Chapter 3

Airport Demand and Facility Requirements

The objective of this chapter is to identify, in general terms, the adequacy of the existing facilities at North Las Vegas Airport (VGT) and outline what facilities may be needed to accommodate future demands. Airport facilities include both runway and airside (hangars, aprons, taxilanes) components. Runway components include the runway system (runways and taxiways), navigational aids, lighting, markings, aprons, and hangars. Landside components include terminal facilities, maintenance facilities, auto parking, surface road access, and support facilities. Having established the facility needs, alternatives for providing these facilities will be evaluated in the following chapter.

3.1 INTRODUCTION

Capacity and demand analyses were completed for airside, landside, and support facilities to evaluate existing infrastructure against forecast demand. These analyses were then used to develop facility requirements for the base year (2023), near-term (2028), mid-term (2033), and long-term (2043) timeframes. These planning milestones will allow the Clark County Department of Aviation (CCDOA) to make informed decisions regarding the timing of development and expansion. While the forecast and facility needs are tied to specific planning years in this airport master plan, the facility needs would need to be adjusted a corresponding amount should actual demand deviate from the forecasts.

A summary of based aircraft and operations forecasts is presented in **Figure 3.1**. Design hour operations reported in Chapter 2 reflect an average of 10 busiest hours experienced during the peak month (October). Peak hour operations forecasts were developed for this chapter to calculate annual service volume. Peak hour operations were calculated based on an average of the peak hours of each day during the peak month, resulting in a peak hour of 122 operations. The growth rate for peak hour operations was assumed to be commensurate with design day operations. The purpose of developing a second peak operations forecast was to provide a more accurate representation of elevated levels of airfield demand that regularly occur on the airfield and more accurately reflect the airfield's actual annual service volume.

Figure 3.1 – *Forecast Summary*

YEAR	Based Aircraft	Annual Operations	Peak Month Operations	Design Day Operations	Design Hour Operations	Peak Hour Operations
2023	511	164,781	18,059	735	60	122
2028	584	198,404	22,260	816	67	135
2033	638	213,637	24,525	905	74	150
2038	696	230,547	27,066	1,004	82	167
2043	758	249,773	29,973	1,114	91	185
CAGR (2023-2043)	2.0%	2.1%	2.6%	2.1%	2.1%	2.1%

Source: FAA OPSNET; Traffic Flow Management System Count
Coffman Associates
Note: CAGR = compound annual growth rate
2023 total operations are represented by the last 12 months of data collected ending July of 2023.

The recommendations in this chapter incorporate forecast operational data from Chapter 2, as well as feedback from airport personnel, tenants, and other stakeholders, which was obtained during technical advisory committee (TAC) and planning advisory committee (PAC) meetings, interviews, and public meetings.

3.2 AIRFIELD DEMAND AND CAPACITY

The analysis presented in this section reflects the airfield's anticipated ability to accommodate forecast levels of demand, as presented in Chapter 2. A detailed capacity analysis was completed as part of the 2020 *North Las Vegas Runway Incursion Mitigation Study* (RIM Study). The RIM Study utilized the Transportation Research Board's (TRB) Airport Cooperative Research Program (ACRP) Project 3-17 (published in 2012), which is an updated model of airfield capacity, compared to the Federal Aviation Administration's (FAA) Advisory Circular (AC) 150/5060-5, *Airport Capacity and Delay*, which was last updated in 1995. The results of the RIM Study's capacity analysis are summarized below and updated to reflect the forecasts prepared in this master plan.

3.2.1 AIRFIELD CAPACITY

Airfield capacity, also referred to as throughput capacity, is a measure of the maximum number of aircraft operations an airfield can accommodate in a specified time period (i.e., hourly or annually) without incurring substantial delay. As operations or demand approach and potentially exceed the capacity of the airfield, individual aircraft delay will increase.

Airfield capacity evaluation is used in long-range planning to help identify and justify any capacity-related airfield improvements that may be needed over the planning horizon. The analysis also determines the average amount of aircraft delay that could be expected during peak periods of activity. Strategies to mitigate aircraft delay and enhance airfield capacity typically require significant lead time; therefore, it is important to identify potential capacity constraints well in advance of actual needs. The estimated airfield capacity and delay at VGT can be expressed in the following measurements:

- Hourly capacity is the maximum number of aircraft operations the airfield can safely accommodate under continuous demand in a one-hour period.
- Annual service volume is the maximum number of aircraft operations the airfield can accommodate in a one-year period without excessive delay.
- Delay is the time difference between an unconstrained operation (no interference from other aircraft) and the actual amount of time required to conduct an operation. Delay is typically presented in terms of minutes.

Airfield Capacity Analysis

Airfield capacity can be affected with or without physical construction occurring at the airport. Multiple factors impact airfield capacity, including runway configuration and usage, location of exit taxiways, meteorological conditions, percentage of touch-and-go operations, airspace constraints, operational aircraft fleet mix, and others. Based on factors impacting airfield capacity at VGT, application of methodologies and guidance described in ACRP Project 3-17 were used to determine peak hour capacity and annual service volume. Peak hour capacity is determined for both visual flight rule (VFR) and instrument flight rule (IFR) conditions and is a measurement of the maximum number of operations an airfield can accommodate in a one-hour period. Annual service volume (ASV) reflects total annual operations that an airfield configuration can accommodate (accounting for the identified capacity calculation factors) without incurring significant delay on a regular basis.

The capacity analysis completed for the RIM Study established that the airfield layout can be modeled in north and south flow configurations. In a north flow configuration, Runways 30L/30R and 25 are in use. In a south flow configuration, Runways 12L/12R and 7 are in use. Based on prevailing wind conditions, the north flow configuration is in effect for 40 percent of operations and the south flow configuration is in effect for 60 percent of operations. These assumptions are carried forward as part of the capacity analysis for this master plan.

As summarized in **Table 3.1**, VGT's VFR and IFR hourly capacities are anticipated to increase slightly over the planning period – which is primarily a result of increased total operations levels spread more throughout the day – which dampens peaking period impacts, along with an increasing percentage of touch-and-go operations occurring at VGT. The VFR capacity increases from 166 currently to 188 by 2043, and the IFR capacity increases from 130 to 155. ASV is expected to range between 221,700 and 265,300. Fluctuations in ASV over the course of the planning period can be attributed to changes in the aircraft fleet mix (increasing flight training activity) and changing peaking statistics.

Table 3.1 | Airfield Capacity Summary

Year	VFR Hourly Capacity	IFR Hourly Capacity	Annual Service Volume	VGT Annual Ops	% ASV
2023	166	130	221,700	164,781	74%
2028	181	149	265,300	198,404	75%
2033	183	151	256,900	213,637	83%
2038	186	154	256,500	230,547	90%
2043	188	155	252,700	249,773	99%

Source: ACRP Project 3-17; Coffman Associates

Aircraft Delay

FAA AC 150/5060-5 provides guidance to calculate annual aircraft delay in terms of minutes per aircraft operation. This is an important component because it highlights impacts of potential airfield constraints compared with expected activity and identifies if capacity-enhancing improvements may be needed. Delay is calculated based on the ratio of existing and forecast operations to annual service volume. **Table 3.2** shows the forecast annual operations, expected average aircraft delay (minutes per operation), and total annual aircraft delay (hours). As shown, it is anticipated that VGT will incur approximately 9,991 hours of total aircraft delay by 2043.

Table 3.2 | Annual Service Volume, Capacity, and Annual Aircraft Delay

Year	VGT Annual Operations	Annual Service Volume	Ratio of Operations to Annual Service Volume	Delay per Aircraft Operation (minutes)	Total Annual Delay (hours)
2023	164,781	221,700	74%	0.7	1,922
2028	198,404	265,300	75%	0.7	2,315
2033	213,637	256,900	83%	1.1	3,917
2038	230,547	256,500	90%	1.4	5,379
2043	249,773	252,700	99%	2.4	9,991

Sources: FAA Advisory Circular 150/5060-5, Airport Capacity and Delay; Coffman Associates, 2024

Airfield Demand-Capacity Summary

The FAA recommends that an airport sponsor should begin planning for airfield capacity enhancements (such as additional exit taxiways, additional runways, etc.) when the ratio of annual demand to annual service volume reaches 60 percent, and that implementation of such improvements should occur when the ratio reaches 80 percent. As shown in **Table 3.2**, VGT is already at the 60 percent threshold and will reach the 80 percent threshold between 2033 and 2038. Ultimately, annual operations are forecasted to reach 99 percent of ASV by 2043.

Airfield capacity constraints at VGT and across the entire Clark County system of airports are a known issue to the CCDOA. To address this, the CCDOA has started planning the development of a Southern Nevada Supplemental Airport (SNSA). While the primary purpose of the SNSA is to alleviate commercial aviation congestion at Harry Reid International Airport (LAS), the new airport would also supplement the county airport system's capacity to handle general aviation traffic and could mitigate capacity issues at VGT, to an extent; however, capacity enhancements at VGT will still be necessary and will be considered during the alternatives process. Due to the constrained nature of the airfield, major capacity enhancement projects, such as constructing an additional runway, may not be feasible. Other options – such as adding runway exits and making the taxiway system more efficient, which could enhance ASV by as much as 12 percent – will be explored.

3.3 FAA DESIGN STANDARDS

FAA AC 150/5300-13B defines the applicable airport design standards for North Las Vegas Airport. Some key design standards, along with how they are determined, associated safety areas they affect, and where they apply at an airport, are defined in **Table 3.3**. A graphical representation of where the various design standards apply at VGT is found on **Figure 3.2**.

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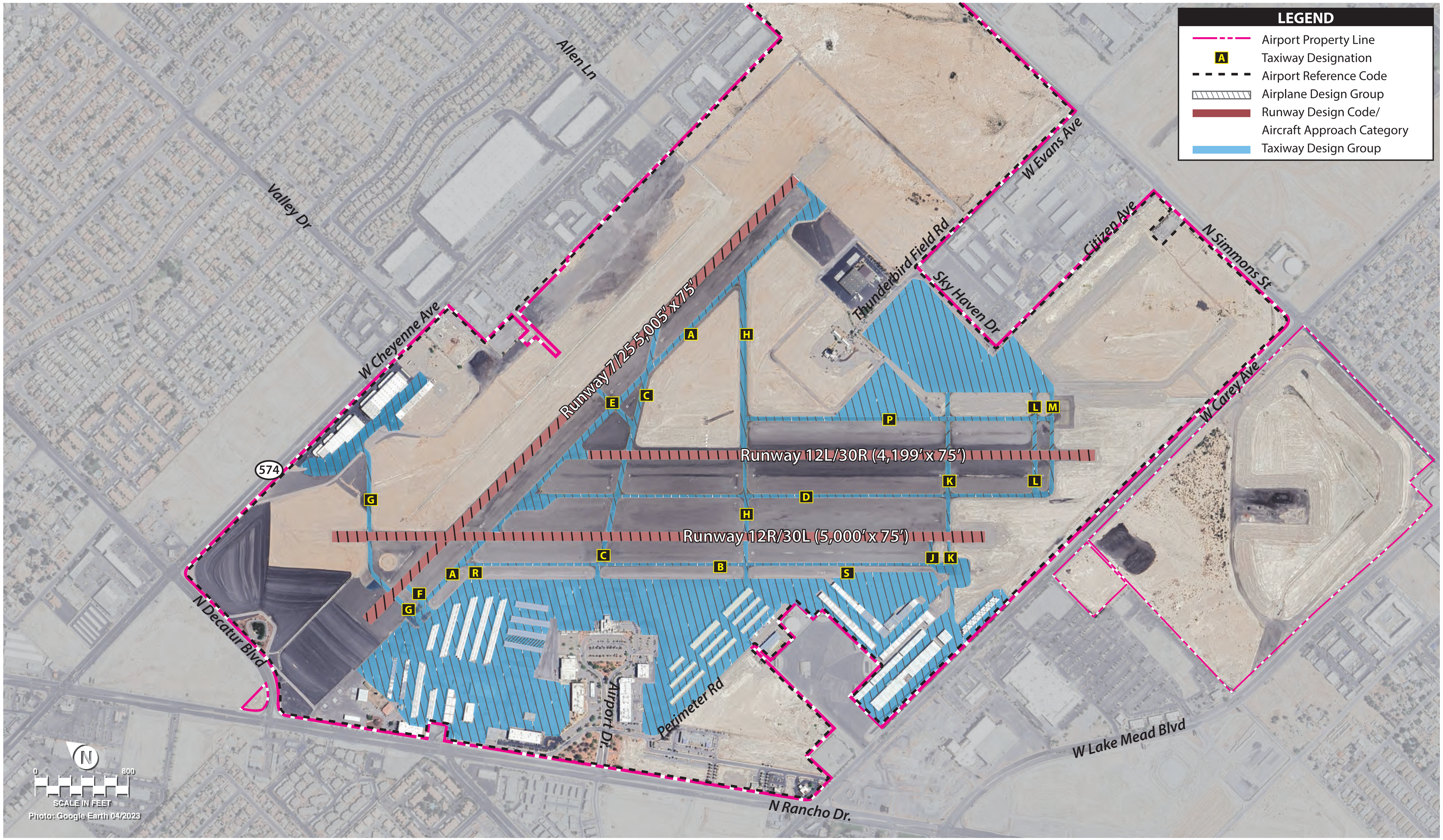


Figure 3.2
APPLICABILITY OF FAA DESIGN STANDARDS

Table 3.3 | Applicability of FAA Design Standards

FAA Design Standards	Applies To	Applicable Design Standards	Defined By
Airport Reference Code (ARC)	Entire Airport	N/A	Airport's highest RDC (minus the visibility component)
Runway Design Code (RDC)	Runway Environment	• Runway Width • Runway Shoulders • Blast Pad Size • Runway Safety Area • Runway Obstacle Free Zone • Runway Object Free Area • Runway Protection Zone • Hold Line Location • Runway to Parallel Taxiway Separation • Runway to Aircraft Parking Areas	RDC for an individual runway. The RDC is comprised of the aircraft approach category (AAC), airplane design group (ADG), and runway visibility minimums. The runway end with the most restrictive visibility minimums defines the visibility component for the runway.
Aircraft Approach Category (AAC) (included as part of the RDC)	Runway Environment	• Runway Width • Runway Safety Area • Runway Object Free Area • Runway Protection Zone • Runway to Parallel Taxiway Separation	Approach speed
Taxiway Design Group (TDG)	Taxiway Environment Apron Areas	• Taxiway Width Taxiway Edge Safety Margin • Taxiway Shoulder Width • Taxiway/Taxilane Centerline to Parallel Taxiway/Taxilane Centerline	Outer to outer main gear width and cockpit to main gear distance
Airplane Design Group (ADG) (included as part of the RDC)	Runway Environment Taxiway Environment Apron Areas	• Taxiway Safety Area • Taxiway Object Free Area • Taxilane Object Free Area • Taxiway Centerline to Parallel Taxiway/Taxilane Centerline Taxilane Centerline to Parallel Taxilane Centerline • Taxiway Centerline to Fixed or Movable Object • Taxilane Centerline to Fixed or Movable Object • Taxiway Wingtip Clearance • Taxilane Wingtip Clearance	Aircraft wingspan and tail height

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

3.3.1 AIRPORT REFERENCE CODE

An airport's design standards are determined by the most demanding aircraft or grouping of aircraft that conduct or are anticipated to conduct 500 annual operations. This is referred to as the critical design aircraft. As previously noted, **an airport's ARC and critical design aircraft are unrelated to aircraft classifications used for airport capacity determinations.**

The airport reference code (ARC) is composed of two airplane classification systems, the aircraft approach category (AAC) and the airplane design group (ADG). The AAC refers to the approach speed of an aircraft in landing configuration and is depicted by a letter (A through E). The higher the approach speed (operational characteristic), the more restrictive the applicable design standards. The AAC generally applies to runways and runway-related facilities, such as runway width, runway safety area (RSA), runway object free area (ROFA), runway protection zone (RPZ), and separation standards. The ADG, which is depicted by a Roman numeral (I through VI), is a classification of aircraft that relates to aircraft wingspan or tail height (physical characteristics). When the aircraft wingspan and tail height fall in different groups, the higher group (more restrictive) is used. The ADG influences design standards for the taxiway safety area (TSA), taxiway object free area (TOFA), taxilane object free area, apron wingtip clearance, and various separation distances.

