are based on technical, economical, and practical judgment, the most favorable airfield development option should be the one most compatible with system wide planning initiatives, as consistent with social, political and environmental goals of the Arizona Department of Transportation, Aeronautics Division (ADOT) and the local public, business community, as well as the National Forest and National Park Services. The favorable expansion alternative, based on a judgmental assessment of all factors involved with airside and landside expansion, should be the alternative having the greatest potential for implementation.

Alternatives Analysis Formulation

The airport alternatives analysis will initially focus on airfield development due to the fact that runway expansion often requires the greatest commitment of airport infrastructure and financial resources. Once the potential airfield alternatives have been established, the course of the alternatives analysis for GCN will then identify and explore terminal area development concepts. Development concepts involving airport support facilities including airport fueling/ fuel farm facilities, aircraft rescue and firefighting (ARFF), snow removal/ equipment (SRE) and air traffic control tower (ATCT) facilities will be evaluated at the conclusion of the alternatives chapter.

In conducting the evaluation of GCN airfield and terminal area expansion alternatives, two options will be examined: *no action* and *development of the existing facilities*. In examining the potential development of existing facilities, four (4) alternative airfield development concepts will be assessed while three (3) development concepts will be considered for future terminal building and public auto parking needs. Both airfield and terminal area alternative actions will be evaluated in relation to social, political, and economic attributes to determine which is the most beneficial development concept to pursue. Once an airfield and terminal area development alternative action is decided on,

it should provide the course of action for accommodating the operational needs and aviation demand of the airport and local community.

Airfield Alternative Concepts

Airfield alternative concepts were developed and presented to ADOT in anticipation of presenting the runway concepts to members of the GCN Planning Advisory Committee (PAC) for their input. **Airfield Alternatives A, B and C** present a broad range of runway expansion options and are discussed in the following passages. These selected airfield alternatives are those that are viewed as the development options most viable to serve the future demand for services at GCN.

Airfield Alternative A- 'No Action' Option: Alternative A involves no airfield expansion and dictates that Runway 3-21 remain at its current length of 8,999 feet throughout the planning period. Issues affecting this alternative are the Papillion Grand Canyon Helicopter facility, located to the northwest of the Airport, that is located within the Runway 21 Runway Protection Zone (RPZ). Additionally, the Object Free Area (OFA) for Runway 21 is also encroached on by the airport terminal area access road. Further alternatives will provide corrective measures to mitigate this existing condition within receiving a waiver from the FAA. A waiver from the FAA design standards would be necessary for implementation of Alternative A.

Airfield Alternative B- Runway 3 Extension: Alternative B depicts the extension of the Runway 3 end by 1,001 feet intended to accommodate anticipated large on-demand air carrier/ commercial service aviation operational demand. Alternative B would increase GCN's usable runway length to 10,000 feet. Alternative B does not provide mitigation to design issues that exist for the Runway 21 end.

Airfield Alternative C- Development of Parallel Runway/ Runway 21 Mitigation/ Extension of Runway 3: Alternative C incorporates a 1,001 foot extension to the Runway 3 end intended to accommodate anticipated large on-demand air carrier/ commercial service aviation operational demand making the ultimate length of Runway 3-21 10,000 feet. Alternative C also includes the development and siting of a partial dual parallel taxiway, as well as a 5,600' x 75' parallel runway to the northwest of Runway 3-21. This alternative projects that the 20-year planning period at GCN will rise above the recommended threshold of aircraft activity to warrant airfield development for capacity enhancement purposes. Alternative C also provides mitigation to design issues that exist for Runway 21 as presented in Alternative A.

Aside from the above selected airfield alternatives, five additional alternative expansion options were offered to ADOT for consideration and were determined not to be favorable based on various siting, economic, operational or environmental factors. The following



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passages discuss runway expansion options eliminated from further consideration for future implementation.

Extension of Runway 3 End Only Option: This alternative depicted the extension of the Runway 3 end to the southwest by an additional 1,001 feet to an ultimate runway length of 10,000 feet. However, this option did not show a mitigative course of action taking place to remedy the Runway Protection Zone (RPZ) encroachment by the Papillion facility off the end of Runway 21, nor was an option presented to realign or remove the terminal access road from within the Runway 21 Object Free Area (OFA).

Runway 21 Mitigation/ Extension of Runway: This development option is similar to **Airfield Alternative C** in that it mitigates the Runway 21 condition and extends the Runway 3 end out to an ultimate runway length of 10,000 feet. However, this option depicts the Runway 21 end being relocated approximately 970 feet to the southwest while abandoning Taxiways A and B in favor of abandoning 970 feet of usable paved runway and constructing a new entrance taxiway at the newly relocated threshold. This alternative was viewed as operationally and financially impractical.

'No Action' Airfield Taxiway Improvements: Similar to the **'No Action' Alternative**, this development option considered a parallel taxiway being constructed to the northwest of the existing runway as a means of preparing for greater than expected operational demand in the future, thereby increasing the overall airport capacity. Since the Airport's Annual Service Volume (ASV) is not expected to rise above levels that would necessitate consideration of capacity planning measure, this alternative was discarded from further consideration.

Parallel Runway Development Proposals: The final two alternatives to be removed from consideration for future implementation involved the construction of a parallel runway in various configurations to the northwest of the existing runway. In addition to the development of a full length parallel taxiway, the parallel runway was sited approximately 900 feet from the existing runway's centerline and required approximately 26 acres of property acquisition and massive grading and earthwork within the Kaibab National Forest. The Automated Weather Observation System (AWOS) and glideslope antenna for Runway 3 was also shown to be relocated. Given the economic, operational and environmental attributes associated with this proposal, it was removed from further consideration as part of this alternatives analysis.



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Airfield Alternative A- 'No Action' Option

Alternative A, depicted in **Exhibit 5.1**, as already discussed, calls for no additional runway or airfield expansion. The primary objective of Alternative A is to preserve airfield infrastructure at its current level and to reduce the likelihood of property acquisition, while at the same time providing enough usable runway length to accommodate existing air carrier and commercial service aircraft operators.

The following list of attributes are characteristics of Airfield Alternative A:

- ✦ Papillion Grand Canyon Helicopter facility remains within the RPZ for Runway 21.
- ✦ The airport access road located to the northwest of Runway 3-21 will remain within the OFA for Runway 21.
- ✦ A waiver must be obtained from the FAA, Western Pacific Region and granted that will allow the RPZ and OFA for the Runway 21 end to remain where they are currently located. This waiver would involve a deviation to design standards for the RPZ and OFA condition.
- ✦ No additional airfield infrastructure changes or property acquisition will be required.

Operational Considerations

As discussed in the *Takeoff Runway Length Requirements* section of the Facility Requirements chapter, the current airfield length is capable of accommodating 79 to 85 percent of the available payloads of approximately 86 percent of the Part 121 air carrier fleet operating at GCN during hot days. However, the current length of 8,999 feet is not expected to adequately accommodate the anticipated Part 121 aircraft fleet and market demand during hot day conditions for air carrier aircraft operating beyond a 500 nautical mile haul/ stage length.

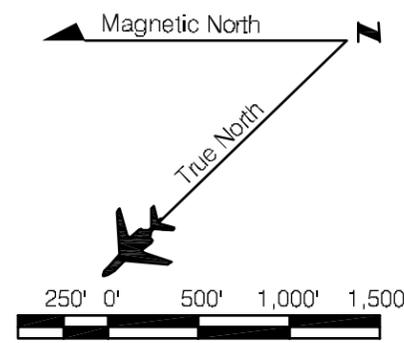
Financial Considerations

A detailed analysis of the financial implications of each airfield alternative was prepared as part of this alternatives analysis. Development costs for Alternative A were not prepared due to the fact that the airfield component of the facility would not experience any expansion or development beyond routine preventive maintenance or rehabilitation of the paved surfaces or lighting systems.

Potential Environmental Impacts

Due to the noise sensitive environment of the Grand Canyon, it would be reasonable to imply that due to the anticipated increase in aviation operational activity, as well as potential capital development expected to occur at GCN, including a 'No Action' development alternative, that all development options consider the potential noise impact

*Runway 3-21- 8,999' x 150' (Ultimate)



LEGEND

Paved Surface -	
Property Line- Existing -	
Runway Protection Zone (RPZ)- Existing -	
Runway Object Free Area (OFA)- Existing -	
Runway Centerline -	



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of the Airport on the surrounding environment. Based on current and forecast conditions, including established flight routes directed away from and around flight-free zones, the overall noise impact at GCN is expected not to impose significant impacts on the environment and would be considered minimal by current FAA criteria. Alternative A would not be expected to result in any adverse environmental impacts to the surrounding community or airport environment with the exception being potential noise considerations.

Airfield Alternative B- Runway 3 Extension Option

Alternative B, depicted in **Exhibit 5.2**, depicts a 1,001 foot extension to the Runway 3 end and will require implementation of airfield infrastructure relocation and upgrade, property acquisition, structure relocation and access road realignment.