VGT's current (2020) airport layout plan (ALP) assigned the Beechcraft King Air 350 as the existing and future critical design aircraft for each runway, which is classified with an ARC of B-II. The ARC and critical design aircraft were reevaluated in Chapter 2 of this master plan. Based on operational data obtained via the FAA's Traffic Flow Management System Counts (TFMSC) database, the existing ARC is within C-II; however, forecasts indicate an ultimate ARC of D-III.

The change in critical design aircraft and associated ARCs is significant for VGT. FAA design standards for C-II and D-III runways are more stringent than the requirements for B-II runways. These changes will be described in more detail in the following sections.

3.3.2 RUNWAY DESIGN CODE

The runway design code (RDC) is a code signifying the specific design standards that apply to each individual runway. The RDC is based on planned development and has no operational component. The RDC is simply the ARC combined with the runway visual range (RVR). The RVR component relates to the available instrument approach visibility minimums, expressed by values in feet of 1,200 (1/8-mile), 1,600 (1/4-mile), 2,400 (1/2-mile), 4,000 (3/4-mile), and 5,000 (1-mile). The RVR values approximate standard visibility minimums for instrument approaches to the runways. A runway designed for visual approaches only will use “VIS” in place of a numerical value for the RVR.

Table 3.4 provides a summary of existing runway design dimensions and separation standards for existing and ultimate RDCs. The FAA issued Draft Change 1 to FAA AC 150/5300-13B on October 31, 2023; the following table and airfield design discussions reflect this draft document.

Table 3.4 | Runway Design and Separation Standards (measurements in feet)

Design Criteria	Runway 12L-30R	Runway 12R-30L	Runway 7-25	Ultimate
	B-II-5000	C-II-5000	B-II-VIS	D-III-4000
RUNWAY DESIGN				
Runway Width	75	75	75	100
Shoulder Width	10[a]	10[a]	10[a]	20
Blast Pad Width	95	95[b]	95	140
Blast Pad Length	150	150	300	200
RUNWAY PROTECTION				
Runway Safety Area (RSA)				
Length Beyond Runway End	300	1,000	300	1,000
Length Prior to Threshold	300	600	300	600
Width	150	500	150	500
Runway Object Free Area (ROFA)				
Length Beyond Runway End	300	1,000	300	1,000
Length Prior to Threshold	300	600	300	600
Width	500	800	500	800
Runway Obstacle Free Zone (ROFZ)				
Length Beyond Runway End	200	200	200	200
Width	400	400	400	400
Approach Runway Protection Zone				
Inner Width	500	500	500	1,000
Outer Width	700	1,010	700	1,510
Length	1,000	1,700	1,000	1,700
Departure Runway Protection Zone				
Inner Width	500	500	500	500
Outer Width	700	1,010	700	1,010
Length	1,000	1,700	1,000	1,700
RUNWAY SEPARATION				
Holding Position	200	250	200	272[c]
Parallel Taxiway Centerline	240	300	240	400

[a] Unpaved shoulders. Paved shoulders are standard for ADG IV and larger runways.
[b] Standard blast pad width is 120 feet.
[c] Standard is 250 feet plus 1 foot per 100 feet of airport elevation above sea level.

Source: Draft FAA AC 150/5300-13B, Airport Design, Change 1

Each runway has previously been planned to meet the same B-II design standards. However, historical operational data reflect that C-II design standards should now be applied to Runway 12R-30L, which is considered the primary runway.

The alternatives analysis will evaluate which parallel runway at VGT is the best candidate for improvement to RDC D-III-4000 standards in the ultimate condition. Crosswind Runway 7-25 is planned to remain a B-II-VIS runway.

3.3.3 TAXIWAY DESIGN GROUP

The TDG is a classification of airplanes based on certain undercarriage dimensions of the aircraft. Both outer-to-outer main gear width (MGW) and cockpit-to-main gear (CMG) distances are used in the classification of an aircraft. The TDG is depicted by an alphanumeric system: 1A, 1B, 2A, 2B, 3, 4, 5, 6, and 7. The taxiway design elements determined by the application of the TDG include the taxiway width, taxiway edge safety margin, taxiway shoulder width, taxiway fillet design and dimensions, and (in some cases) the separation distance between parallel taxiways/taxilanes. Other taxiway elements – such as the taxiway safety area (TSA), taxiway object free area (TOFA), taxiway/taxilane separation to parallel taxiway/taxilanes or fixed or movable objects, and taxiway/taxilane wingtip clearances – are determined solely based on the wingspan (ADG) of the design aircraft utilizing those surfaces. It is appropriate for taxiways to be planned and built to different TDG standards based on expected use.

A review of the FAA's TFMSC data (summarized in **Table 3.5**) shows that TDG 2/2A is the highest TDG to exceed 500 annual operations each year since 2020; therefore, the VGT taxiway system should meet TDG 2/2A design standards in the existing condition. In the ultimate condition, the taxiway system is planned to meet ADG III and TDG 2B design standards to accommodate the Gulfstream G550.

Table 3.5 | Operations by Taxiway Design Group

TDG	2020	2021	2022	2023
1A	2,719	3,806	4,422	5,277
1B	691	1,190	1,410	1,960
2	1,516	2,323	2,814	3,140
2A	1,250	1,807	1,702	2,203
2B	18	36	22	128
3	3	14	31	45
4	0	2	0	5
TDG = taxiway design group				

Source: FAA TFMSC Data

Existing and ultimate taxiway and taxilane design standards are summarized in **Table 3.6**. The entirety of the taxiway system at VGT currently meets all ADG II and TDG 2A design requirements. Certain portions of the airside area that are utilized exclusively by small aircraft, such as the T-hangar areas, should adhere to TDG 1A/1B standards.

Table 3.6 | Taxiway/Taxilane Dimensions and Standards (measured in feet)

ADG Standards	ADG I	ADG II	ADG III
TAXIWAY PROTECTION			
Taxiway Safety Area Width	49	79	118
Taxiway Object Free Area Width	89	124	171
Taxilane Object Free Area Width	79	110	158
TAXIWAY SEPARATION			
Taxiway Centerline to:			
Fixed or Movable Object	44.5	62	85.5
Parallel Taxiway/Taxilane	70	101.5	144.5
Taxilane Centerline To:			
Fixed or Movable Object	39.5	55	79
Parallel Taxilane	64	94.5	138
WINGTIP CLEARANCE			
Taxiway Wingtip Clearance	20	22.5	26.5
Taxilane Wingtip Clearance	15	15.5	20
TDG STANDARDS	**TDG 1A/1B**	**TDG 2A/2B**	
Taxiway Width Standard	25	35	
Taxiway Edge Safety Margin	5	7.5	
Taxiway Shoulder Width	10	15	
Notes: ADG = airplane design group TDG = taxiway design group			

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

3.4 AIRSIDE FACILITIES

Airside facilities, as defined in this master plan, include the runway and taxiway system; the runway approach areas; and the associated appurtenances, such as airfield lighting, visual aids, and navigational aids (NAVAIDs). Aircraft parking areas and hangars are also included in this section. The ability of the present runway facilities to accommodate existing and future traffic are examined in the following subsections, as well as the facilities required through the year 2043.

3.4.1 RUNWAY REQUIREMENTS

Applicable design standards were defined in the previous sections of this chapter. This section defines the runway requirements needed to satisfy the forecast demand in terms of runway length, pavement strength, crosswind coverage, and safety areas. Accommodation of these requirements will provide satisfactory facilities for the variety of aircraft expected to use VGT throughout the planning period.

Runway Length Overview

Runway length is one of the most important factors when considering operational efficiency and facility requirements for forecast aviation activity at VGT. As detailed in FAA AC 150/5325-4B, *Runway Length Requirements*, runway length requirements are influenced by multiple factors, including an airport's elevation above mean sea level (MSL), air temperature, runway gradient, runway surface conditions (e.g., dry, wet), and aircraft operating weight. Generally, required takeoff runway length for aircraft increases as the aforementioned factors increase, due to the fact that air is less dense at higher elevations and temperatures. For example, the greater an airport's elevation above MSL, the greater takeoff distance an aircraft will require. Similarly, the required runway length for takeoff will increase as air temperature rises. In both cases, the density altitude is higher, requiring more runway length for aircraft to achieve the lift necessary to safely operate. Since VGT is situated in a warm, desert climate at 2,205 feet above MSL, aircraft will generally require more takeoff runway length than if the same aircraft were operating at an airport located in a cooler climate and/or at a lower elevation.

Although the runway can accommodate a variety of business jets throughout the year, particularly during cooler weather conditions, the existing length significantly limits the potential for most business jet operations during the summer months. Subsequently, some aircraft – including the airport's existing (Challenger 300) and ultimate (Gulfstream G550) critical aircraft – must operate with restrictions to their takeoff weight, due to operational limitations. This is done through either reduced fuel load and/or reduced passenger/cargo capacity. Reductions in fuel load adversely affect the range of aircraft, meaning that an aircraft will need to refuel sooner than its normal range. For example, an aircraft departing from VGT bound for east coast destinations generally will not be able to plan for a non-stop flight because of required weight limitations, which are often achieved through a reduced fuel load; rather, the aircraft will need to plan a stop en route to refuel. This subsequently reduces VGT's marketability for corporate aircraft. The main role of VGT is to serve as a reliever to Harry Reid International Airport (LAS) for these large business jet operations. This role helps minimize delays at LAS and benefits the National Airspace System in reducing overall delays into Southern Nevada.

Because forecasted future demand indicates that VGT should aim to accommodate aircraft operations with ARCs up to and including D-III, the alternatives to follow in the next chapter will include an analysis of possible runway extension alternatives to a minimum of 5,900 feet, which would satisfy takeoff requirements for the existing and ultimate critical aircraft at 60 percent useful load. Longer extensions will also be considered for feasibility to provide even greater utility for larger business jet aircraft.

Runway Length Analysis

There are three methodologies for determining runway length requirements, which are based on the maximum takeoff weight (MTOW) of the critical aircraft or the airplane group for each runway. The airplane group consists of multiple aircraft with similar design characteristics. The three weight classifications are those airplanes with a MTOW of 12,500 pounds or less, those weighing over 12,500 pounds but less than 60,000 pounds, and those weighing 60,000 pounds or more. **Table 3.7** shows these classifications and the appropriate methodology to use in runway length determination.

Table 3.7 | Airplane Weight Classification for Runway Length Requirements

Airplane Weight Category (MTOW)		Design Approach	Methodology
12,500 pounds or less	Approach speeds of less than 30 knots	Family grouping of small airplanes	Chapter 2: para. 203
	Approach speeds of at least 30 knots but less than 50 knots	Family grouping of small airplanes	Chapter 2: para. 204
	Approach speeds of 50 knots or more with fewer than 10 passenger seats	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-1
	Approach speeds of 50 knots or more with 10 or more passenger seats	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-2
Over 12,500 pounds but less than 60,000 pounds		Family grouping of large airplanes	Chapter 3: Figures 3-1 or 3-2 and Tables 3-1 or 3-2
60,000 pounds or more, or regional jets		Individual large airplanes	Chapter 4: *Airplane Performance Manuals*

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

The determination of runway length requirements for the airport is based on five primary factors:

- Mean maximum temperature of the hottest month
- Airport elevation
- Runway gradient
- Critical aircraft type expected to use the runway
- Stage length of the longest non-stop destination (specific to larger aircraft)

The mean maximum daily temperature of the hottest month for VGT is 104.3°F, which occurs in July. The airport elevation is 2,205 feet MSL. The primary runway (12R-30L) has a gradient of 0.84 percent.

Small General Aviation Aircraft (≤12,500 pounds)

Most operations occurring at VGT are conducted using smaller general aviation (GA) aircraft weighing less than 12,500 pounds. Following guidance from AC 150/5325-4B, to accommodate 95 percent of these small aircraft with less than 10 passenger seats, a runway length of 4,200 feet is recommended. For 100 percent of these small aircraft, a runway length of 4,800 feet is recommended. For small aircraft with 10 or more passenger seats, 4,900 feet of runway length is recommended.

Small and Mid-Size Turbine Aircraft (12,500 - 60,000 pounds)

Turbine operations make up a smaller percentage of VGT operations, but this category of activity is projected to experience strong growth over the planning period. Runway length requirements for this classification of aircraft also utilize charts from AC 150/5325-4B and take into consideration the runway gradient and landing length requirements for contaminated (wet) runways. Business jets tend to need greater runway length when landing on a wet surface because of their increased approach speeds. AC 150/5325-4B stipulates that runway length determination for business jets consider a grouping of airplanes with similar operating characteristics. The AC provides two separate family groupings of airplanes, each of which is based on its representative percentage of aircraft in the national fleet. The first grouping is those business jets that make up 75 percent of the national fleet, and the second group is those that make up 100 percent of the national fleet. **Table 3.8** shows example aircraft for both groups.

Table 3.8 | Aircraft Categories for Runway Length Determination

0-75 Percent of the National Fleet	MTOW (pounds)	75-100 Percent of the National Fleet	MTOW (pounds)
Challenger 300	38,850	Lear 55	21,500
Lear 40/45	20,500	Lear 60	23,500
Cessna 550 Citation II	14,100	Hawker 800XP	28,000
Cessna 560XL Excel	20,000	Hawker 1000	31,000
Cessna 650 VII	22,000	Cessna 650 III/IV	22,000
Cessna 680 Sovereign	30,775	Cessna 750 X	35,700
Beechjet 400	15,800	Challenger 604	47,600
Falcon 50	18,500	Falcon 2000	42,800

Notes:
MTOW = maximum takeoff weight

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

The following is the five-step process for determining the recommended runway length for aircraft with a MTOW between 12,500 pounds and 60,000 pounds.

Step #1: Identify the critical airplane or airplane group.

This runway length analysis assumes that the critical aircraft is a mid-sized business jet that weighs less than 60,000 pounds MTOW. There are more than 500 annual operations by these types of aircraft at VGT. In this case, the appropriate runway length methodology is to examine the general runway length tables from Chapter 3 of AC 150/5325-4B for aircraft weighing between 12,500 pounds and 60,000 pounds.

Step #2: Identify the airplanes or airplane group that will require the longest runway length at maximum certificated takeoff weight (MTOW).

Business jets typically require the longest runway lengths; therefore, the runway length curves in Chapter 3 of AC 150/5325-4B will be examined for future conditions.

Step #3: Determine which of the three methods described in the AC will be used for establishing the runway length.

In consideration of the growing number of business jets, it is necessary to select the specific methodology to use for the business jets. Chapter 3 of the AC groups business jets that weigh over 12,500 pounds but less than 60,000 pounds into the following two categories:

- 75 percent of the fleet
- 100 percent of the fleet

The AC states that the airplanes in the 75 percent of the fleet category generally need 5,000 feet or less of runway at MSL and standard day temperature (59°F), while those in the 100 percent of the fleet category need more than 5,000 feet of runway under the same conditions.

The AC indicates that the airport designer must determine which category to use for runway length determination. VGT experiences significant levels of business jet activity from the full range of the business jet fleet.

There are two runway length curves presented in the AC under the 75-100 percent category:

- 60 percent useful load
- 90 percent useful load

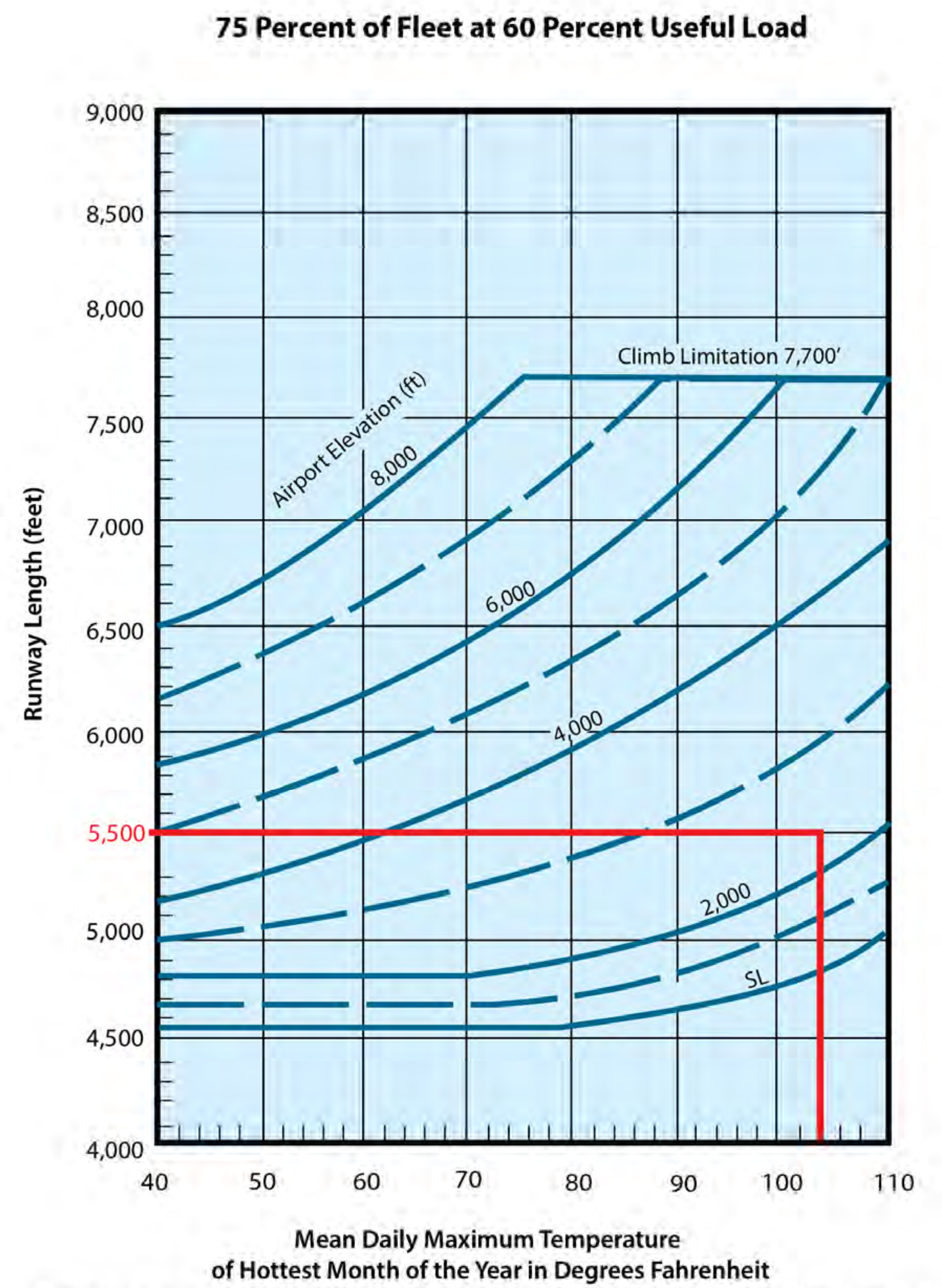
The useful load is the difference between the maximum allowable structural weight and the operating empty weight (OEW). The useful load consists of passengers, cargo, and usable fuel. The determination of which useful load category to use will have a significant impact on the recommended runway length; however, it is inherently difficult to determine because of the variable needs of each aircraft operator. For shorter flights, pilots may take on less fuel; however, pilots may choose to ferry fuel so that they do not have to refuel frequently. Because of the variability in aircraft weights and haul lengths, the 60 percent useful load category is typically considered the default, unless there are specific known operations that would suggest using the 90 percent useful load category. For VGT, there are known long-haul operations that would suggest applying the 90 percent useful load classification. TFMSC data documents city pairs by departing aircraft. An examination of the destinations shows that there were 529 departures from VGT in 2023 to destination airports that are 1,000 miles or more away from VGT. Because of the frequency of long-haul flights to and from VGT, both the 60 and 90 percent useful load categories are included when calculating runway length requirements for business jets weighing between 12,500 and 60,000 pounds.

Step #4: Select the recommended runway length from the appropriate methodology.

The next step is to examine the performance charts (see **Figure 3.3**). These charts require the following inputs:

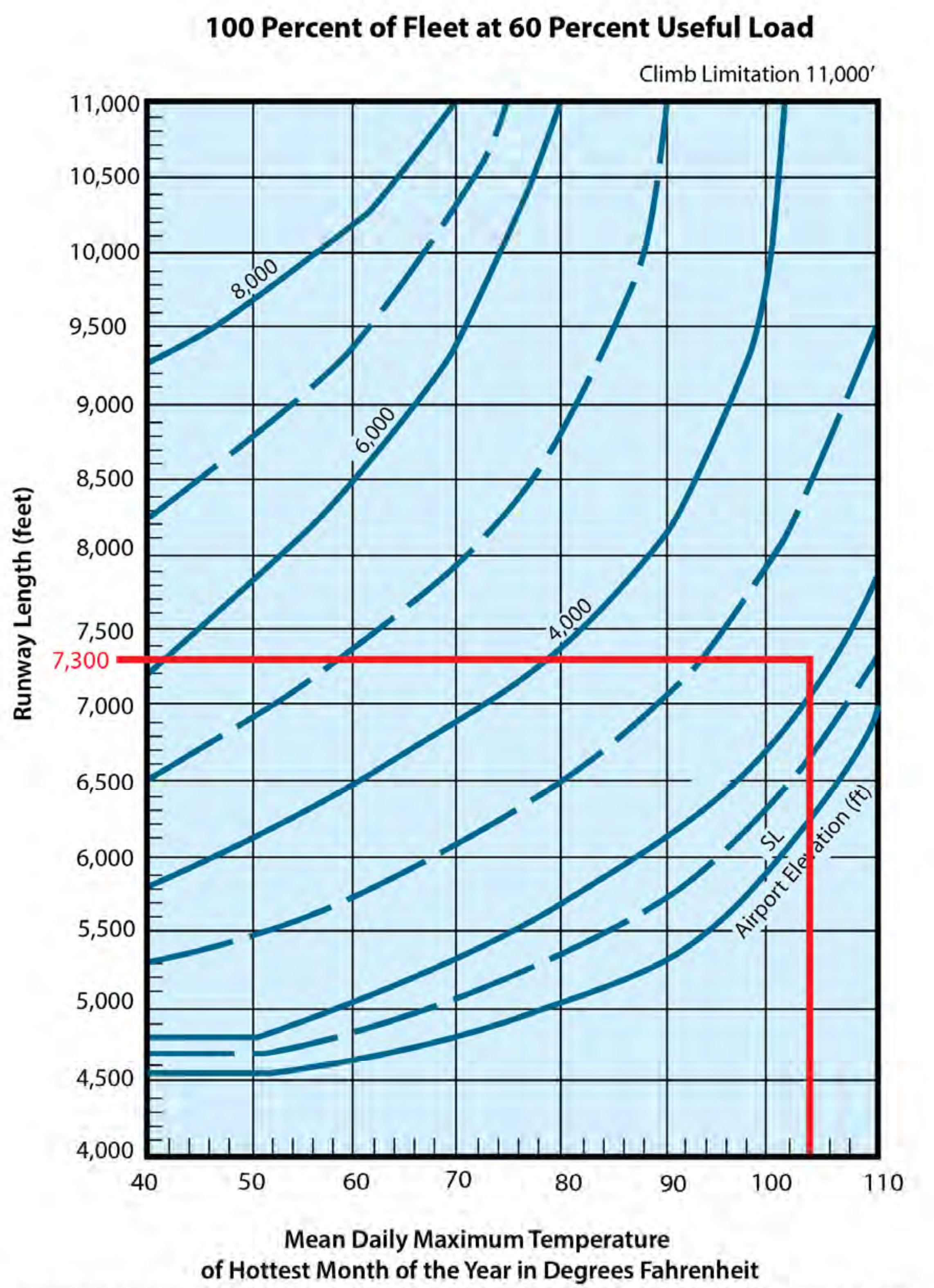
- The mean maximum daily temperature of the hottest month: July at 104.3°F
- The airport elevation: 2,205 feet above MSL

Figure 3.3 – *Business Jet Runway Length Charts*



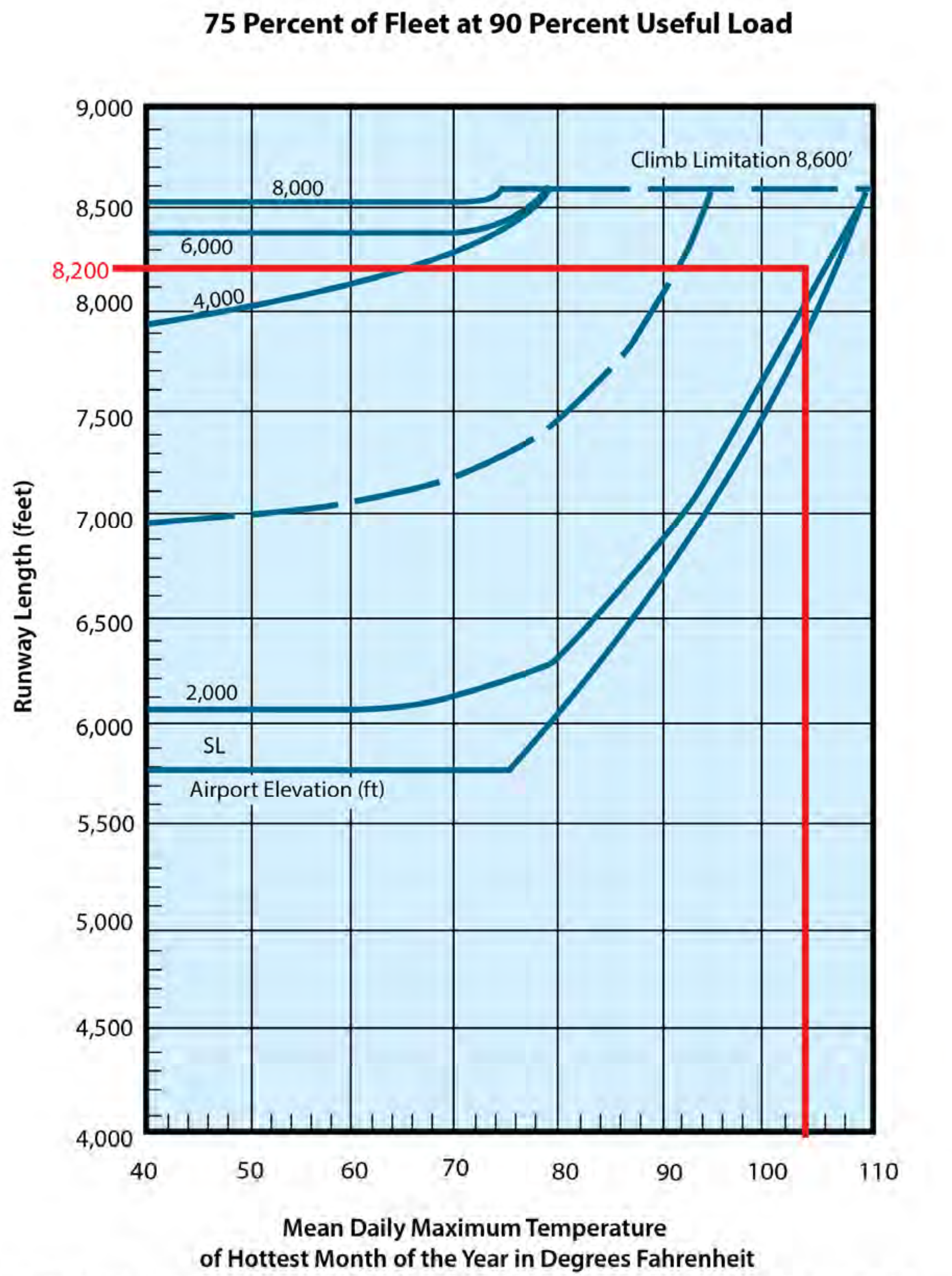
Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design. Reproduced by Coffman Associates

Figure 3.3 – *Business Jet Runway Length Charts (continued)*



Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design. Reproduced by Coffman Associates

Figure 3.3 – *Business Jet Runway Length Charts (continued)*



Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design. Reproduced by Coffman Associates

Due to VGT's elevation and high summertime temperatures, aircraft within the 100 percent of fleet group operating at 90 percent useful load are subject to a climb limitation. This means the aircraft in this group cannot operate at VGT during the hottest periods of the summer at useful loads up to 90 percent; therefore, the runway length chart for that grouping is not included.

Step #5: Apply any necessary adjustments to the obtained runway length.

The raw runway lengths calculated in Step #4 are based on no wind, a dry runway surface, and zero effective runway gradient; therefore, the following criteria are applied:

- Wet runway surface (applies to landing operations only)
- 0.84% effective runway gradient, 42 feet of elevation difference for Runway 12R-30L (applies to takeoff operations only)

To account for a wet/contaminated surface, the runway length obtained from the load performance chart used in Step #4 is increased by 15 percent, or up to 5,000 feet, for the 60 percent category and 7,000 feet for the 90 percent category (whichever is less).

The runway length obtained from Step #4 is also increased at the rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline. At VGT, this equates to an additional 420 feet of runway length.

Table 3.9 presents the results of the runway length analysis for business jets that weigh between 12,500 and 60,000 pounds, developed following the guidance provided in AC 150/5325-4B. To accommodate 75 percent of the business jet fleet at 60 percent useful load, a runway length of 6,000 feet is recommended. This length is derived from a raw length of 5,500 feet which is adjusted for runway gradient and consideration of landing length needs on a contaminated runway (wet and slippery). To accommodate 100 percent of the business jet fleet at 60 percent useful load, a runway length of 7,800 feet is recommended, and to accommodate 75 percent of the fleet at 90 percent useful load, a runway length of 8,700 feet is recommended.

Table 3.9 | Runway Length Requirements – Aircraft Between 12,500 and 60,000 Pounds

Airport Elevation	2,205' feet above mean sea level			
Average High Monthly Temp.	104.3°F (July)			
Runway Gradient	0.84% Runway 12R-30L (42')			
Fleet Mix Category	**Raw Runway Length from FAA AC**	**Runway Length with Gradient Adjustment**	**Wet Surface Landing Length for Jets (+15%)[1]**	**Final Runway Length[2]**
75% of fleet at 60% useful load	5,500'	5,920'	5,500'	6,000'
100% of fleet at 60% useful load	7,300'	7,720'	5,500'	7,800'
75% of fleet at 90% useful load	8,200'	8,620'	7,000'	8,700'

[1]Max 5,500' for 60% useful load and max 7,000' for 90% useful load in wet conditions
[2]Longest runway need rounded up to nearest hundred

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Supplemental Analysis Undertaken for Typical Business Jets Operating with Local Conditions

Another method to determine runway length requirements for aircraft at VGT is to examine aircraft flight planning manuals under conditions specific to the airport. **Table 3.10** provides a detailed runway length analysis for several of the most common turbine aircraft in the national fleet. These data were obtained from UltraNav software, which computes operational parameters for specific aircraft based on flight manual data. The analysis includes the MTOW allowable and the percent useful load from 60 percent to 100 percent.