The following items are characteristics of Airfield Alternative B:

- ✦ The Runway 3 threshold will be extended 1,001' x 150' to the southwest allowing the current runway length of 8,999 feet to be increased to 10,000 feet. Runway and safety area dimensions will adhere to Airport Reference Code (ARC) C-III airport design criteria. Additionally, a runway stopway is recommended to be constructed on the Runway 3 end measuring 200' x 200'.
- ✦ Construct a 1,001' x 50' extension to Taxiway P and a new 400' x 50' entrance/ exit taxiway serving the relocated Runway 3 threshold. Both taxiways are intended to adhere to Airplane Design Group (ADG) III airport design criteria.
- ✦ Relocate and re-site the Instrument Landing System (ILS) and all associated components of the ILS. The Approach Lighting System (ALS) installed on the Runway 3 end will also require a relocation of nearly 1,000 feet. The ILS Glideslope antenna and accompanying transmitter shelter located at the Runway 3 end will require relocation approximately 885 feet to the southwest.
- ✦ The retention/ irrigation pond occupying approximately four (4) acres of land located to the southwest of the Runway 3 threshold will require fill and relocation to accommodate the ultimate Runway Safety Area (RSA) for the Runway 3 end.
- ✦ Acquire approximately two (2) acres of land to the southwest of the existing airport property boundary to accommodate the relocation of the ALS and corresponding Inner Approach Runway Obstacle Free Zone (ROFZ) for the Runway 3 end.
- ✦ The Papillion Grand Canyon Helicopter facility, including auto parking and helipads, will require removal and relocation out of the RPZ for the Runway 21 end.



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- ✦ The airport access road located to the north of the Runway 21 threshold will require realignment and relocation outside of the OFA.

Operational Considerations

Alternative B is intended primarily to accommodate anticipated long-haul Part 121 on-demand air carrier/ commercial service aircraft demand during hot day conditions operating on 1,800 nautical mile haul lengths by extending the runway an additional 1,001 feet to an ultimate length of 10,000 feet. This ultimate runway length is expected to accommodate nearly all of the Boeing 737-300/ 800 and MD-87 Series aircraft during periods of extreme weather conditions when taking into account increased available aircraft payloads, physical runway conditions, and engine performance characteristics.

Financial Considerations

A detailed analysis of the financial implications of each airfield alternative was prepared as part of this alternatives analysis. Probable construction costs for the implementation of Alternative B were calculated to be approximately \$7.5 million. This probable cost estimate included the relocation of the Instrument Landing System (ILS) including the Glideslope (GS) antenna, as well as the extension/ relocation of airfield lighting and the Approach Lighting System (ALS) located at the Runway 3 threshold. With regard to paved surfaces, an extension of 1,001' x 150' to the Runway 3 threshold, construction of new entrance/ exit taxiway to the Runway 3 end, and a 1,001' x 50' extension of Taxiway P was also included in the estimated costs. Relocation of the Papillion facility, as well as realignment of the access road, accounted for nearly \$5 million of the total project cost.

Potential Environmental Impacts

Alternative B results in potential environmental impacts which affect water supply/ water quality, prime forest land property acquisition, potential aircraft and airport noise, social impacts with structure relocation, as well as surface transportation considerations that are a result of the access road realignment. Option B would require the four acre retention/ irrigation pond located southwest of the Runway 3 threshold to be filled to accommodate the ALS and RSA, potentially affecting water supply to outlying farming operations. Filling this irrigation pond may be considered by the U.S. Army Corps of Engineers as depositing dredge or fill material into jurisdictional waters of the United States requiring permitting guidelines to be adhered to prior to construction activities taking place on Option B. The irrigation/retention basin located in the RPZ for Runway 3 is a significant environmental area and will require extensive coordination with several governmental agencies should a runway extension be planned for this runway end. The following agencies should be considered in coordination for any design/construction within this area: ADOT Environmental Planning Group, ADOT Environmental Planning Group, Arizona Department of Environmental Quality, Army Corps of Engineers, and the Arizona Department of Water Resources.



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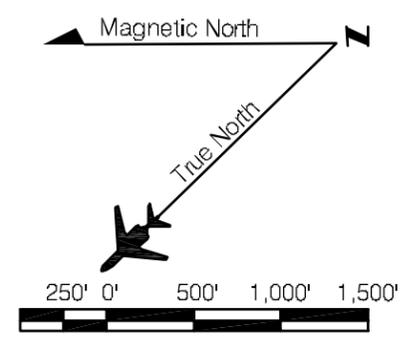
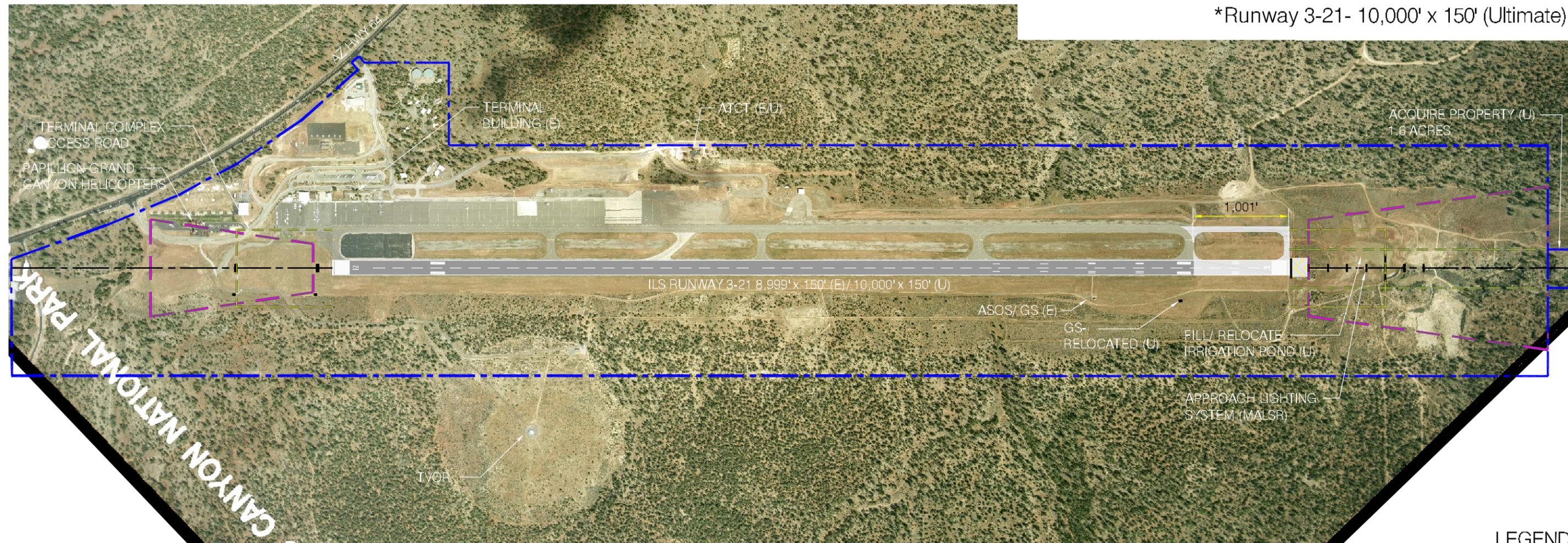
Exhibit 5.2

Airport Alternatives Analysis

Airfield Alternative 'B'

No Mitigation of Rwy 21 OFA/ RPZ Encroachments &
Extend Runway 3-21 by 1,001 Feet

*Runway 3-21- 10,000' x 150' (Ultimate)



LEGEND

Paved Surface - Existing -	
Paved Surface - Ultimate -	
Property Line- Existing -	
Property Line- Ultimate -	
Runway Protection Zone (RPZ)- Ultimate -	
Inner Approach Runway Obstacle Free Zone (ROFZ)- Ultimate -	
Runway Object Free Area (OFA)- Ultimate -	
Runway Centerline -	



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Aside from potential water supply impacts, Alternative Option B also requires acquisition of approximately two acres located within the Kaibab National Forest administered by the National Forest Service. The land is required to accommodate the ALS, as well as the Runway Obstacle Free Zone (ROFZ) for the Runway 3 end extension.

As discussed with Alternative A, ambient airport and aircraft sound is considered a potential environmental issue associated with Alternative B.

Airfield Alternative C- Development of Parallel Runway/ Runway 21 Mitigation/ Extension of Runway 3

Airfield Alternative C, depicted in **Exhibit 5.3**, shows the development of a partial parallel taxiway, as well as a parallel runway and taxiway to the northwest of the existing Runway 3-21. Alternative Option C, aside from proposing a partial dual parallel taxiway and parallel runway, depicts an extension to Runway 3-21 of 1,001 feet to an ultimate length of 10,000 feet to accommodate anticipated long-haul on-demand air carrier/ commercial service aircraft demand during hot day conditions. Additionally, this proposal depicts a mitigation to the conditions affecting the Runway 21 RPZ and OFA by relocating the threshold for Runway 21 as well.

The following planning attributes are characteristics of long range airfield development proposal:

- ✦ Remove the abandoned Air Traffic Control Tower (ATCT) facility located to the northwest of Runway 3-21 situated near the Terminal VOR (TVOR).
- ✦ Construct a partial dual parallel taxiway measuring 5,600' x 50' being served by three entrance/ exit taxiways measuring 400' x 50' apiece in addition to one high speed exit taxiway measuring approximately 425' x 50'. The recommended centerline separation distance between the partial dual parallel taxiway and Runway 3-21 is recommended to be 400 feet. The parallel taxiway, and the entrance/exit and high speed exit taxiways, are intended to adhere to Airplane Design Group (ADG) III airport design criteria.
- ✦ Construct a 5,600' x 75' parallel runway to the northwest of Runway 3-21. The newly constructed runway will be sited so that the Runway 3-21 and parallel runway centerline separation distance between the two runways will be 700 feet. Additionally, this runway centerline separation criteria will require that the centerline separation distances between the new parallel runway and the partial dual parallel taxiway will be 300 feet. Runway and safety area dimensions will adhere to Airport Reference Code (ARC) B-I airport design criteria.



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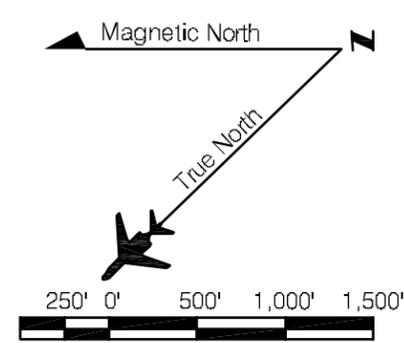
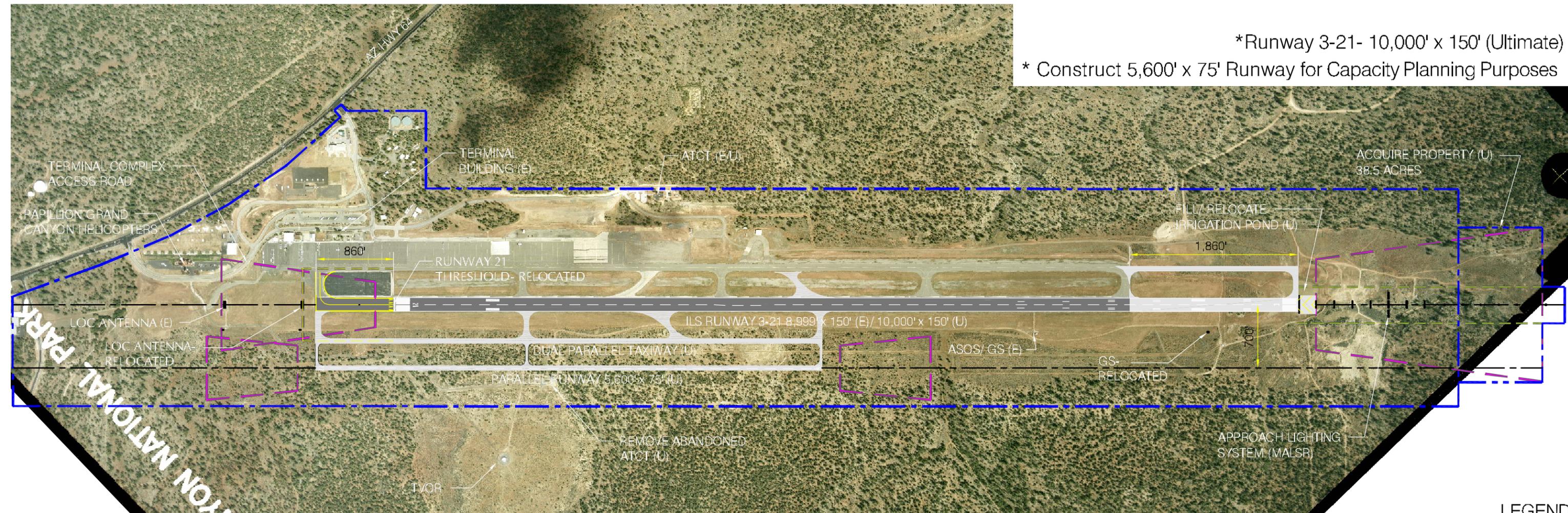
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*Runway 3-21- 10,000' x 150' (Ultimate)

* Construct 5,600' x 75' Runway for Capacity Planning Purposes



LEGEND

Paved Surface - Existing-	
Paved Surface - Ultimate -	
Property Line- Existing -	
Property Line- Ultimate -	
Runway Protection Zone (RPZ)- Ultimate -	
Inner Approach Runway Obstacle Free Zone (ROFZ)- Ultimate -	
Runway Object Free Area (OFA)- Ultimate -	
Runway Centerline -	



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- ✦ Construct three entrance/ exit taxiways measuring 300' x 25' apiece to serve the newly constructed parallel runway. The entrance/exit taxiways are intended to adhere to Airplane Design Group (ADG) I airport design criteria.
- ✦ Runway 21 threshold will be relocated approximately 860 feet to the southwest while the Runway 3 threshold is also relocated approximately 1,860 feet to the southwest allowing the current runway length of 8,999 feet to be extended ultimately to 10,000 feet. Runway and safety area dimensions will adhere to Airport Reference Code (ARC) C-III airport design criteria. Additionally, a runway stop way is recommended to be constructed on the Runway 3 end measuring 200' x 200'.
- ✦ Construct an 1,860' x 50' extension to Taxiway P and construct a new 400' x 50' entrance/exit taxiway serving the relocated Runway 3 threshold. Both taxiways are intended to adhere to Airplane Design Group (ADG) III airport design criteria.
- ✦ Relocate and re-site the Instrument Landing System (ILS) and all associated components of the ILS. The Localizer (LOC) antenna array and transmitter shelter installed at the Runway 21 end will require relocation of nearly 840 feet to the southwest while the Approach Lighting System (ALS) installed on the Runway 3 end will also require a relocation of nearly 1,860 feet. The ILS Glideslope antenna and accompanying transmitter shelter located at the Runway 3 end will require to be relocated approximately 1,880 feet to the southwest as well.
- ✦ The retention/ irrigation pond occupying approximately four acres of land located to the southwest of the Runway 3 threshold will be required to be filled and relocated to accommodate the ultimate paved runway surface, stop way and RSA for the Runway 3 end.
- ✦ Acquire approximately 39 acres of land to the southwest of the existing airport property boundary to accommodate the relocation of the ALS, RPZ, Building Restriction Line (BRL) and corresponding Inner Approach ROFZ for the Runway 3 end.

Operational Considerations

Alternative C assumes that the demand for airport services and facilities will eventually surpass the threshold of the Airport's Annual Service Volume (ASV) which, as a general rule, recommends that consideration and preparation need to be made for capacity-related capital development. ASV is defined as a means of reasonable quantifying the measure of an airport's annual capacity. In this instance, the intent of the parallel runway is to accommodate general aviation and non-air tour aircraft demand to relieve demand on the primary runway for air tour and Part 121 air carrier operational activity.



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Financial Considerations

The engineer's opinion of probable construction costs for the implementation of Airfield Alternative C was calculated to be approximately \$10.6 million. The probable cost estimates account for the construction of a 5,600' x 50' partial parallel taxiway equipped with three entrance/ exit and one high speed taxiways and a basic visual 5,600' x 75' parallel runway served by three additional entrance/ exit taxiways. As with Alternatives A and B, the probable cost estimates for Alternative C also consider the relocation of the ILS and GS antenna, extension/ relocation of airfield lighting and the ALS, as well as expansion of the Runway 3 end and Taxiway P.

Potential Environmental Impacts

Like Airfield Alternative B, Alternative C will potentially affect water supply/ water quality and prime forest land property acquisition in the immediate vicinity of the Airport, particularly within the RPOZ and RSA for the Runway 3 end. Additionally, this proposal will create a significant volume of earthwork and grading to the northwest of the airport located outside of the Airport property boundary.

As with Airfield Alternative B, the following agencies should be considered in coordination for any design/construction within this area, including ADOT Environmental Planning Group, Arizona Department of Environmental Quality, Army Corps of Engineers and the Arizona Department of Water Resources. Lastly, as discussed with Alternative A and B, ambient airport and aircraft sound is considered a potential environmental issue associated with Alternative C.

Summary of Airfield Alternative Concepts

Table 5.1 summarizes the three airfield alternative development options, as well as the long range airfield development proposal for the GCN alternatives analysis. Development cost estimates for each airfield development course of action were limited to airfield infrastructure items including runway, taxiway, lighting, NAVAIDS and required earthwork that would be involved with implementation of each alternative. Costs associated with land acquisition are not included as part of the alternatives analysis summary. Each alternative development option was examined and graded based on a Likert rating scale (1- least favorable, 4- most favorable) considering selected physical attributes and site characteristics associated with each airfield development option.

Based on the merits of the airfield development alternatives analysis including operational, financial and environmental considerations, the Grand Canyon National Park Airport Planning Advisory Committee elected to pursue **Airfield Alternative C** as the preferred ultimate proposed capital development option. **Airfield Alternative C** provides the optimum level of economy, efficiency and safety capable of accommodating the future demand at GCN.



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Table 5.1
Airfield Alternative Concept Comparison
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Operational Considerations			
Physical Attribute	'No Action' Alternative A	Airfield Alternative B	Airfield Alternative C
Primary Runway Dimensions	8,999' x 150'	10,000' x 150'	10,000' x 150'
Parallel Runway Dimensions	n/a	n/a	5,600' x 60'
Haul Length Accommodations*	500 Nm	1,800 Nm	1,800 Nm
Financial Considerations**			
Development Cost (Millions)	n/a	\$7.5	\$10.6
Potential Land Acquisition (Acres)	n/a	2.0	38.5
Potential Environmental Impacts			
Impact Category	Airport/ Aircraft Noise	Water Quality/ Supply, Forest Land, Airport/ Aircraft Noise/ Social/ & Surface Transportation	Water Quality/ Supply, Forest Land, & Airport/ Aircraft Noise
Alternative Concept Analysis Matrix (1- Least Favorable, 4- Most Favorable)			
Airfield Infrastructure Modifications	4	3	3
Part 77/ Airspace Issues	4	4	4
Requires Modifications to Standards	1	4	4
Meets Long-Term Facility Needs	3	4	4
Accommodates Future Aircraft Demand	3	4	4
Site Preparation (Earthwork)	4	2	1
Potential Environmental Impacts	4	1	2
Development Costs	4	2	1
Overall Design rating	27	25	23

(*)- Nautical Miles; (**)- Excludes costs associated with land acquisition.