The analysis shows that many business jets can only operate at VGT at less than 60 percent useful load during the hottest days of the summer. The existing /ultimate critical aircraft are highlighted in the table. The Challenger 300 (existing critical aircraft) and Gulfstream G550 (ultimate critical aircraft) cannot take off on less than 5,000 feet of runway at 60 percent useful load.

Table 3.10 | Supplemental Business Aircraft Takeoff Length Requirements

		Takeoff Length Requirements (feet)				
		Useful Load				
Aircraft	MTOW	60%	70%	80%	90%	100%
Challenger 300	**38,850**	**5,876**	**6,449**	**7,041**	**7,719**	**8,516**
Challenger 605	48,200	6,370	7,046	7,826	8,651	9,482
Citation 560 XLS	20,200	4,592	4,999	5,463	6,036	C/L
Citation CJ3	13,870	3,833	4,170	4,641	5,156	5,775
Citation II (550)	13,300	4,237	4,734	5,273	5,854	6,477
Citation Sovereign	30,300	3,906	4,245	4,622	5,063	5,627
Citation X	35,700	6,285	6,895	C/L	C/L	C/L
Falcon 2000	35,800	6,663	7,267	7,929	8,855	C/L
Falcon 50EX	41,000	5,618	6,249	C/L	C/L	C/L
Falcon 7X	70,000	5,570	6,252	7,067	7,929	C/L
Falcon 900EX	49,200	5,510	6,270	7,050	7,790	8,420
Global 5000	92,500	5,375	5,994	6,645	7,326	C/L
Global Express	98,000	5,885	6,612	7,378	C/L	C/L
Gulfstream G280	39,600	5,481	6,128	6,908	7,798	8,760
Gulfstream G450	74,600	5,615	6,207	6,881	7,604	8,427
Gulfstream G550	**91,000**	**5,874**	**6,608**	**7,702**	**8,956**	**FLL**
Gulfstream G650	99,600	5,886	6,545	7,276	8,212	C/L
Hawker 4000	39,500	5,332	5,858	6,578	7,414	8,326
Hawker 800XP	28,000	5,526	C/L	C/L	C/L	C/L
Hawker 900 XP	28,000	5,132	5,658	6,236	C/L	C/L
King Air 350	15,000	4,485	4,691	4,888	5,267	5,695
King Air C90B	10,100	3,384	3,633	3,882	4,160	4,470
Lear 40	21,000	6,051	7,080	8,328	FLL	FLL
Lear 55	21,500	7,010	FLL	FLL	FLL	FLL
Lear 60	23,500	6,917	7,620	8,534	9,702	FLL
Phenom 300	18,551	2,700	3,042	3,500	4,700	6,715
Pilatus PC-12	9,921	2,569	2,794	3,031	3,281	3,543

Notes:
Red figures are greater than 5,000 feet (length of the primary runway at VGT).
Runway length calculation assumptions: 2,205' MSL field elevation; 104.3°F ambient temperature; 0.84% runway grade
C/L = climb limited: aircraft cannot maintain required climb gradient
FLL = field length limited: field length is too short; takeoff is rejected at V1
MTOW = maximum takeoff weight
Challenger 300 = existing critical aircraft
Gulfstream G550 = ultimate critical aircraft

Source: UltraNav software

Table 3.11 presents the runway length required for landing under three operational categories: Title 14 Code of Federal Regulations (CFR) Part 25, CFR Part 135, and CFR Part 91k. CFR Part 25 operations are those conducted by individuals or companies that own their aircraft. CFR Part 135 applies to all for-hire charter operations, including most fractional ownership operations. CFR Part 91k includes operations in fractional ownership that utilize their own aircraft under the direction of pilots specifically assigned to said aircraft. Part 91k and Part 135 rules regarding landing operations require operators to land at the destination airport within 60 percent of the effective runway length. An additional rule allows operators to land within 80 percent of the effective runway length if the operator has an approved destination airport analysis in the airport's program operating manual. The landing length analysis conducted accounts for both scenarios.

Table 3.11 | Supplemental Business Aircraft Landing Length Requirements

		LANDING LENGTH REQUIREMENTS (feet)					
		Dry Runway Condition			Wet Runway Condition		
Aircraft Name	MLW	Part 25	80% Rule	60% Rule	Part 25	80% Rule	60% Rule
Citation II (550)	12,700	2,753	3,441	4,588	6,654	8,318	11,090
Citation 560 XLS	18,700	3,917	4,896	6,528	6,198	7,748	10,330
Citation X	31,800	4,628	5,785	7,713	6,700	8,375	11,167
Citation Sovereign	27,100	3,349	4,186	5,582	4,400	5,500	7,333
Citation CJ3	12,750	3,539	4,424	5,898	4,859	6,074	8,098
Challenger 300	**33,750**	**2,727**	**3,409**	**4,545**	**5,228**	**6,535**	**8,713**
Challenger 605	38,000	2,948	3,685	4,913	4,708	5,885	7,847
Falcon 7X	62,400	3,063	3,829	5,105	3,523	4,404	5,872
Falcon 900EX	44,500	3,841	4,801	6,402	4,417	5,521	7,362
Falcon 2000	33,000	3,270	4,088	5,450	3,760	4,700	6,267
Falcon 50 EX	35,715	3,062	3,828	5,103	3,522	4,403	5,870
Gulfstream G280	32,700	3,401	4,251	5,668	3,912	4,890	6,520
Gulfstream G450	66,000	3,411	4,264	5,685	6,392	7,990	10,653
Gulfstream G550	**75,300**	**2,901**	**3,626**	**4,835**	**5,713**	**7,141**	**9,522**
Gulfstream G650	83,500	4,348	5,435	7,247	5,702	7,128	9,503
Global 5000	78,600	2,776	3,470	4,627	3,192	3,990	5,320
Global Express	78,600	2,776	3,470	4,627	3,192	3,990	5,320
Hawker 800XP	23,350	2,785	3,481	4,642	4,345	5,431	7,242
Hawker 900 XP	23,350	2,785	3,481	4,642	4,337	5,421	7,228
Hawker 4000	33,500	3,621	4,526	6,035	4,164	5,205	6,940
King Air 350	15,000	2,742	3,428	4,570	No Data	No Data	No Data
King Air C90B	9,600	1,351	1,689	2,252	No Data	No Data	No Data
Lear 40	19,200	3,086	3,858	5,143	4,027	5,034	6,712
Lear 55	18,000	3,603	4,504	6,005	5,765	7,206	9,608
Lear 60	19,500	3,898	4,873	6,497	5,357	6,696	8,928
Phenom 300	17,273	2,800	3,500	4,667	3,220	4,025	5,367
Pilatus PC-12	9,921	2,088	2,610	3,480	No Data	No Data	No Data

Notes:
Red figures are greater than 5,000 feet (length of the primary runway at VGT).
Runway length calculation assumptions: 2,205' MSL field elevation; 104.3°F ambient temperature; 0.84% runway grade
MLW = maximum landing weight
No Data = turboprop aircraft landing lengths are not adjusted for wet runway conditions
Challenger 300 = existing critical aircraft
Gulfstream G550 = ultimate critical aircraft
Source: UltraNav software

The landing length analysis shows that most business jets are capable of landing at VGT during dry runway conditions under the 80 percent rule; however, additional length is needed for most business jets during wet runway conditions and to satisfy the 60 percent rule in both dry and wet conditions.

Runway Width

Each runway at VGT is currently 75 feet wide. The RDC B-II-5000 design standard is 75 feet wide, so each runway currently meets this design standard. The RDC C-II-5000 and D-III-4000 design standard is 100 feet wide. The alternatives chapter will present options for widening one of the parallel runways to meet this standard. Runway 7-25 is planned to continue to meet RDC B-II-VIS standards through the planning period and therefore should maintain its current 75-foot width.

Runway Shoulders

Runway shoulders provide resistance to soil erosion, decrease the likelihood of engine ingestion of foreign objects, and accommodate the passage of maintenance and emergency equipment, as well as the occasional passage of aircraft deviating from the runway. Like design standards for runway width, runway shoulder width is determined by the RDC. Paved shoulders are required for ADG IV and higher aircraft and are recommended for ADG III aircraft. Turf, aggregate-turf, soil cement, or lime or bituminous stabilized soil are recommended adjacent to runways accommodating ADG I and ADG II aircraft.

The runway shoulder design standard for each runway at VGT currently is set at 10 feet. Each runway currently meets this standard, with 10 feet of unpaved shoulder available. This design standard increases to 20-foot-wide shoulders in the ultimate RDC D-III-4000 condition. The ultimate condition also recommends paved runway shoulders; therefore, the alternatives will consider adding 20 feet of paved shoulder to one of the parallel runways to meet this ultimate condition. Runway 7-25 should continue to meet the 10-foot-wide unpaved shoulder standard.

Runway Blast Pads

Blast pads are paved surfaces adjacent to the ends of runways that provide erosion protection from jet blast and propeller wash. According to the FAA, blast pads must always be paved; must extend across the full width of the runway plus the shoulders; and must be able to support the occasional passage of the most demanding aircraft, as well as maintenance and emergency response vehicles. Blast pad dimensions are detailed in FAA AC 150/5300-13B and are determined by the RDC of the critical design aircraft ARC.

The parallel runways at VGT are equipped with blast pads measuring 150 feet long and 95 feet wide, which meets the RDC B-II-5000 design standard. RDC C-II-5000 design standards require blast pads to be 120 feet wide. In the ultimate RDC D-III-4000 condition, the blast pad width requirement increases to 140 feet and the length requirement extends to 200 feet. The alternatives analysis will consider applying the ultimate design standard to one of the parallel runways.

Runway 7-25 also has blast pads measuring 95 feet wide and extending 300 feet long, which is twice as long as the standard. The existing blast pads are planned to be maintained through the planning period.

Runway Orientation

A runway's designation is based on its magnetic headings, which are determined by the magnetic declination for the area. The magnetic declination in the area of VGT is 11° 9'E. The parallel runways are oriented northeast-southwest and have true headings of 134°/314°. Adjusting for the magnetic declination, the current magnetic headings of the parallel runways are 133.85° and 302.85°. As such, the current designation for the parallel runways at VGT is appropriate and is not anticipated to change throughout the planning period.

Runway 7-25 is the crosswind runway at VGT and is oriented east-west with a true heading of 88°/268°. Adjusting for magnetic declination, the current magnetic heading of the runway is 76.85°/256.85°; therefore, the designation for this crosswind runway should be changed to Runway 8-26.

According to FAA Order 5100.38D, *Airport Improvement Handbook*, only one runway at any NPIAS airport is eligible for ongoing maintenance and rehabilitation funding, unless the FAA Airports District Office (ADO) has made a specific determination that a crosswind or secondary runway is justified. A runway that is not a primary runway, crosswind runway, or secondary runway is an *additional* runway, which is not eligible for FAA funding. It is not unusual for a two-runway airport to have a primary runway and an additional runway, and no crosswind or secondary runway. **Table 3.12** presents the eligibility requirements for runway types.

Table 3.12 | Runway Eligibility

The following runway type…	Must meet all of the following criteria…	And is…
Primary Runway	1. A single runway at an airport is eligible for development consistent with FAA design and engineering standards.	Eligible
Crosswind Runway	1. The wind coverage on the primary runway is less than 95%.	Eligible if justified
Secondary Runway	1. There is more than one runway at the airport. 2. The non-primary runway is not a crosswind runway. 3. Either of the following: a) The primary runway is operating at 60% or more of its annual capacity. b) The FAA has made a specific determination that the runway is required.	Eligible if justified
Additional Runway	1. There is more than one runway at the airport. 2. The non-primary runway is not a crosswind runway. 3. The non-primary runway is not a secondary runway.	Ineligible

Source: FAA Order 5100.38D, AIP Handbook

FAA AC 150/5300-13B recommends a crosswind runway when the primary runway orientation provides for less than 95 percent wind coverage for specific crosswind components. The 95 percent wind coverage is computed based on wind not exceeding a 10.5-knot (12 miles per hour [mph]) component for runway design code (RDC) A-I and B-I; 13-knot (15 mph) component for RDC A-II and B-II; 16-knot (18 mph) component for RDC A-III, B-III, C-I through C-III, and D-I through D-III; and 20-knot component for wider wingspans.

It is preferable to analyze weather data that is local to the airport being studied. The automated surface observing system (ASOS) weather sensor currently located at VGT is connected to the National Oceanic and Atmospheric Administration (NOAA) and its data are therefore available for analysis.

According to FAA guidelines, the most recent 10 years of wind data should be analyzed to determine various facility requirements, including the appropriate runway configuration. Wind data specific to VGT are summarized on the wind rose exhibit (Figure 1.10 in Chapter One). The table at the top of the wind rose indicates the percent of wind coverage for each runway at specific wind intensities.

The parallel runways provide 90.18 percent wind coverage at 10.5 knots and 94.02 percent wind coverage at 13 knots, while exceeding 95 percent wind coverage at 16 and 20 knots. Runway 7-25 provides 85.39 and 90.80 percent wind coverage at 10.5 and 13 knots, respectively. Combined, the parallel runways and the crosswind runway provide 94.19 percent crosswind wind coverage at 10.5 knots and greater than 95 percent at 13 knots and above. Because the parallel runway configuration provides less than 95 percent wind coverage in the 13-knot condition, a crosswind runway is justified and is eligible for FAA funding up to the ARC B-II design standard. The crosswind runway is currently designed to RDC B-II-VIS standards.

For VGT to qualify for maintenance of a parallel runway, the airfield must be operating at 60 percent or greater of its ASV. As stated previously, VGT is already operating at approximately 74 percent of its ASV and operation levels are only anticipated to increase over the planning period; therefore, VGT meets the threshold for maintaining a secondary (parallel) runway, which is eligible for FAA funding.

Runway Holding Position Lines

Runway holding position lines indicate the position beyond which aircraft require airport traffic control tower (ATCT) authorization before proceeding on or across a runway. When specifically instructed by the ATCT, aircraft must stop so that no part of the aircraft extends beyond the holding position marking. These markings are used where it is necessary to hold an aircraft on a taxiway that intersects a runway so that the aircraft does not interfere with runway operations. Design standards for runway hold lines are published in FAA AC 150/5300-13B and are measured in terms of distance from the runway centerline in feet.

All holding position markings at VGT are currently set at 200 feet from each runway centerline. This separation distance meets RDC B-II-5000 design standards. RDC C-II-5000 design standards call for holding position markings to be located 250 feet from the runway centerline. In the ultimate RDC D-III-4000 condition, the holding position separation standard is established at a base separation of 250 feet plus one foot per 100 feet of airport elevation above sea level. VGT's elevation of 2,205 feet above sea level adds 22 feet to the separation standard, which results in a standard separation distance of 272 feet. The alternatives analysis will consider options for relocating the holding position markings and associated runway hold signs to the ultimate standard separation.

Runway Safety Areas

The runway safety area (RSA) is a two-dimensional designated surface on the ground surrounding a runway to reduce the risk of damage to an aircraft in the event of an undershoot, overshoot, or excursion from the runway. The RSA must be cleared and graded, have no hazardous surface variations, and be free of all objects, except those needed for air navigation or aircraft ground maneuvering. While it is desirable not to have any objects in RSAs, it has been determined that the location of some NAVAIDs is critical for proper functioning. In this case, a fixed-by-function designation is given to certain NAVAIDs and allows them to be located within RSAs.

The RSA must be cleared and graded, have no hazardous surface variations, and be free of all objects to protect aircraft in the event of a runway undershoot, overshoot, or excursion from the runway. RSA design standards are published in FAA AC 150/5300-13B and are a function of the RDC. These standards cannot be modified through a modification of standards (MOS) process and should be continually evaluated for all practicable alternatives to improve any substandard RSAs.

The RDC B-II-5000 RSA design standard calls for dimensions of 150 feet wide, centered on the runway and extending 300 feet beyond the ends of the runway. RDC C-II-5000 RSA design standards call for dimensions of 500 feet wide and extending 1,000 feet beyond the runway ends. The RSAs as they currently exist at VGT are depicted on **Figure 3.4**.

	Runways		
	12R-30L	12L-30R	7-25
Runway Design Code	C-II-5000	B-II-5000	B-II-VIS
Runway Safety Area (RSA)	500' wide x 1,000' beyond runway end	150' wide x 300' beyond runway end	
Runway Object Free Area (ROFA)	800' wide x 1,000' beyond runway end	500' wide x 300' beyond runway end	
Runway Obstable Free Zone (ROFZ)	400' wide x 200' beyond runway end	400' wide x 200' beyond runway end	
Runway Protection Zones			
Approach (inner width x outer width x length)	500' x 1,010' x 1,700'	500' x 700' x 1,000'	500' x 700' x 1,000'
Departure (inner width x outer width x length)			

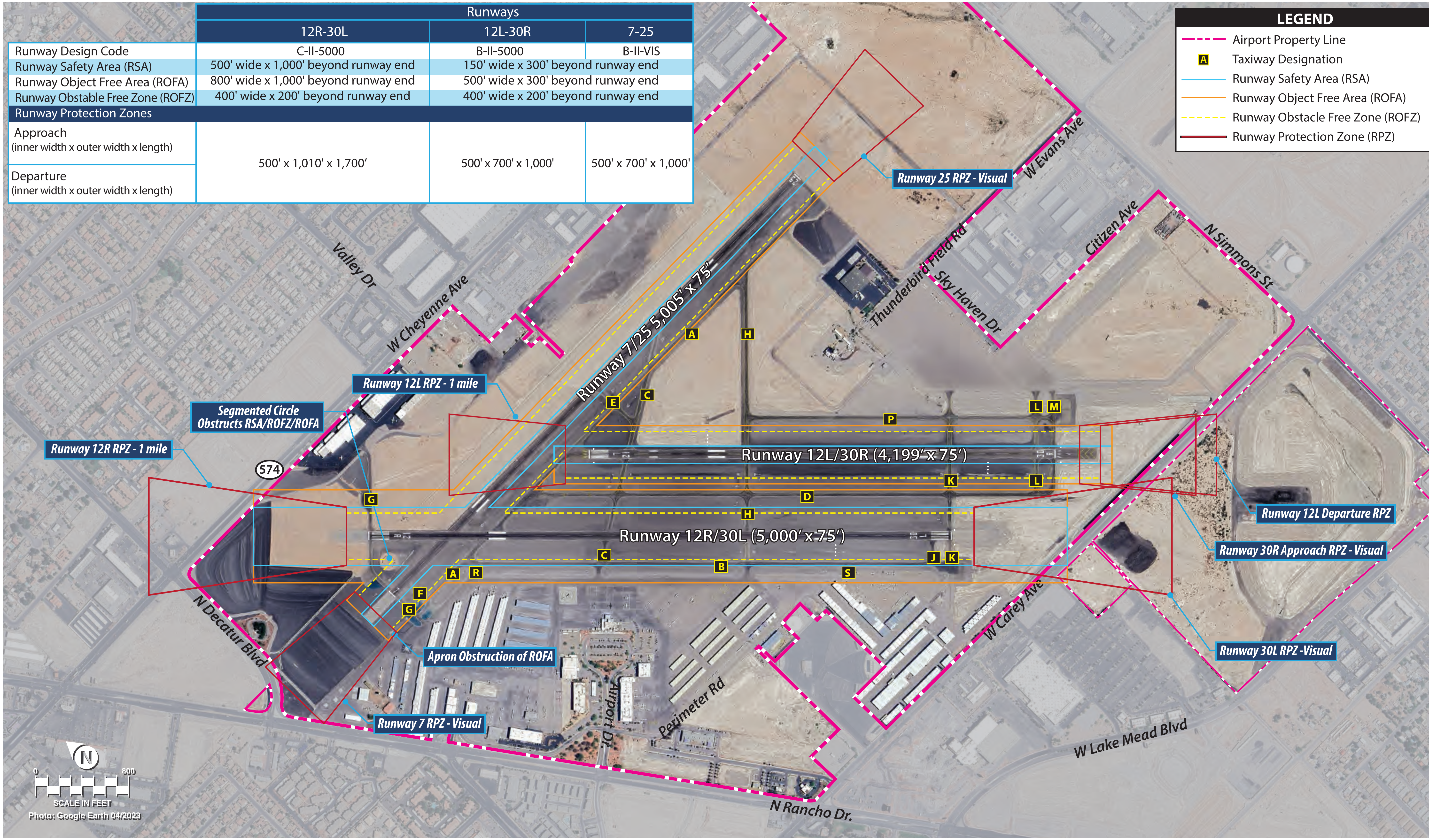


Figure 3.4
EXISTING SAFETY AREAS

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There are no known incompatibilities within the RSAs associated with Runways 12L-30R or 7-25. Because of the recent change in design standards for Runway 12R-30L, the larger RSA dimensions result in incompatibilities including perimeter fencing, the perimeter road, and West Carey Avenue to the south. The entirety of Taxiway B is also located within the wider RSA.

Ultimate RDC D-III-4000 RSA standards call for a 500-foot width, extending 1,000 feet beyond the runway end with no allowance for narrower widths. The alternatives analysis will evaluate how the airfield can be improved to meet C-II-5000 and D-III-4000 RSA design standards.

Runway Gradient

As the AAC increases, the requirements for longitudinal and traverse gradients become more stringent. It is also important to note that FAA standards have also evolved over time. Ideally, runways are crowned, enabling water to flow off the runway pavement and towards airfield drainage facilities placed in the infields. The runway grading standards published in FAA AC 150/5300-13B are summarized in **Table 3.13**.

Table 3.13 | Runway Grading Requirements

FAA Standards	AACs: A and B	AACs: C, D, and E
Maximum Longitudinal Grade	±2.0%	±1.5%
Other Longitudinal Grade Standards	Vertical curves for longitudinal grade changes are parabolic. The length of the vertical curve is a minimum of 300 feet for each 1.0% of change.	Longitudinal grades may not exceed ±0.80% in the first and last quarter, or first and last 2,500 feet – whichever is less – of the runway length.
Maximum Allowable Grade Change	±2.0%	±1.5%
Other Grade Change Standards	–	No grade changes are allowed in the first and last quarter of the runway length.
Transverse Gradients	Between 1.0% and 2.0%	Between 1.0% and 1.5%

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

The full-length longitudinal grade changes for each runway are as follows: 0.83 percent (12R-30L), 1.03 percent (12L-30R), and 0.63 percent (7-25); therefore, each runway at VGT currently meets AAC A/B longitudinal grading standards. These grades are also under the maximum allowable longitudinal grade for AAC C, D, and E runways; however, Runways 12L-30R and 12R-30L have grade changes within the first and last quarter of the runway. In the ultimate condition, if one of the parallel runways is improved to meet the higher design standard, portions of the runway will need to be reconstructed to remove grade changes within the first/last quarter of the runway pavement.

Runway Line-of-Sight

Because each runway at VGT has a full-length parallel taxiway, the runway line-of-sight requirement is that any point five feet above the runway centerline must be mutually visible with any other point five feet above the runway centerline that is located at a distance less than one half the length of the runway. A review of the topographic data reveals that line-of-sight requirements are met for each runway.

Runway Obstacle Free Zones

The runway obstacle free zone (ROFZ) is a volume of airspace that is centered above the runway centerline, above a surface with an elevation that at any point is the same as the elevation of the nearest point on the runway centerline and extends up to 150 feet above the airport elevation. In the case of VGT, the ROFZ for each runway extends to 2,355 feet MSL. Additionally, each runway's ROFZ extends 200 feet beyond the runway ends and is 400 feet wide in both the existing and ultimate conditions. The ROFZ must be kept clear during aircraft operations, except for specific NAVAIDs that need to be in the ROFZ because of their functions. Like RSAs, the modification to standards process does not apply to ROFZs.

The segmented circle, which is a system of visual indicators designed to provide traffic pattern information to pilots, currently obstructs the ROFZ for both Runway 12R-30L and 7-25. The alternatives will consider options for relocating the segmented circle outside the ROFZ. Navigational aid equipment – including precision approach path indicators (PAPIs) and runway end identifier lights (REILs) associated with each runway end – are located inside the ROFZ but are permissible due to their functions.

Runway Object Free Areas

The runway object free area (ROFA) is an area centered on the runway centerline and should not include any aboveground objects protruding above the nearest point of the RSA, including parked aircraft, agricultural operations, and other fixed objects. ROFA dimensions are determined based on the runway's RDC. Like the RSA, objects that are fixed by function, such as NAVAIDs, are to be frangible and are permitted inside the ROFA.

RDC B-II-5000 design standards call for the ROFA to be 500 feet wide and extend 300 feet beyond the end of the runway. This applies to Runways 12L-30R and 7-25 at VGT in the current condition. RDC C-II-5000 design standards, which apply to Runway 12R-30L call for the ROFA to be 800 feet wide and extend 1,000 feet beyond the runway end. Currently, the segmented circle and a portion of apron pavement obstruct the Runway 7-25 ROFA. Runway 12R-30L ROFA obstructions include the segmented circle and lighted wind cone, West Cheyenne Avenue, the perimeter road, and security fencing to the north, and the perimeter road, security fencing, and West Carey Avenue to the south. The alternatives analysis will consider options to mitigate these ROFA obstructions.

Ultimate RDC D-III-4000 design standards call for the ROFA to be 800 feet wide and extend 1,000 feet beyond the end of the runway. The alternatives analysis will evaluate how one of the parallel runways can be improved to meet ultimate ROFA design standards.

Runway Protection Zones

The runway protection zone (RPZ) is a trapezoidal area centered on the runway, typically beginning 200 feet beyond the runway end. When an RPZ begins at a location other than 200 feet beyond the end of a runway, two RPZs are required (i.e., a departure RPZ and an approach RPZ). The RPZ has been established by the FAA to provide an area clear of obstructions and incompatible land uses to enhance the protection of people and property on the ground.

The FAA published AC 150/5190-4B, *Airport Land Use Compatibility Planning*, on September 16, 2022. This AC represented a significant effort to address RPZ land use compatibility. Airport-compatible land uses are those that can coexist with a nearby airport without constraining the safe and efficient operations of the airport. Assuring compatible land uses within the RPZ is best achieved through:

1. Airport ownership of the RPZ property;
2. Possessing sufficient interest in the RPZ property through easements, deed restrictions, etc.;
3. Possessing sufficient land use control authority to regulate land use in the jurisdiction that contains the RPZ;
4. Possessing and exercising the power of eminent domain over the RPZ property; or
5. Possessing and exercising permitting authority over proponents of development within the RPZ.

Expectations of Airport Sponsors

The FAA requires all federally obligated airport sponsors to comply with FAA grant assurances. These include (but are not limited to) Assurance 21, *Compatible Land Use*. Sponsors should take appropriate measures to protect against, remove, or mitigate land uses that introduce incompatible development within RPZs. For projects proposed by the sponsor (such as runway extensions or new runways) that would result in moving the RPZ into an area that has incompatible land uses, the FAA expects the sponsor to have or secure sufficient control of the RPZ, ideally through fee simple ownership, including any off-airport property within the RPZ.

Existing Incompatible Land Uses

The FAA expects airport sponsors to seek all possible opportunities to eliminate, reduce, or mitigate existing incompatible land uses. Examples may include land acquisition, land exchanges, right-of-first-refusal to purchase, agreements with property owners on land uses, easements, or other such measures. The FAA also expects sponsors to actively consider and evaluate available options any time there is an ALP update or master plan update, and to be vigilant for any other opportunities – especially opportunities to purchase land – to eliminate or minimize existing incompatibilities. The FAA expects airport sponsors to document their efforts to demonstrate that they are complying with relevant FAA grant assurances. **Table 3.14** summarizes FAA expectations regarding existing incompatible land uses within an RPZ.

Table 3.14 | Expectations of Airport Sponsors – Existing Incompatible Land Uses

Type of Land Use Control	Expectations of Airport Sponsors
The airport sponsor owns the land.	Because the sponsor has total land use control, the FAA considers it a reasonable expectation that the sponsor will establish and enforce the necessary zoning controls or lease terms to enable it to address existing incompatible land uses when the opportunity arises.
The property is off airport, but the sponsor has land use authority, or the local jurisdiction and land use regulatory authority are owned by the same governing body.	Because the sponsor has at least some influence over land use control, the FAA considers it a reasonable expectation that the sponsor will seek to establish the necessary zoning controls to enable it to address existing incompatible land uses when the opportunity arises.
The sponsor has no land use control (i.e., the RPZ land falls in another jurisdiction).	Even though the sponsor has no land use control, the FAA still considers it a reasonable expectation that the sponsor will actively seek opportunities to establish the necessary zoning controls to enable it to address existing incompatible land uses when the opportunity arises. The FAA will consider financial assistance to public-sector airport sponsors for land acquisition even if the airport sponsor has no land use control, but only if the airport sponsor demonstrates that the sponsor is taking all appropriate steps available to enhance control and mitigate existing risks.

Source: FAA AC 150/5190-4B, Airport Land Use Compatibility Planning

Proposed Incompatible Land Uses

Regardless of the funding source(s) involved, the FAA expects the airport sponsor to take active steps to prevent or mitigate proposed incompatible land uses; to actively seek opportunities to prevent or mitigate risks associated with proposed incompatible land uses within the RPZ; and to secure control of land within the RPZ if a sponsor-initiated project results in incompatible land use within the newly defined RPZ. Sponsors should actively monitor conditions and publicly object to proposed incompatible land uses and should make it a high priority (financially or otherwise) to acquire land or otherwise establish land use controls that prevent incompatible uses. The FAA expects airport sponsors to document their efforts so they can demonstrate that the airport is complying with FAA grant assurances. **Table 3.15** summarizes FAA expectations regarding proposals for introducing new incompatible land uses within an RPZ.

Table 3.15 | Expectations of Airport Sponsors – New Incompatible Land Uses

Type of Land Use Control	Expectations of Airport Sponsors
The airport sponsor owns the land.	Because the sponsor has total land use control, the FAA expects that the sponsor will establish all necessary protections to prevent new incompatible land uses.
The property is off airport, but the sponsor has land use authority, or the local jurisdiction and land use regulatory authority are owned by the same governing body.	The FAA expects the sponsor to take all appropriate steps available to establish and exercise zoning controls necessary to prevent any new incompatible land uses. The FAA recognizes that the standard of “appropriate action, to the extent reasonable” does not mean, in this case, that the sponsor can always prevail; rather, the FAA expects the sponsor to demonstrate and document a reasonable effort.
The sponsor has no land use control (i.e., the RPZ land falls within another jurisdiction).	Even though the sponsor has no land use control, the FAA still expects the sponsor to actively pursue and consider all possible steps to secure land necessary to prevent any new incompatible land uses. The FAA recognizes that the standard of “appropriate action, to the extent reasonable” may not succeed. Even so, the FAA expects the sponsor to demonstrate and document a reasonable effort. The FAA expects the airport sponsor to adopt a strong public stance; to oppose incompatible land uses; to communicate the purpose of the RPZ and associated risks to the proponent; and to actively consider measures such as land acquisition, land exchanges, right-of-first-refusal to purchase, agreements with property owners regarding land uses, or other such measures.