Source: BWR, Airfield Alternative Concept Comparison, June 2004.

Terminal Building Alternative Concepts

A future terminal building alternative concept was developed and presented to ADOT in anticipation of presenting the future terminal building alternative layout to members of the GCN Planning Advisory Committee (PAC). Following the initial terminal building concept presentation to ADOT, it was decided that, in addition to the simple/ linear terminal concept combination originally intended to replace the current terminal building facility, a unit terminal or modular terminal concept be designed to accommodate ultimate peak hour passenger enplanement activity. Two unit terminal or modular terminal concepts were designed which resulted in a new stand alone terminal building, as well as a



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horizontal expansion of the existing terminal facility to include the addition of unit terminals.

Unlike the airfield alternative concepts, a 'No Action' terminal building alternative will not be included as one of the development options. The commercial service terminal area facility requirements analysis determined that the existing terminal building is inadequate for current, as well as future, needs of airport passenger activity. A 'No Action' option is not viewed as a feasible course of action from an operational standpoint given the current and anticipated passenger demand at GCN. Therefore, **Terminal Building Alternatives A, B, and C** present a broad range of terminal building expansion options that are intended to replace the existing terminal building structure. Terminal Building Alternatives A, B, and C are discussed in the following passages.

Terminal Building Alternative A- Centralized Linear Option: Terminal Building Alternative A involves the development of a 60,000 square foot single-level centralized linear terminal building accommodating eight Type A aircraft gates designed to host Category C aircraft.

Terminal Building Alternative B- Centralized Linear/ Unit-Terminal Option: Terminal Building Alternative B involves the same square footage requirement as Alternative A, but involves the development of four attached modular departure lounge structures accommodating eight Type A aircraft gates designed to host Category C aircraft linked by an enclosed passenger access corridor.

Terminal Building Alternative C- Centralized Linear/ Unit-Terminal/ Pier Option: Terminal Building Alternative C involves the same square footage requirement as Alternatives A and B and involves the development of four attached modular departure lounge structures linked by an enclosed passenger access corridor as with Alternative B. However, Alternative C is in essence a horizontal expansion of the existing terminal building and features a pier extension from the core of the newly renovated terminal building that accommodates concessionaire services and passenger circulation lobbies.

Table 4.19 located in the *Airport Facility Requirements* chapter summarizes the passenger terminal building spatial requirements and recommended terminal facilities to be included in the terminal building alternatives for GCN. The terminal building spatial requirements for GCN were based on the estimation that the Airport would experience approximately 279 peak hour commercial service enplanements in the year 2022. More importantly, the GCN terminal building spatial analysis was also based on the assumption that 100 percent of commercial service fixed wing passenger enplanements taking place at GCN would be processed exclusively through the future passenger terminal building.

Terminal Building Alternative A- Centralized Linear Option

Terminal Building Alternative A, depicted in **Exhibit 5.4**, shows the development of a 60,000 square foot centralized liner terminal building facility.



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The following list of attributes are characteristics of Terminal Building Alternative A:

- ✦ The new terminal building and parking facilities will be located approximately 2,000 feet south-southwest of the existing terminal building immediately adjacent to Taxiway C.
- ✦ The estimated amount of acreage needed to accommodate Terminal Alternative A equates to approximately 18 acres of airport property.

Operational Considerations

Terminal Building Alternative A provides four airline tickets counters to accommodate eight commercial operators, three restroom facilities, 10-12 concessionaire service areas, one security checkpoint, airport administration/ operations facilities, a baggage claim area, as well as ample terminal building curb frontage (670 linear feet) and public auto parking accommodations for passenger vehicles (419 parking spaces) and employee/tenant parking spaces (63 spaces), as well as bus parking facilities and passenger van accommodations (82 spaces).

Financial Considerations

A detailed analysis of the financial implications of each terminal building alternative was prepared as part of this alternatives analysis. The architect's opinion of probable construction costs for the implementation of Terminal Building Alternative A was calculated to be approximately \$13.9 million.



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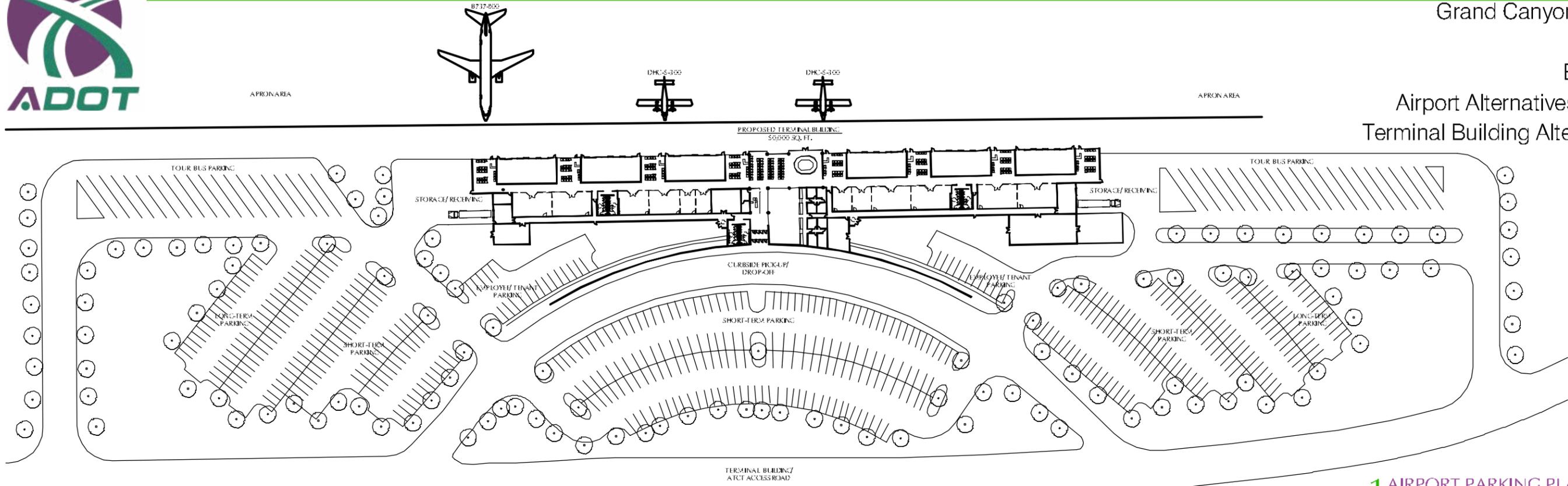


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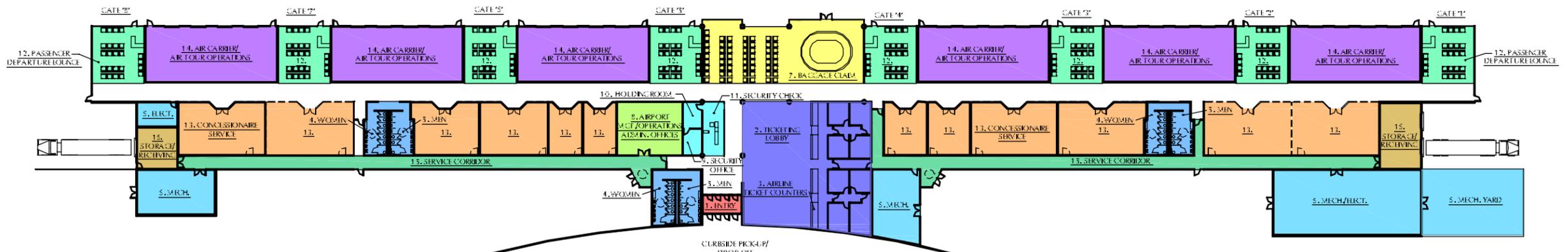
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Exhibit 5.4

Airport Alternatives Analysis Terminal Building Alternative 'A'



1 AIRPORT PARKING PLAN
1" = 50'-0"



1 FLOOR PLAN
1" = 30'-0"



GENERAL AREA PLAN 3/25/11 - Not to Scale



LEGEND

- 1. ENTRY
- 2. TICKETING LOBBY
- 3. AIRLINE TICKET COUNTERS
- 4. WOMEN'S RESTROOM
- 5. MEN'S RESTROOM
- 6. MECHANICAL/ELECTRICAL
- 7. BAGGAGE CLAIM
- 8. AIRPORT AGT/ OPERATIONS/ ADMIN. OFFICES
- 9. SECURITY OFFICE
- 10. HOLDING ROOM
- 11. SECURITY CHECK AREA
- 12. PASSENGER DEPARTURE LOUNGE
- 13. CONCESSIONAIRE SERVICE
- 14. AIR CARRIER/ AIR TOUR OPERATIONS
- 15. SERVICE CORRIDOR
- 16. STORAGE/ RECEIVING



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Potential Environmental Impacts

With the exception of minor construction impacts, Terminal Building Alternative A would not be expected to result in any adverse environmental impacts to the surrounding community or airport environment.