Source: FAA AC 150/5190-4B, Airport Land Use Compatibility Planning

Potential new incompatible land uses within an RPZ might be caused by one or more circumstances. Some of these circumstances may result from airport sponsor-proposed projects, including (but not limited to):

- An airfield project (e.g., runway extension, runway shift);
- 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; or
- A local development proposal in the RPZ (either new or reconfigured), which can include roadway construction, relocation, or improvements.

The FAA has higher expectations for the airport sponsor to mitigate potential incompatible land uses within the RPZs when the introduction of the incompatible land use is the result of an airport sponsor-initiated project (regardless of funding source). The sponsor should submit an alternatives evaluation to the FAA, unless the land use is permissible. These are the permissible land uses requiring no further evaluation:

- Farming that meets airport design clearance standards in FAA AC 150/5300-13 and guidance outlined in AC 150/5200-33;
- Irrigation channels that meet the standards of AC 150/5200-33 and the FAA/USDA manual, *Wildlife Hazard Management at Airports*;

- Airport service roads, as long as they are not public roads and are directly controlled by the airport operator;
- Underground facilities, as long as they meet other design criteria (such as RSA standards), as applicable;
- NAVAIDs and aviation facilities, such as equipment for airport facilities considered fixed-by-function in regard to the RPZ; and
- Aboveground fuel tanks associated with backup generators for unstaffed NAVAIDs.

The existing RPZs for each runway at VGT are depicted on **Figure 3.4**. Because Runway 12R-30L and 7-25 have 1-mile or greater visibility minimums and no threshold displacements, the approach and departure RPZs coincide. The Runway 30R approach and departure RPZs are offset due to the 199-foot threshold displacement.

There are existing incompatible land uses within the RPZs. Public roads pass through the 12R, 30L, and 30R RPZs. Several commercial buildings north of West Cheyenne Avenue are within the 12R RPZ. It should be noted that FAA guidance on land use compatibility within RPZs has changed over time. In recent years, the FAA has placed a greater emphasis on land use compatibility within RPZs. While public roads are now considered incompatible land use within the RPZ, addressing this type of incompatibility was not previously emphasized the way it is now. The alternatives chapter of this master plan will detail opportunities to reduce or eliminate incompatible land uses within the RPZs.

3.4.2 TAXIWAY REQUIREMENTS

Taxiway requirements for VGT are presented in the following sections. These include safety areas, separation standards, and a review of the existing taxiway layout against current taxiway design principles found in AC 150/5300-13B.

Parallel Taxiway Separation

Each runway at VGT is equipped with a full-length parallel taxiway. Taxiway A serves Runway 7-25, Taxiway B serves Runway 12R-30L, Taxiway P serves Runway 12L-30R, and Taxiway D is located between the parallel runways. Taxiways A and B are both separated from the runway by 240 feet (runway centerline to taxiway centerline), which meets RDC B-II-5000 design standards. Taxiway P is located at a separation distance of 310 feet from Runway 12L-30R and Taxiway D is located 350 feet from the centerlines of both parallel runways. To meet RDC C-II-5000 requirements, a 300-foot runway/taxiway separation standard is required. For ultimate RDC D-III-4000 requirements, 400 feet of runway/taxiway separation is required. Alternatives to meet these requirements will be evaluated in the alternatives chapter.

Feedback from air traffic controllers at VGT is that Taxiway A is the only access point to the runway end when Runway 25 is in use; therefore, the alternatives will consider the addition of a parallel taxiway on the north side of Runway 7-25 to enhance taxiway capacity and efficiency.

Taxiway and Taxilane Safety Areas

As noted earlier, the taxiway system at VGT should meet ADG II and TDG 2A design standards in the existing condition. In the ultimate condition, ADG III and TDG 2B standards will apply; however, these standards can apply only to the portions of the airfield that accommodate the largest aircraft operating at the airport. For portions of the airfield that will continue to be utilized primarily by small aircraft and up to small business jets, the existing taxiway design standards will still apply.

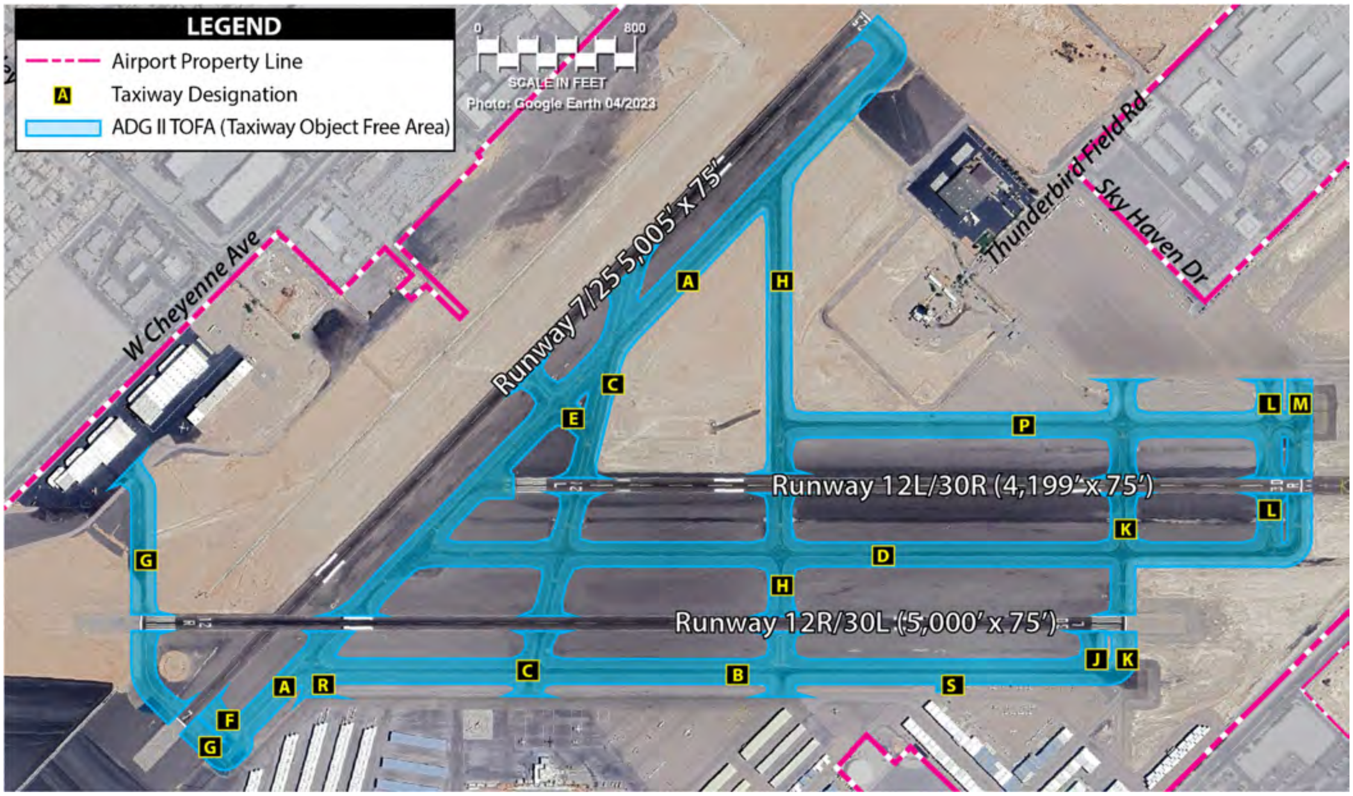
Taxiway safety areas (TSAs) for ADG II aircraft are 79 feet wide, centered on the taxiway centerline. ADG III TSAs are 118 feet wide. A review of the taxiways at VGT against topographic mapping and aerial imagery shows no penetrations to the TSAs. Taxilanes – which are considered non-movement areas on aprons and in hangar areas – also have safety areas that are the same dimensions as the TSA. The apron edge taxilane running parallel to Taxiway B serves as the primary taxilane for the terminal and apron area and is capable of accommodating ADG II aircraft between Taxiways R and H. ADG I aircraft can be accommodated in areas near hangars (Taxiways F and G and H and S). The alternatives will consider appropriate taxiway and taxilane safety area dimensions to accommodate the type of aircraft being served in any given area.

Taxiway and Taxilane Object Free Areas

Taxiway object free areas (TOFAs) also are centered on the taxiway and are 124 feet wide and 171 feet wide for ADG II and ADG III aircraft, respectively. **Figure 3.5** depicts the existing TOFAs, which are based on ADG II standards. The TOFA should be cleared of objects and parked aircraft, except for objects needed for air navigation or aircraft ground maneuvering purposes. The TOFAs throughout the taxiway system at VGT are clear of obstructions.

Taxilane object free areas (TLOFAs) are slightly smaller in size than TOFAs because aircraft operate at lower speeds on taxilanes. ADG II TLOFAs are 115 feet wide and ADG III TLOFAs are 162 feet wide. The main north/south taxilane on the eastern edge of the apron areas has sufficient clearance to accommodate an ADG III TLOFA.

Figure 3.5 – *Taxiway Object Free Areas*



Runway Exit Taxiways

Taxiways that intersect with the runway function as exit taxiways. Exit taxiways should be located so that they provide an efficient means for arriving aircraft to exit the runway. Well-placed runway exits can benefit the overall capacity of the runway. A factor in runway exit placement is the aircraft fleet mix anticipated to use the runway. Smaller, slower, and lighter aircraft can slow faster from landing than larger, faster, and heavier aircraft.

The number of exits for each runway was compared against exit factors described in FAA AC 150/5060-5, *Airport Capacity and Delay*, to determine if additional exits may further increase the capacity of the airport. For the runway configuration at VGT, the AC identifies a target exit range between 2,000 feet and 4,000 feet from the landing threshold. Exits within this target range should be spaced a minimum of 750 feet from each other to be counted as separate exits. Each runway threshold at VGT has two exits in the target range, except Runway 25, which only has one. It should also be noted that one of the two exits for Runway 7 is Taxiway C, which intersects with the runway at an acute angle and requires a 330-degree turn for aircraft to exit. Aircraft taking this exit are forced to reduce to slower speeds to take this exit than if the exit was oriented at a 90-degree angle, thus increasing runway occupancy times.

The Transportation Research Board (TRB) ACRP Project 3-17, which was used in modeling the airport's airfield capacity, states that runways with at least four exits in the target exit range will have higher capacity estimates; therefore, each runway at VGT should be considered for additional exits to help improve capacity. The alternatives analysis will examine locations for new exits for each runway.

Hot Spots

There are currently four[1] FAA-designated hot spots on the airfield. Each is identified and described on **Figure 3.6**. During a master plan study, a full analysis of options to mitigate hot spots is required to be undertaken. That analysis will be documented in the next chapter.

[1] Since the original publishing of this chapter, the FAA has eliminated hot spots 5 and 6 resulting in four total hot spots at VGT.

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Hot Spot Descriptions

Hot Spot 1 -Encompasses the area around the intersections of Taxiways F and G with the Runway 7 end. The hold lines on Taxiways F and G are in close proximity to the edge of a large paved area, and pilots often cross the Runway 7 hold line on Taxiway G without ATC authorization.

Hot Spot 2 -Is the result of pilots sometimes entering or crossing Runway 12R without authorization.

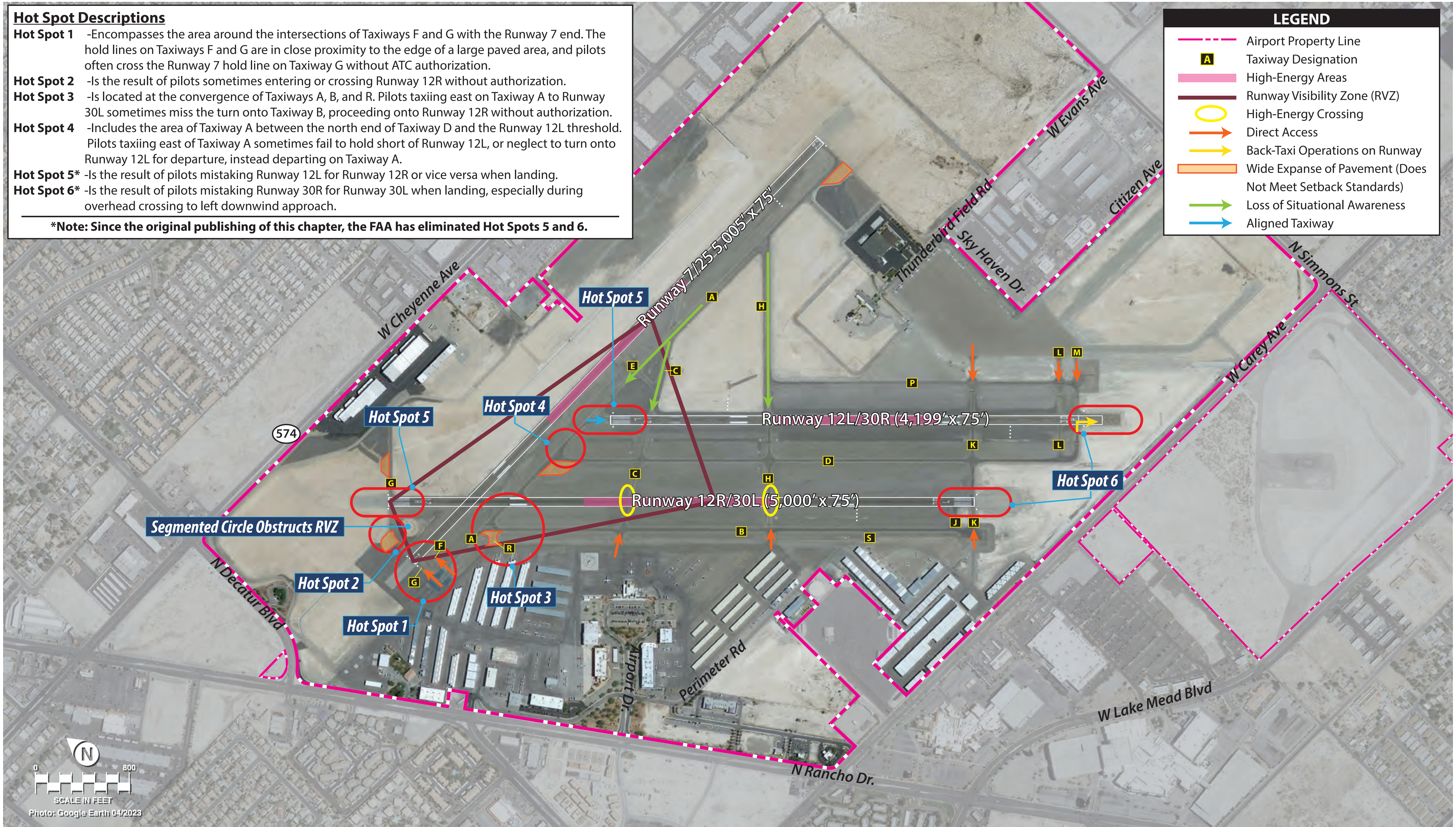
Hot Spot 3 -Is located at the convergence of Taxiways A, B, and R. Pilots taxiing east on Taxiway A to Runway 30L sometimes miss the turn onto Taxiway B, proceeding onto Runway 12R without authorization.

Hot Spot 4 -Includes the area of Taxiway A between the north end of Taxiway D and the Runway 12L threshold. Pilots taxiing east of Taxiway A sometimes fail to hold short of Runway 12L, or neglect to turn onto Runway 12L for departure, instead departing on Taxiway A.

Hot Spot 5* -Is the result of pilots mistaking Runway 12L for Runway 12R or vice versa when landing.

Hot Spot 6* -Is the result of pilots mistaking Runway 30R for Runway 30L when landing, especially during overhead crossing to left downwind approach.

***Note: Since the original publishing of this chapter, the FAA has eliminated Hot Spots 5 and 6.**



Source: North Las Vegas Airport (VGT) Runway Incursion Mitigation Study, 2020

Figure 3.6
AIRFIELD GEOMETRY REVIEW

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Review of Taxiway Geometry

In 2020, the CCDOA completed a runway incursion mitigation (RIM) study for VGT. A summary of existing non-standard airfield geometry conditions identified in that study is described below. It should be noted that the FAA's taxiway geometry requirements have changed over time, with most of the requirements being incorporated into the FAA's *Airport Design* advisory circular in 2012. Many of the existing conditions are common at many airports and have only recently been identified as non-standard.

- *High-Energy Runway Crossings* | The high-energy portion of a runway consists of the middle third of the runway. When aircraft are permitted to cross through this portion of the runway, it increases the potential for substantial aircraft damage if an aircraft incident occurs because the aircraft on the runway tend to be operating at a higher rate of speed. There are two high-energy runway crossings at the following locations:
    - Taxiway C crossing Runway 12R-30L
    - Taxiway H crossing Runway 12R-30L
- *Direct Access* | The FAA discourages airport design where a taxiway permits aircraft to taxi directly from an apron to a runway environment without requiring a turn. Direct access increases the potential for runway incursions (RIs). There are eight locations with direct runway access from an apron, including the following:
    - Taxiway M at Runway 12L-30R
    - Taxiway L at Runway 12L-30R
    - Taxiway K at Runway 12L-30R and 12R-30L
    - Taxiway H at Runway 12R-30L
    - Taxiway C at Runway 12R-30L
    - Taxiway F at Runway 7-25
    - Taxiway G at Runway 7-25
- *Wide Expanse of Pavement* | Wide expanses of pavement can cause pilot confusion while taxiing around an airfield. Wide expanses of pavement can also put airfield signage in inconvenient locations and make it difficult for pilots to navigate. There are very few wide expanses of pavement at VGT; however, the run-up pads around the airfield need to be reconfigured to meet current standards. There are five wide expanses of pavement at the following locations:
    - The intersection of Taxiways A, B, and R, encompassing Hot Spot 3
    - Run-up pad on Taxiway G between the Runway 12R end and Cheyenne Air Center
    - Run-up pad on Taxiway G between the Runway 12R end and Runway 7 end
    - Run-up pad on the Taxiway A/D intersection between the Runway 12R end and Runway 12L end
    - Run-up pad on Taxiway A adjacent to the Runway 25 end

- *Aligned Taxiway* | Aligned taxiways are discouraged by the FAA because it is desirable for aircraft to enter the runway environment perpendicular to the runway, as opposed to underneath an approach end. There is one aligned taxiway located at the Runway 12L end. The length of the straight portion of the aligned taxiway centerline is approximately 180 feet to the southern edge of Taxiway A. This aligned taxiway does not have a taxiway designation and was formerly dedicated as displaced arrival threshold pavement as a way to lower the likelihood of a runway incursion. This area is identified as Hot Spot 4.

- *Loss of Situational Awareness* | When a pilot taxis for a substantial distance without a turn, situational awareness can become a concern. When considering situational awareness leading up towards a runway environment, there is an increased potential for runway incursions. Three existing taxiways have long, straight taxiing operations leading to a runway: Taxiways A, C, and H. Conversely, pilots who encounter a runway environment very quickly after entering the movement area can also experience loss of situational awareness because of the multiple markings, hold bars, ATCT directions, and traffic in a dense area. This is evident at the intersection of Taxiways F and G at Runway 7, which is denoted as Hot Spot 1.

- *Dual Use of Pavement* | Dual use of pavement consists of aircraft utilizing a runway as a taxiway. This type of operation is not desirable, as it increases the potential for significant aircraft accidents and can be confusing to pilots. Runway 30R departures need to back-taxi on the runway to depart using the full-length, due to the lack of a parallel taxiway serving either side of the displaced threshold; however, it should be noted that full-length Runway 30R departures are seldom requested and authorized by VGT ATCT.

- *Misaligned Approach Thresholds* | The approach thresholds to Runways 12L and 12R are staggered and not aligned. The FAA Runway Safety Office has found that misaligned thresholds can lead to wrong surface landings at airports across the country. In discussions with local stakeholders, including the VGT ATCT, they generally prefer to have the thresholds staggered so that they can better tell which runway an aircraft is lined up to, which is more obvious when one aircraft is at a higher altitude than another. This helps provide enhanced situational awareness for ATCT personnel in an area where it is challenging to obtain visual contact with aircraft.

All of these items are illustrated on **Figure 3.6**.

3.4.3 NAVIGATIONAL AIDS

Visual and electronic NAVAIDs are available on each runway at VGT, including PAPIs and REILs. Runway 12L is also equipped with instrument landing system (ILS) glideslope and localizer equipment. These NAVAIDs are sufficient to support operations at the airport and there is no anticipated need for additional equipment through the planning period.

It is important to note that the Las Vegas VORTAC – which is used by the existing ILS or localizer (LOC) instrument flight procedures into Runway 12L – is located off-airport. This NAVAID, as well as the other en-route and transition VORs/ VORTACs, appears to be sufficient to continue supporting the current instrument flight procedures.

3.4.4 AIRFIELD LIGHTING AND MARKING REQUIREMENTS

Airfield Lighting

Each runway at VGT is equipped with medium intensity runway lights (MIRLs). All taxiways are lit with medium intensity taxiway edge lights (MITLs). Each runway end also has threshold lights.

Existing airfield lighting meets the requirements noted in FAA AC 150/5340-30J, *Design and Installation Details for Airport Visual Aids*. Airfield lighting requires periodic inspection and maintenance that is accomplished through airport operations and maintenance functions.

Runway Markings

Runway 12L is marked with precision approach markings, which consist of the landing designator (runway number), runway centerline, threshold markings, touchdown zone markings, and pavement edge markings. Runways 12R and 30L are marked with non-precision approach markings, which consist of the landing designator, runway centerline, and threshold markings. Runways 30R, 7, and 25 are marked with basic markings, which consist of the landing designator and runway centerline. All runway ends also include aiming points. All runway markings are white in color and are listed as being in good condition on the Airport Master Record.

Runway markings meet the requirements in FAA AC 150/5340-1M, *Standards for Airport Markings*. Runway markings require regular maintenance and refreshing, which is accomplished through airport operations and maintenance functions.

Taxiway Markings

The existing taxiways at VGT are marked with taxiway centerlines. Taxiway centerlines provide pilots with continuous visual guidance to permit taxiing along the designated path. All taxiways at VGT have enhanced taxiway centerline markings. These markings precede runway hold lines, are typically 150 feet long, and consist of yellow dashed lines on both sides of the taxiway centerline. Taxiway markings are yellow in color.

Runway holding position markings and surface-painted hold signs are present on all taxiways that intersect with the runways. These markings are painted on the taxiway surface. Further information about the locations of the holding position markings was presented above.

Taxiway markings meet the requirements in FAA AC 150/5340-1M, *Standards for Airport Markings*. Taxiway markings require regular maintenance and refreshing, which is accomplished through airport operations and maintenance functions.

3.4.5 AIRFIELD PAVEMENT

Each runway at VGT is constructed of asphalt. A summary of runway pavement strength ratings is provided in **Table 3.16**.

Table 3.16 | Runway Pavement Strength

Main Landing Gear Configuration	Runway 12R-30L	Runway 12L-30R	Runway 7-25
Single Wheel Loading (S)	116,000	40,000	116,000
Dual Wheel Loading (D)	165,000	60,000	199,000
Dual Tandem Wheel Loading (2D)	270,000	110,000	320,000
Double Dual Tandem Wheel Loading (2D/2D2)	670,000	N/A	762,000

Source: 2016 VGT Pavement Condition Index Report

The available strength ratings for Runway 12R-30L and Runway 7-25 are sufficient to meet the needs of existing and ultimate users of the airport. Runway 12L-30R's current strength rating is sufficient to accommodate a 27 percent useful load of the ultimate critical aircraft (Gulfstream G550). As such, the runway should be considered for strengthening up to 100,000 pounds dual wheel loading, which would accommodate the G550 at maximum takeoff weight. Runway pavement strengthening will be considered as part of the alternatives analysis.

As noted in Chapter 1 (see Figure 1.11), the 2022 Airfield Pavement Management Program Services Pavement Condition Index report for VGT reported the majority of airfield pavement at VGT as generally in good to fair condition. Pavements in poor condition include the full length of Taxiway B, portions of Taxiway A and Taxiway C, the Runway 12L holding bay, and a few minimal ramp areas. Very poor pavement was indicated at the Taxiway A/G/F intersection, Taxiway B/K intersection, and a few minimal ramp areas.

3.4.6 HELICOPTER LANDING AREAS AND ADVANCED AIR MOBILITY

VGT has 18 helipads and helicopter parking spaces on the main GA apron and three helipads on the Cheyenne apron. Each is constructed of asphalt, except for five concrete helipads near the inter-agency hangars. Most helicopter operations arrive or depart from one of these helipads or aprons adjacent to the operator's facility. VGT experiences significant helicopter traffic, so the alternatives analysis will consider opportunities for expanded helicopter facilities.

Feedback from air traffic controllers at VGT is that more room is needed for helicopter training patterns. Taxiway P is currently used for helicopter training activities and its 310-foot separation from Runway 12R-30L can cause a parallax effect for controllers. Parallax is a type of visual illusion in which the position and motion of aircraft are difficult to discern by an observer (air traffic controllers). One remedy could be to add height to the ATCT. This and other options will be considered in the alternatives analysis.

Advanced Air Mobility

Private companies have been developing and testing advanced air mobility (AAM) technologies since the turn of the decade. AAM, which may also be called urban air mobility (UAM), is a new concept of air transportation using electric vertical takeoff and landing (eVTOL) aircraft to move people and cargo between places that are not easily or currently served by surface or air modes. A common example is the air taxi, in which a person or small group of people could travel within or between metropolitan areas, including airports, using small eVTOL aircraft. Development of infrastructure in support of AAM is currently underway in test cities across the county, with AAM expected to become a key component of the nation's air transportation network. Images are provided below of several different AAM/eVTOL aircraft currently in development that would use a vertiport, such as the one proposed in these recommendations.

Various eVTOL Aircraft in Development (Courtesy of VoloCopter, Joby, and Lilium)

Guidelines for Vertiport Facilities

This section reviews applicable guidelines established by the FAA regarding the design of vertiports for eVTOL aircraft. A vertiport is defined as an aviation facility with the primary purpose of supporting eVTOL aircraft. As previously stated, AAM is still a developing technology. The FAA Office of Airports and Technical Center recently solicited aircraft design information from AAM developers. Nine companies responded to the inquiry with varying levels of cooperation, including aircraft design and specifications; operational concepts; infrastructure design; and takeoff and landing profiles. As a result of the feedback, the FAA was able to develop an interim document on the design of vertiports, titled Engineering Brief (EB) 105, *Vertiport Design*.

Reference Aircraft

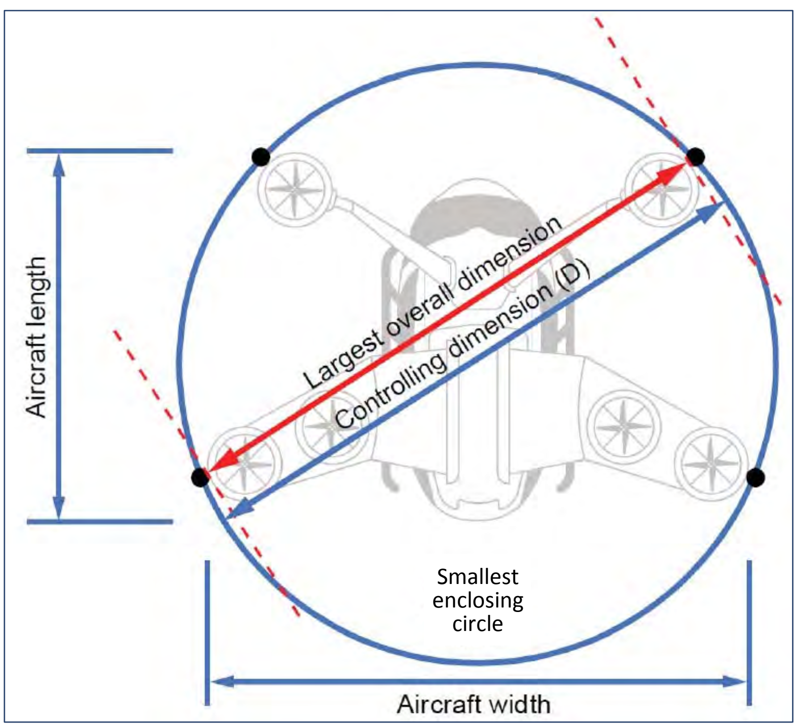
The design criteria established in *Vertiport Design* are intended for eVTOL aircraft that meet the performance criteria and design characteristics of the Reference Aircraft. The Reference Aircraft denotes an eVTOL aircraft that integrates certain performance and design features of the nine previously mentioned emerging aircraft. These aircraft models are evolving rapidly, and manufacturers are approaching aircraft certification with a wide range of designs. Furthermore, new eVTOL aircraft have not yet received FAA airworthiness certification and do not have established safety records. This makes it impractical for the FAA to categorize these aircraft the way fixed-wing and helicopter aircraft have been categorized; however, the feedback from eVTOL manufacturers revealed common characteristics, which the FAA used to produce *Vertiport Design*. These preliminary design characteristics, expected performance capabilities, and assumptions regarding takeoff and landing area design for eVTOL aircraft are summarized in **Table 3.17** and on **Figure 3.7**.

Table 3.17 | Reference Aircraft

Design Characteristics	Criteria
Propulsion	Electric battery driven, utilizing distributed electric propulsion
Propulsive Units	Two or more
Battery Systems	Two or more
Maximum Takeoff Weight (MTOW)	12,500 pounds (5,670 kg) or less
Aircraft Length	50 feet (15.2 m) or less
Aircraft Width	50 feet (15.2 m) or less
Operating Conditions	
Operation Location	Land-based (ground or elevated) – no amphibian or float operations
Pilot	Onboard
Flight Conditions	VFR
Performance	
Hover	Hover out of ground effect (HOGE) in normal operations
Takeoff	Vertical
Landing	Vertical
Downwash/Outwash	Must be considered in TLOF/FATO sizing and ingress/egress areas to ensure no endangerment to people/property in the vicinity and no impact to safety critical navigational aids and surfaces, supporting equipment, nearby aircraft, and overall safety
TLOF = touchdown and liftoff area FATO = final approach and takeoff area	

Source: FAA Engineering Brief 105, Vertiport Design

Figure 3.7 – *Reference Aircraft Controlling Dimensions*



Design Standards for Vertiports

Once the reference aircraft is determined, the design dimensions for the vertiport can be established. A vertiport may consist of several facilities, including aircraft charging and storage, passenger terminal, and takeoff and landing areas. The support facilities of a vertiport will be specific to and determined by the unique AAM company that chooses to establish a presence in the study area. The airfield facilities are the focus of EB 105. The takeoff and landing area design and geometry contained in *Vertiport Design* include the TLOF, the FATO, and the Safety Area, which are defined in detail below.

- *Final Approach and Takeoff Area (FATO)* | The FATO is a defined, load-bearing area over which the aircraft completes the final phase of the approach to a hover or landing, and from which the aircraft initiates takeoff. The FATO is similar to the total surface of a helipad.

- *Touchdown and Liftoff Area (TLOF)* | The TLOF is a load-bearing, generally paved area centered in a FATO on which the aircraft performs a touchdown or liftoff, and is analogous to the center "H" of a helipad.

- *Safety Area* | The safety area is a defined area surrounding the FATO that is intended to reduce the risk of damage to aircraft accidentally diverging from the FATO. The vertiport safety area is identical in purpose to a runway or taxiway safety area.