Terminal Building Alternative B- Centralized Linear/ Unit-Terminal Option

Terminal Building Alternative B, depicted in **Exhibit 5.5**, accommodates the same spatial requirements and recommended facilities as Terminal Alternative A with some discreet differences. These differences are noted within the *Operational Considerations* section below.

The following list of project attributes are characteristics of Terminal Building Alternative B:

- ✦ The new terminal building and parking facilities will be located approximately 2,000 feet south-southwest of the existing terminal building immediately adjacent to Taxiway C.
- ✦ The estimated amount of acreage needed to accommodate Alternative B equates to approximately 16 acres of airport property.

Operational Considerations

Terminal Alternative B provides five large concessionaire services areas and two restroom facilities in the centralized portion of the terminal building. However, unlike Alternative A, Alternative B is equipped with four unit terminals or modules that accommodate a total of four increased capacity departure lounges accompanied by eight Type A aircraft gates, four restroom facilities and three air tour operations/ canyon tour shuttle common areas designated to accommodate buses during periods of inclement weather. Like Alternative A, Alternative B depicts the four unit terminals/ modules being connected by an enclosed passenger access corridor.

Like Terminal Alternative A, Terminal Alternative B is also expected to accommodate the same curb frontage and parking facilities as in Alternative A, including 670 linear feet curb frontage, 419 parking spaces public auto parking spaces for passenger vehicles and 63 spaces for employee/ tenant parking, as well as 82 spaces for bus parking facilities and passenger van accommodations.

Financial Considerations

The architect's opinion of probable construction costs for the implementation of Terminal Building Alternative B was calculated to be approximately \$13.0 million.

Potential Environmental Impacts

With the exception of minor construction impacts as with Alternative A, Alternative B would not be expected to result in any adverse environmental impacts to the surrounding community or airport environment.



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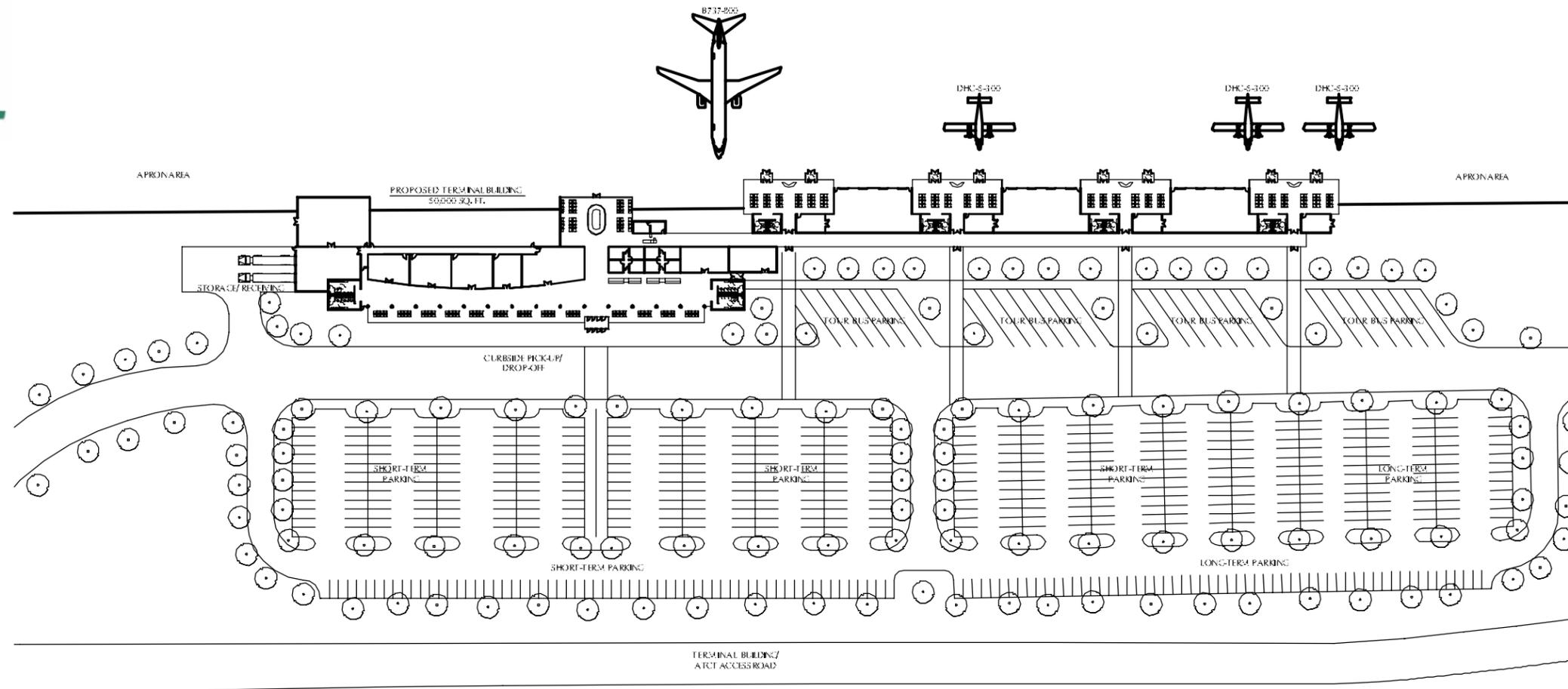


Grand Canyon National Park Airport

Grand Canyon, Arizona

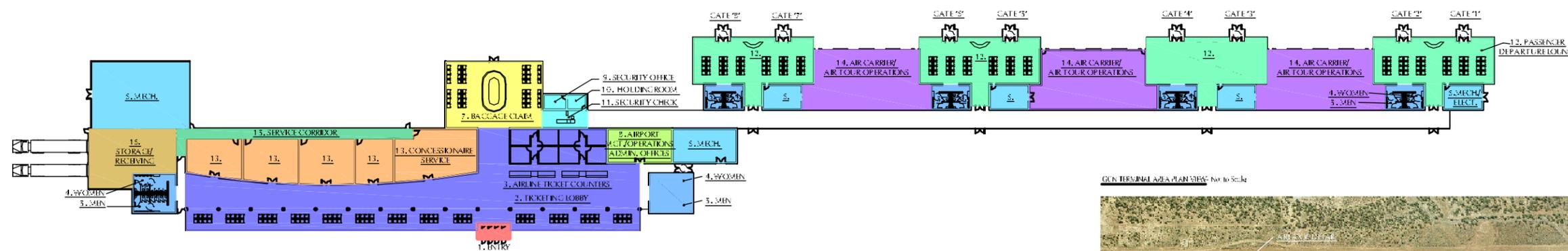
Exhibit 5.5

Airport Alternatives Analysis
Terminal Building Alternative 'B'



2 AIRPORT PARKING PLAN

1" = 50' 0"



2 FLOOR PLAN

1" = 40' 0"



GEN. TERMINAL AREA PLAN VIEW Not to Scale



- LEGEND
- 1. ENTRY
 - 2. TICKETING LOBBY
 - 3. AIRLINE TICKET COUNTERS
 - 4. WOMEN'S RESTROOM
 - 5. MEN'S RESTROOM
 - 6. MECHANICAL/ELECTRICAL
 - 7. BAGGAGE CLAIM
 - 8. AIRPORT MGMT./OPERATIONS/ADMIN. OFFICES
 - 9. SECURITY OFFICE
 - 10. HOLDING ROOM
 - 11. SECURITY CHECK AREA
 - 12. PASSENGER DEPARTURE LOUNGE
 - 13. CONCESSIONAIRE SERVICE
 - 14. AIR CARRIER/AIR TOUR OPERATIONS
 - 15. SERVICE CORRIDOR
 - 16. STORAGE/RECEIVING



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Terminal Building Alternative C- Centralized Linear/ Unit-Terminal/ Pier Option

Terminal Building Alternative C, depicted in **Exhibit 5.6**, accommodates the same spatial requirements and recommended facilities as Terminal Alternatives A and B. Alternative C, however, incorporates three terminal design concepts with the centralized terminal building concept and utilizes the existing terminal building facility. By utilizing the current facility, Alternative C is a linear horizontal expansion of the existing GCN terminal building.

Alternative C incorporates a unique design in that it includes the development of a pier extension accommodating concessionaire service areas, passenger circulation and waiting lounges, as well as restroom facilities. Also included in Alternative C is the design of a rotunda-like ticketing lobby accommodating up to seven air tour ticketing counters, as well as additional area for airport management, operations and administration offices.

The following list of attributes are characteristics of Terminal Building Alternative C:

- ✦ The new terminal building and parking facilities will be located adjacent to the existing terminal building immediately south and west of the airport apron.
- ✦ The estimated amount of acreage needed to accommodate Alternative C equates to approximately eight acres of airport property. This estimate does not take into account the renovation of the current terminal building or the reconfiguration of existing auto parking facilities. The eight acres accounts for the new terminal building structure, as well as the development of additional auto parking areas.
- ✦ Removal and relocation of the existing airport administration office structure to the south of the existing terminal building.
- ✦ Removal and relocation of the airport mobile maintenance structures located to the east of the airport administration building.
- ✦ Renovation and rehabilitation of the existing 8,500 square foot passenger terminal building to accommodate primarily concessionaire service providers and baggage pick-up area.
- ✦ Reconfiguration of the existing terminal building auto and bus parking areas.

Operational Considerations

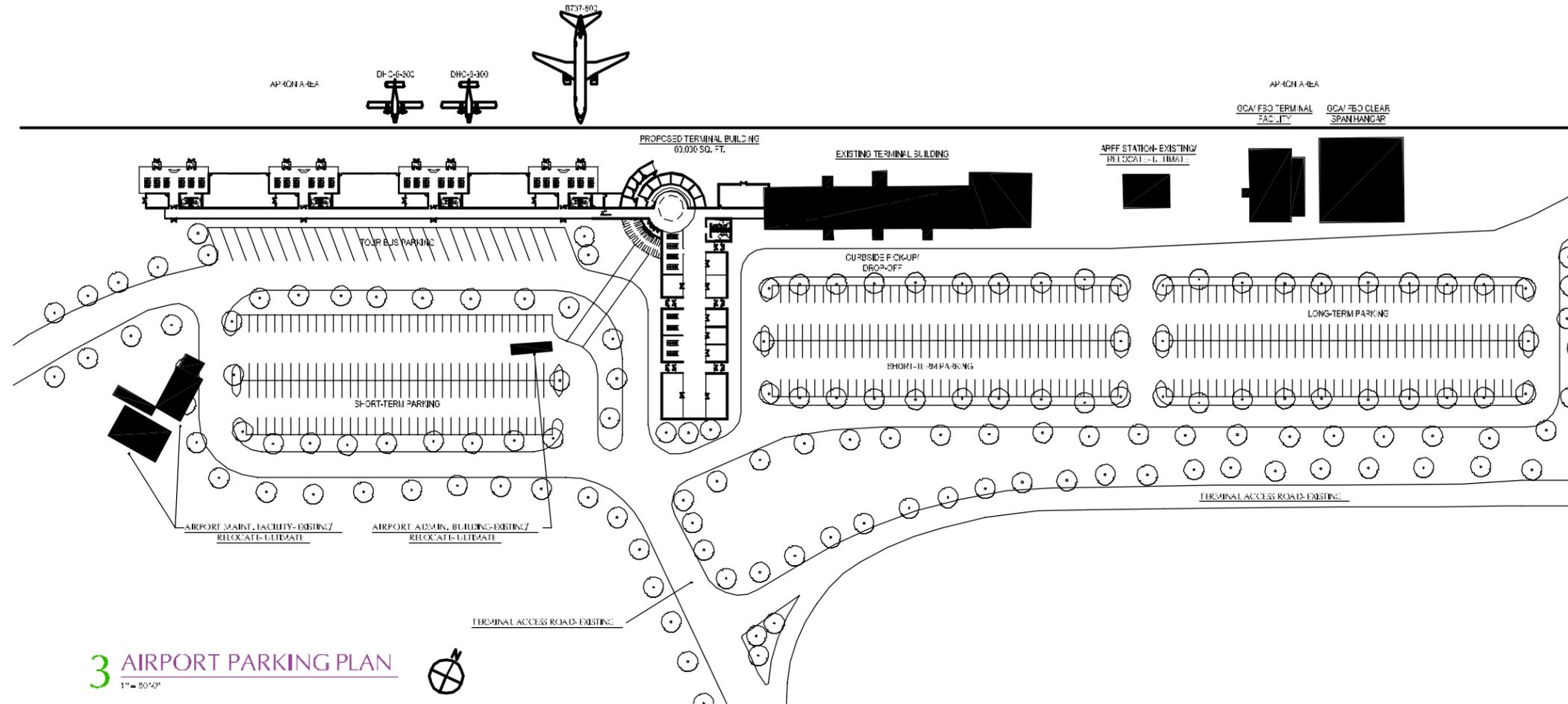
Additional physical design characteristics of Terminal Building Alternative C include eight concessionaire service areas in addition to the renovation of the current GCN terminal building, and one restroom facility in the centralized portion of the terminal building. Like Alternative B, Alternative C is equipped with four unit terminals or modules that accommodate increased capacity departure lounges accompanied by



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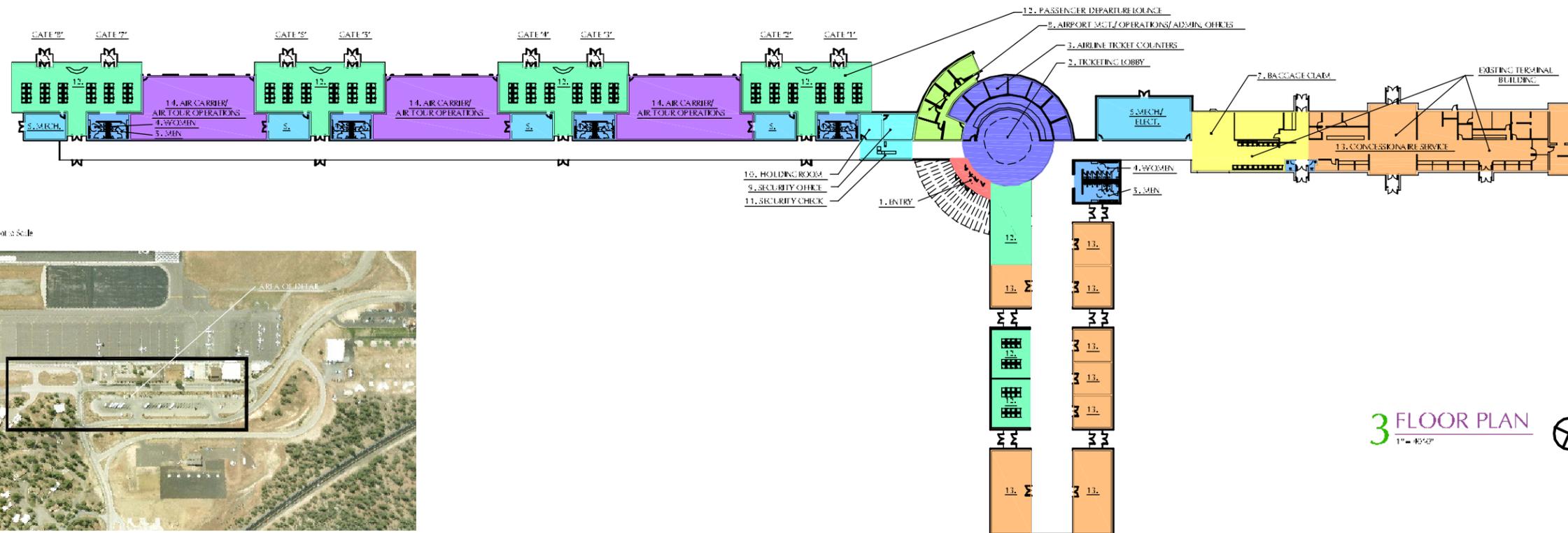
Grand Canyon, Arizona

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3 AIRPORT PARKING PLAN

1" = 80'-0"



3 FLOOR PLAN

1" = 40'-0"

- LEGEND
- 1. ENTRY
 - 2. TICKETING LOBBY
 - 3. AIRLINE TICKET COUNTERS
 - 4. WOMEN'S RESTROOM
 - 5. MEN'S RESTROOM
 - 6. MECHANICAL/ELECTRICAL
 - 7. BAGGAGE CLAIM
 - 8. AIRPORT SGT./OPERATIONS/ADMIN. OFFICES
 - 9. SECURITY OFFICE
 - 10. HOLDING ROOM
 - 11. SECURITY CHECK AREA
 - 12. PASSENGER DEPARTURE LOUNGE
 - 13. CONCESSIONAIRE SERVICE
 - 14. AIR CARRIER/AIR TOUR OPERATIONS

CON TERMINAL AREA PLAN VIEW: NOT TO SCALE





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eight Type A aircraft gates, four restroom facilities, and three air tour operations/ canyon tour shuttle common areas designated to accommodate buses during periods of inclement weather. Like Terminal Alternatives A and B, Alternative C also depicts the four unit terminals/ modules being connected by an enclosed passenger access corridor. Additionally, as with Alternatives A and B, Alternative C will accommodate the required curb frontage and auto parking facilities specified in the commercial service terminal area facility requirements analysis.

Financial Considerations

The architect's opinion of probable construction costs for the implementation of Terminal Building Alternative C was calculated to be approximately \$10.5 million.

Potential Environmental Impacts

With the exception of minor construction impacts as with Alternatives A and B, Alternative C also would not be expected to result in any adverse environmental impacts to the surrounding community or airport environment.

Summary of Terminal Building Alternative Concepts

Table 5.2 summarizes the three terminal building development options for the GCN alternatives analysis. Development cost estimates for each terminal building concept were limited to terminal infrastructure items including public auto parking facilities, utility extension to the site, demolition of the existing terminal building and paved areas, substructure stabilization, exterior and interior items, security equipment, structural and mechanical items, as well as engineering, architectural, legal and administrative costs. Each terminal development design option was examined and graded based on a Likert rating scale (1- least favorable, 4- most favorable) considering selected physical attributes and site characteristics associated with each proposed option.

Based on the terminal building development alternatives analysis including operational, financial and environmental considerations, the GCN PAC elected to pursue **Terminal Building Alternative C** as the preferred ultimate passenger terminal building development option. **Terminal Building Alternative C** provides the optimum level of passenger convenience and operational efficiency capable of accommodating the future passenger demand characteristics at GCN.

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Table 5.2
Terminal Building Alternative Concept Comparison
Grand Canyon National Park Airport

Operational Considerations			
	Terminal Alternative A	Terminal Alternative B	Terminal Alternative C
Physical Attributes			
Terminal Building Size (Area)	60,000 sq. ft.	60,000 sq. ft.	60,000 sq. ft.
Number of Aircraft Gates	Eight (8)	Eight (8)	Eight (8)
Single/ Multi Level	Single Level	Single Level	Single Level
Terminal Building Concept	Centralized	Unit Terminal	Unit- Terminal
Terminal Design Concept	Simple/ Linear	Simple/ Linear	Simple/ Linear/ Pier
Utilize Existing Terminal Building	No	No	Yes
Financial Considerations			
Development Costs (Millions)	\$13.9	\$13.0	\$10.5
Potential Environmental Impacts			
Impact Category	Construction Impacts	Construction Impacts	Construction Impacts
Terminal Building Concept Analysis Matrix (1- Least Favorable, 4- Most Favorable)			
Runway Configuration	4	4	4
Surface Transportation Access	3	3	4
Expansion Potential	4	4	4
FAA Design Criteria	4	4	4
Existing Planned Facilities	4	4	3
Terrain/ Topography	2	2	3
Environmental Impacts	3	3	3
Overall Design Rating	24	24	25

For additional information on the future terminal building rating evaluation criteria, refer to Chapter IV, Passenger Terminal Building Siting Considerations section.

Source: BWR, Terminal Building Alternative Concept Comparison, June 2004.

Support Facility Alternative Concepts

Support facilities present at GCN include airport fueling/ fuel farm facilities, aircraft rescue and firefighting (ARFF), snow removal/ equipment (SRE) and air traffic control tower (ATCT) facilities. This section of the alternatives analysis will include a general summary of the current and anticipated status of support facilities, as well as the projected need for additional facilities.

Airport Fueling/ Fuel Farm Facilities

The airport fueling facilities administered and operated by Grand Canyon Airlines (GCA) were inventoried and discussed in Chapter II, *Airport Inventory*, as well as Chapter IV,



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Airport Facility Requirements. During the course of completing Chapter IV, it was determined that the fueling storage facilities and dispensing capabilities were adequate to accommodate the existing and ultimate peak hour aviation demand throughout the 20 year planning period. Therefore, fuel facility alternative development concepts will not be necessary as part of the GCN support facility alternatives analysis.

Air Traffic Control Tower (ATCT) Facilities

The GCN ATCT facilities were inventoried and described in Chapter II and Chapter IV. Commissioned in March 2003 and owned and operated by the FAA, the GCN ATCT is expected to remain in service for at least 10 years beyond its 20 year design life span (2033). Based on this conclusion, ATCT alternative development concepts will not be necessary as part of this support facility alternatives analysis.

Aircraft Rescue & Firefighting (ARFF)

GCN ARFF facilities and capabilities were inventoried and described in Chapter II and Chapter IV. The current ARFF facility, located to the immediate northeast of the existing passenger terminal building, is inadequate from a spatial and facility standpoint to accommodate aviation demand levels throughout the 20 year planning period. As indicated in Chapter IV, plans are under way to initiate construction of a new \$3.5 million ARFF/ maintenance/ snow removal and equipment (SRE) facility capable of accommodating four ARFF vehicles, as well as another four SRE maintenance/ snow removal vehicles. The general location of the new GCN ARFF facility is depicted in **Exhibit 5.7**.

Snow Removal Equipment (SRE) & Maintenance Facilities

The GCN SRE and maintenance facilities were inventoried and described in Chapter II and Chapter IV. The current SRE and maintenance facilities, located to the southeast of the airport administration building, are anticipated to be relocated and housed within the new \$3.5 million ARFF/ maintenance/ SRE facility scheduled for completion during the first phase of capital development. The general location of the new GCN SRE and maintenance facility is depicted in **Exhibit 5.7**.

Additional Landside Alternative Concepts

Residential Use Alternatives

During completion of Chapter IV, the National Forest Service (NFS) representative of the GCN PAC commented that the current NFS living quarters were approaching capacity. This is due, in part, to FAA personnel who work at GCN occupying residences at the NFS facility. On learning of this condition at the NFS facility, the GCN PAC suggested that alternative concepts be generated to determine on-airport locations best fit to accommodate additional residences for individuals who work at the Airport. It should be noted that airport personnel employed by ADOT currently reside on airport property in state sanctioned and administered housing facilities located to the southeast of the airport administration building.



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The FAA, Western Pacific Region (WPR), was contacted to determine potential issues with development of additional residences on airport property. The FAA WPR cautioned that although the Airport currently accommodates residences for existing airport personnel employed by ADOT, residential use on-airport is a non-aeronautical and incompatible land use with airports and advised against it. The FAA WPR did concede that given the unique location and operation of the Airport, residential use on airport property, although not ideal, is a necessity for employees who administer and operate the Airport on a full-time basis. The FAA WPR suggested that ADOT and NFS officials discuss land acquisition by ADOT or transfer of property from the NFS to ADOT to be used for additional residential accommodations for Federal employees at the Airport. The amount of land required, as well as utility demand for Federal employee residential development at GCN, would need to be determined by the FAA, NFS and ADOT. The general location of a site ideal for potential residential development is depicted in **Exhibit 5.7**.

Given the discussion above, it is apparent that housing is a critical issue at the Airport, as well as throughout the region. Also, given the non-compatible and non-aeronautical nature of on-airport housing at GCN, ADOT elected to determine what housing options, if any, are available locally, particularly in Tusayan.

Currently, northeast Tusayan is occupied by a Recreational Vehicle (RV) park. This RV park is slated for removal to be replaced by a multiple family residential and commercial development. The timeframe for redevelopment has been tentatively set for two years and the proposed facilities and acreage has yet to be determined. Based on the tentative timeframe for development, it appears that the on-airport housing arrangement is better suited for state airport employees.

The Canyon Forest Village was to be a residential and commercial development that included 300,000 square feet of office space, 900 hotel rooms and 500 to 1,000 housing units. The Village was envisioned to be developed north of Tusayan adjacent to AZ Hwy 64 and located between the Grand Canyon IMAX theater and Moqui Lodge. In recent years the concept was abandoned and it is unknown if the developer will attempt further development at the proposed site. It is unlikely that this property will be further developed for residential use; therefore, the on-airport residential housing appears to be the most feasible option for state employees in the short-term timeframe.

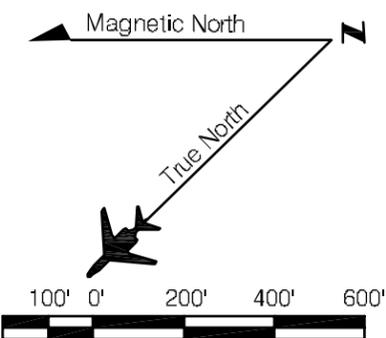
Citing a shortage of housing for school teachers in the Grand Canyon region and in an attempt to reduce commuting times from outlying communities, the Grand Canyon Unified School District (GCUSD), in accordance with the Educational Land Grant Act, has petitioned the National Forest Service for transfer of property located adjacent to the north-northwest section of the airport property boundary. This 80 acre parcel of land will host high school facilities, athletic complex, district offices, maintenance facilities, parking facilities, housing facilities, as well as various educational related structures. Currently, conveyance and development of the property is tentative and viewed as a long-term community investment. It is yet to be determined whether or not the conveyance of this forest land will be in the public good and deeded to the GCUSD. Potential issues



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Airport Alternatives Analysis Support Facility Alternative 'A' ARFF/ SRE/ Maintenance Facility Siting

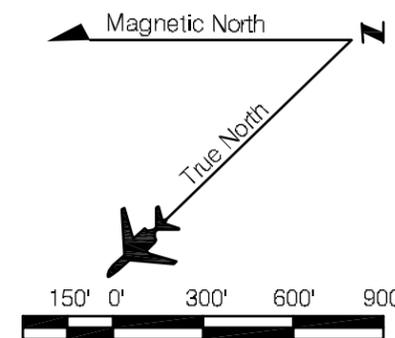
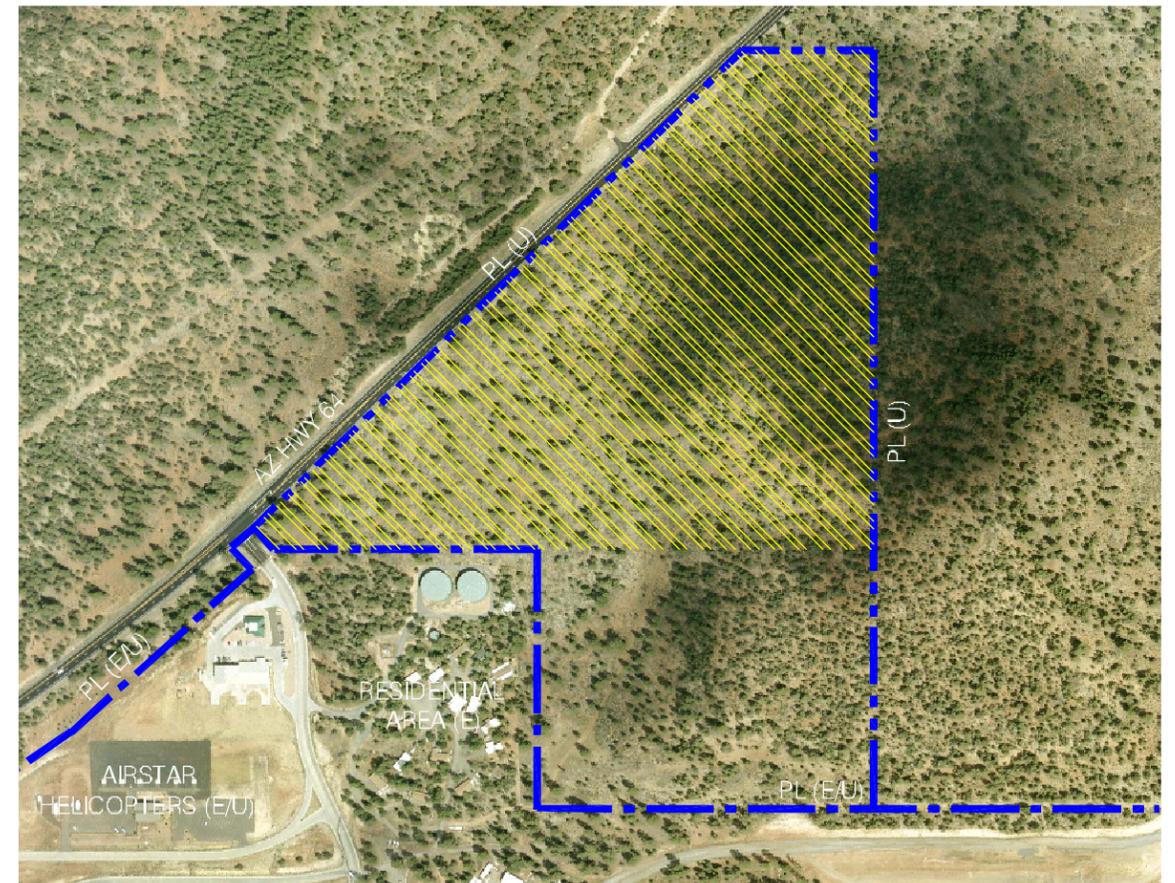


LEGEND
ARFF/ SRE/ Maintenance Siting Area- Ultimate- 
Property Line- Existing - 

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Exhibit 5.7 Airport Alternatives Analysis Landside Development Alternative 'A' Residential Development Siting



LEGEND
Residential Development Area- Ultimate- 
Property Line- Existing - 



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associated with the GCUSD relocation of education facilities adjacent to the Airport involve aircraft overflight as well as airport and aircraft sound levels during hours of airport operations and sustained air tour activity. Although not located within the future 65 DNL noise contour of the Airport, the proposed land use by the GCUSD is incompatible with airport operations. Refer to the Grand Canyon National Park Airport Layout Plan set, *Airport Land Use Plan Drawing*, to reference the conceptual site location of the long-term GCUSD education campus located adjacent to GCN.

Potential Intermodal Transportation Alternative

The 1991 GCN master plan update included a future intermodal hub at the airport in support of aviation, rail and automobile transportation services to the Park. This concept was first introduced by the National Park Service (NPS) and the Grand Canyon Railway (GCRR) as a means of reducing vehicular congestion within the Grand Canyon National Park. It should be noted that each study was generated exclusively of one another and neither the NPS nor the GCRR endorses the other party's transportation plan. Since that time, the topic of Park congestion by vehicular traffic has remained a concern for the NPS. This prompted a study to be conducted by the NPS titled *Report to Congress on Transportation Alternatives for the Grand Canyon National Park*. This study offers five transportation alternatives which involve a combination of rail, bus and shuttle, as well as parking facilities, in an effort to reduce surface traffic in the Park.

Most notably, one concept offered by the GCRR to reduce vehicular traffic by 100 percent from the South Rim includes the development of a Regional Rail Plan that provides high speed rail service between the Community of Tusayan and the Canyon Village Information Plaza (CVIP) at Mather Point located within the Park. Phase II of this plan involves the connection of a new track from the existing alignment through Coconino Canyon to Long Jim Canyon situated northwest of Tusayan. The new Tusayan Station, capable of accommodating 1,750 automobiles and 90 Recreational Vehicles (RV), would then be linked to the CVIP station at Mather Point via high speed rail adjacent to Arizona Highway 64. It should be noted that Phase I of the Plan offered by GCRR includes the construction of a new station in Williams, Arizona to accommodate approximately 2,200 automobiles and 110 RVs and provide service between Williams at the existing Maswik Transportation Center located at Grand Canyon Village. Phase I would effectively reduce vehicular traffic at the South Rim by 50 percent.

The Regional Rail Plan offered by GCRR in 2003 precludes, for the time being, the development of a railroad spurline into GCN. However, given the importance of transportation issues evident at the Grand Canyon coupled with projected Park visitation, passenger demand at the Airport, as well as the potential for GCN to be a center for intermodal transportation, the airport sponsor has elected to set aside area available to accommodate a potential GCN railroad depot and associated facilities including a 20,000 square foot depot/ staging area, roadway access from AZ Hwy 64 and parking facilities capable of accommodating 1,750 automobiles and 90 RVs ultimately. The total estimated area required to accommodate a railroad depot at GCN includes approximately 30 acres of land which does not include an estimate of land required to site the train track into the depot/ staging area.



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Operational and developmental factors to be considered with this development option include the acquisition of Kaibab National Forest land from the National Forest Service, as well as construction of an alternate access route from AZ Hwy 64. Alternative access from Hwy 64 is essential in order to eliminate potential congestion of the airport access roads primarily utilized by airport patrons and employees.

Siting and placement of the railroad spuline is an important factor to consider as far as whether or not the track would be located on airport property or Kaibab Forest land. Additionally, siting a spurline into the Airport from the south would need to be far enough from the existing and ultimate runway end so as to not interfere with the 50:1 precision instrument approach procedures to Runway 3. In this instance, a railspur would need to be located at a distance from the runway end that would allow 23 feet of clearance, depending on terrain elevations, over the train track alignment for the full width of the 50:1 precision approach inner surface. Refer to the Grand Canyon National Park Airport Layout Plan set, *Terminal Area Drawing*, to reference a conceptual site plan of the long-term Grand Canyon Railway depot/ staging area at GCN.

Recreational Vehicle (RV)/ Automobile Use Alternatives

Recreational Vehicle Use Options

In addition to potential residential development at GCN, the issue of establishing RV parking facilities at the Airport, on airport property, was entertained by ADOT to determine whether an alternative option was a feasible course of action for the Airport.

The FAA, Western Pacific Region (WPR), was contacted to determine potential issues with development of RV parking facilities on airport property. The FAA indicated that dedicated RV parking facilities on an airport is a non-aeronautical use and advised against it. The FAA indicated that should airport users arrive at the Airport with the intent of utilizing airport and air tour services, ample parking is recommended for short-term stays at the Airport for vehicles operated by airport patrons which includes recreational vehicles. However, facilities dedicated specifically to be used by RV operators for long-term parking use is not recommended due to the fact that GCN does not have any more land area to be dedicated for non-aeronautical uses. Since GCN does not have additional land area to dedicate to RV parking facilities, the FAA, in addition to viewing RV parking being a non-aeronautical use, would not support such an alternative based on the current land availability conditions at the Airport and would advise the airport operator to discourage long-term RV parking.

Should ADOT desire to convert parts of the airport property for non-aeronautical use, the FAA indicated that the cost of the development is not a reimbursable item eligible for Airport Improvement Program (AIP) funding and suggested that the fees and charges for the use of such non-aeronautical areas to be passed on to the user is recommended to be set at Fair Market Value.



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Automobile/ Private Vehicle Use Options

In addition to potential RV use at the Airport, the airport sponsor and the master plan PAC suggested that additional surfaced based transportation options be explored as potential long-term development options at the Airport. In particular, as discussed within the *Potential Intermodal Transportation Alternative* section above, the option of developing additional automobile and RV parking facilities located adjacent to the current airport property would be explored. This long-term option involves reserving area for the development of auto and RV parking facilities in close proximity to the terminal area complex and employee residential area as a potential alternative site for the proposed Long Jim Canyon GCRR staging area to be located northwest of Tusayan as part of the GCRR Regional Transportation Plan.

The automobile and RV parking facilities for this long-term use option would be developed to accommodate the same number of parking spaces that would be required to accommodate projected parking demand in an attempt to reduce the vehicular traffic to the South Rim of the Grand Canyon. As stated above, the parking facilities would occupy approximately 30 acres of land designed to ultimately accommodate 1,750 vehicles and 90 RVs. However, this development option would primarily involve shuttle service between the parking facility and Grand Canyon Village via AZ Hwy 64, should the option of constructing a railroad spurline into the Airport prove not to be a feasible or operational option. Should the development of the spurline prove to be a reasonable option, both modes of transportation into the park would be available for Park visitors. Operational and developmental factors to be considered with this development option include the same attributes as stated within the *Potential Intermodal Transportation Alternative* section.

Refer to the Grand Canyon National Park Airport Layout Plan set, *Terminal Area Drawing*, to reference a conceptual site plan of the long-term Grand Canyon Railway automobile/ RV parking area facilities at GCN.



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