The dimensions for these areas were presented in **Table 3.17** and are based on the controlling dimension — designated "D" — of the design eVTOL aircraft, as defined for the vertiport facility. "D" is the diameter of the smallest circle enclosing the aircraft on a horizontal plane while the aircraft is in the takeoff or landing configuration, with rotors turning (if applicable). The controlling dimension may be calculated as the largest overall dimension, which is the hypotenuse of a triangle with base legs of the aircraft width and length. The maximum size of each element is presented in **Table 3.18**, based on the maximum design characteristics shown in **Table 3.17**.

Table 3.18 | Takeoff and Landing Area Dimensions

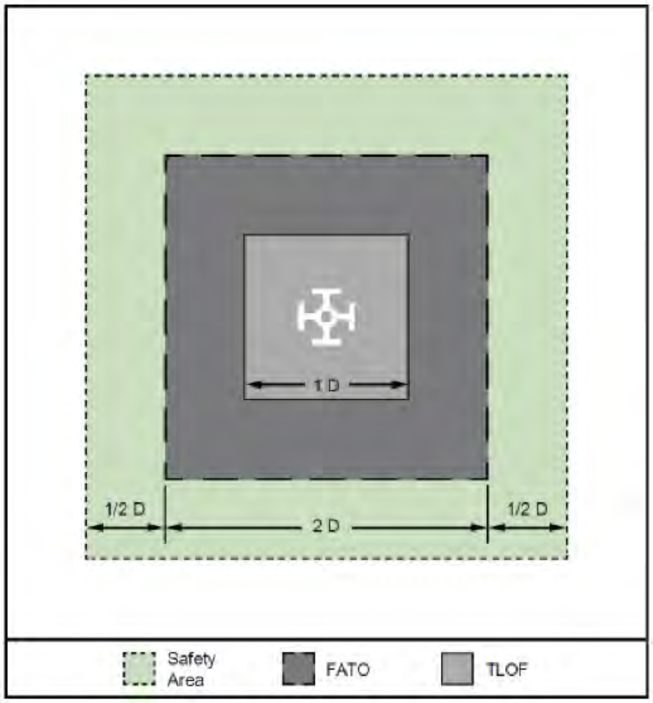
Element	Length	Value (ft)	Maximum Size (sf)
TLOF	1 × D	71	5,041
FATO	2 × D	142	20,164
Safety Area	3 × D	213	45,369

FATO = final approach and takeoff area
TLOF = touchdown and liftoff area

Source: FAA EB 105, Vertiport Design (Table 2-1); Coffman Associates analysis

Each element is centered within the subsequent element: the TLOF is located in the center of the FATO, which is centered within the safety area, as shown by **Figure 3.8**. The "broken wheel symbol" should be used and located in the center of the TLOF to identify the site as a vertiport, as opposed to a heliport. Both the TLOF and FATO are expected to be located on level terrain or a structure, be clear of penetrations and obstructions, and support the weight of the design eVTOL aircraft. The TLOF may be circular, square, or rectangular in shape. Regardless of the shape, the FATO and safety area will have the same shape.

Figure 3.8 – *Takeoff and Landing Area*



Source: FAA EB 105, Vertiport Design

Approach Profiles

The imaginary surfaces defined for heliports in Title 14 Code of Federal Regulations (CFR) Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*, are applicable to vertiports and include the primary surface, approach surface, and transitional surface. Section 77.23 defines these surfaces for heliports, and they have been adopted for use and presented in *Vertiport Design*.

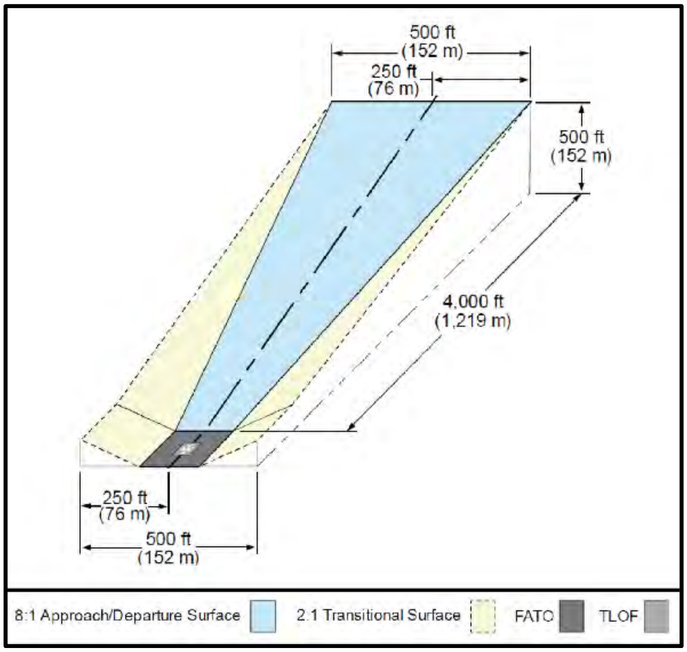
- *Primary Surface* | The primary surface is the same size and shape as the FATO. This surface is a horizontal plane at the established vertiport elevation.

- *Approach Surface* | This surface begins at each end of the vertiport's primary surface, has the same width as the primary surface, and extends outward and upward for a horizontal distance of 4,000 feet, where its width is 500 feet. The slope of this surface is 8:1 and it doubles as the departure surface.

- *Transitional Surface* | The transitional surface extends outward and upward from the lateral boundaries of the primary and approach surfaces at a slope of 2:1 for 250 feet horizontally from the centerline of the primary and approach surfaces.

The primary, approach, and transitional surfaces should remain clear of penetrations whenever possible, unless an FAA analysis determines the penetrations to any Part 77 surface not to be hazardous. **Figure 3.9** is a visual representation of the imaginary surfaces as they apply to vertiports.

Figure 3.9 – *Vertiport Imaginary Surfaces*



Electrical Requirements

Electrical infrastructure will also be needed to support vertiports, to provide power and recharging capabilities for the aircraft. Initial estimates from manufacturers range between 500-kilowatt (kW) to 1.0-megawatt (MW) power supply per charger. The goal is for the charging stations to provide an 80 percent charge in 15-25 minutes. This can be accomplished through expanded use of existing power grid infrastructure and/or utilization of on-site energy production methods, such as a solar farm.

AAM Summary

eVTOLs and AAM/UAM is an emerging, yet unproven, aviation market. Testing and initial adoption are likely to occur in large metropolitan areas, such as Las Vegas, and then expand to mid-sized and smaller markets. Full integration of eVTOL into the national airspace system may not occur for many more years; however, it is prudent for this planning study to consider the potential for this activity at VGT. For this reason, the alternatives analysis may consider siting options for AAM facilities.

3.4.7 AIRPORT TRAFFIC CONTROL TOWER

One of the key recommendations from the 2020 RIM study for VGT was that an ATCT siting study should be conducted to determine the optimum height of the ATCT to provide the highest visibility to the entire airfield. A study conducted by LEAN Technology Corporation, which evaluated the ATCT vantage point, noted that the VGT ATCT sits relatively low to the surface of the runways and has poor vantage when visually attempting to differentiate when an aircraft arriving from the north is landing on either Runway 12L or 12R until they are relatively close to the runway threshold. A solution proposed by LEAN to improve

VGT ATCT capabilities is to increase the height of the ATCT to at least 150 feet above ground level (AGL). At this height, controllers would be better positioned to visually differentiate aircraft arriving to Runways 12L/12R and have a better opportunity to determine if aircraft are lining up to the correct runways when on approach from the south.

3.4.8 RUN-UP APRONS

The airport has five run-up aprons located throughout the airfield. Three of those run-up pads were identified in the 2020 RIM study as not meeting standards. New standards are set to allow aircraft to hold in the run-up apron while allowing another aircraft to pass by on the adjoining taxiway. To meet ADG II TOFA standards, the markings which designate the location on the apron where aircraft can park temporarily to conduct pre-flight engine checks should be located at least 62 feet from the adjacent taxiway centerline.

Feedback from air traffic controllers at VGT is that the run-up apron near the Runway 25 threshold is undersized and can cause backups and delays when Runway 25 is in heavy use. The alternatives will consider options for improving the run-up aprons throughout the airfield to provide more capacity and efficiency.

3.4.9 AIRSPACE PROTECTION

In September 2021, the FAA completed a redesign of the Las Vegas airspace and instrument flight procedures to introduce new performance-based navigation (PBN) procedures and make use of time-based flow management (TBFM) to improve airspace efficiency within the Las Vegas Metroplex. VGT was included in that effort. Conceptual procedures developed for VGT as part of this process included four Area navigation (RNAV) standard instrument departures (SIDs) and four standard terminal arrival routes (STARs). These new procedures are intended to provide more direct routes that are automatically separated from each other and to provide efficient climb and descent profiles. More information regarding this effort can be found at https://www.faa.gov/air_traffic/community_engagement/las.

For airspace protection, the FAA has established imaginary surfaces around and over airports, to be used for identifying obstacles to air navigation and preventing the development of obstacles that could adversely impact aircraft operations. These surfaces define the limits of obstacle heights on and around the airport. For the purposes of this master plan, the airspace requirements encompass the civil airport imaginary surfaces defined in 14 CFR Part 77 (Part 77), *Objects Affecting Navigable Airspace*; obstacle clearance surfaces (OCS), as defined in U.S. Standard for Terminal Instrument Procedures (TERPS); and departure surface criteria found in FAA AC 150/5300-13B.

Part 77 Requirements

Part 77 establishes civil airport imaginary surfaces in relation to the airport and to each runway. The size of each imaginary surface is based on the category of each runway, according to the type of approach available or planned for that runway. The slope and dimensions of the approach surface applied to each end of a runway are determined by the most precise approach existing or planned for that runway end.

Runways 30R, 30L, 7, and 25 are each classified as B (V) – Visual Approach runways. Runway 12L and 12R are non-precision B (C) runways with visibility minimums greater than ¾-mile. The Part 77 surfaces are described below.

- The primary surface is a surface longitudinally centered on a runway. It extends 200 feet beyond each end of the runway; the elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline. The width of a primary surface is 500 feet for each runway at VGT.
- The approach surface is a surface longitudinally centered on the extended runway centerline, extending outward and upward from each end of the primary surface. The inner edge of the approach surface is the same width as the primary surface (500 feet). For visual runways, the approach surface expands uniformly to a width of 1,500 feet and the surface extends for a horizontal distance of 5,000 feet at a slope of 20:1. For non-precision runways, the approach surface expands to a width of 3,500 feet and extends for a horizontal distance of 10,000 feet at a slope of 34:1.
- The transitional surface extends outward and upward at right angles to the runway centerline and the runway centerline extended, at a slope of 7:1, from the sides of the primary surface and from the sides of the approach surfaces.
- The horizontal surface consists of a horizontal plane 150 feet above the established airport elevation. The established airport elevation at VGT is 2,205 feet above MSL; thus, the horizontal surface is 2,355 feet.
- The conical surface extends outward and upward from the periphery of the horizontal surface at a slope of 20:1 for a horizontal distance of 4,000 feet.

There are no anticipated changes to the Part 77 civil airport imaginary surface requirements (i.e., slopes and dimensions) applicable to VGT; however, should the runway threshold locations change in the ultimate runway configuration, the Part 77 surfaces would subsequently need to be modified to reflect any new runway configuration or lengths.

TERPS

VGT is served by two instrument approach procedures: ILS or LOC for Runway 12L and RNAV (GPS) for Runway 12R. For each procedure, the following airspace is required to be protected: the final approach segment, the missed approach segment (especially those portions of the missed approach segment closer to the runway), and circling approach protected areas, which have varying radii based on the respective category of aircraft approach speed.

The ILS or LOC procedure on Runway 12L is currently limited to AAC A and B aircraft approach speeds and does not provide support for AAC C or D, which larger business jets and regional aircraft require for instrument operations. The RNAV (GPS) approach to Runway 12R does support operations by AAC A, B, C, and D aircraft. As part of a separate airspace analysis and modeling effort within this master plan, consideration could be given to enhancing the ILS or LOC procedure to make it available to AAC C and D aircraft and to explore other procedures to improve the accessibility of VGT during periods of poor visibility.

Departure Surface

FAA AC 150/5300-13B includes dimensional criteria for the 40:1 instrument departure surface. The departure surface is broken into two sections. Section 1 starts at the departure end of the runway end elevation and matches the width of the usable runway (75 feet wide). It then projects outward from the runway end at a 40:1 slope. From the edge of the usable runway, Section 2 rises upward to 150 feet above the runway end elevation at a point 500 feet on either side of the runway centerline. It also rises upward along the extended runway centerline at a 40:1 slope until it reaches 304 feet above the runway end elevation. Upon reaching 304 feet, the surface levels out until the end of the departure surface. An airspace evaluation will be performed as part of developing an updated airport layout plan (ALP) drawing set associated with this master plan and will identify existing and ultimate obstructions to the departures surfaces for each runway and will propose action to be taken, if any.

3.4.10 AIRCRAFT STORAGE HANGAR REQUIREMENTS

The demand for hangar space is based on the forecast number and mix of aircraft expected to be based at the airport in the future. Most based aircraft are stored in either individual hangars or shared conventional hangars. It is estimated that 80 percent of small piston aircraft are stored in hangars, while turboprops, jets, and helicopters are all anticipated to be stored in hangars. This percentage is carried forward to future years.

Currently, there is approximately 1,153,400 square feet (sf) of hangar space at the airport. For simplicity, shade structure spaces have been combined with T-hangar spaces, and executive hangar space has been combined with box hangar spaces. Through the long-term planning period, the forecast indicates the addition of up to 247 more based aircraft. The mix of based aircraft is anticipated to continue to include primarily small single-engine piston aircraft, but also a growing number of more sophisticated aircraft (jets, turboprops, and helicopters). For planning purposes, future hangar space needs are a function of providing 1,400 sf for T-hangars, 2,200 sf for individual or connected box hangars, and 3,000 sf for conventional hangars. The future mix of aircraft is then distributed to these hangar types. Over the next 20 years, the hangar space model (**Table 3.19**) shows a need for an additional 455,134 sf of hangar space. Hangar demand projections factor into current hangar vacancies at VGT, including approximately 5,100 sf of T-hangar space and 23,550 sf of executive hangar area that is available. The projection assumes these vacancies will be filled at some point within the next five years.

The hangar need model is based on current and future based aircraft and an estimate of the space needed for each aircraft. Hangars are also used by airport businesses, which make investments based on their business plans and/or the economic conditions to run an aviation business. Airports like VGT may attract aviation businesses that cater to aircraft owners around the country, so the based aircraft model for determining hangar needs is only one consideration. The business model of a developer could show a demand for far more hangars than the based aircraft model.

Table 3.19 | Hangar Needs

	Current	2028	2033	2038	2043
Based Aircraft	511	584	638	696	758
Aircraft to be Hangared	420	481	527	578	632
• Single- and Multi-Engine Piston	363	411	442	473	504
• Turboprops, Jets, and Helicopters	57	70	85	105	128
Hangar Area Requirements					
T-Hangar Area	425,200	487,284	530,684	572,684	659,484
Executive Hangar Area	354,900	346,750	364,350	386,350	434,750
Conventional Hangar Area	373,300	394,300	418,300	448,300	514,300
Total Storage Area (sf):	**1,153,400**	**1,228,334**	**1,313,334**	**1,407,334**	**1,608,534**
New Hangar Area Needed (sf):	**–**	**74,934**	**85,000**	**94,000**	**201,200**

Notes:
Future T-hangar area is estimated at 1,400 sf per aircraft storage space.
Future box hangars are estimated at 2,200 sf per aircraft storage space.
Future conventional hangar area is estimated at 3,000 sf per aircraft storage space.

Source: Coffman Associates analysis

3.4.11 AIRCRAFT PARKING APRON AND TIEDOWN REQUIREMENTS

Aircraft parking aprons should provide for the locally based aircraft that are not stored in hangars; transient aircraft; and apron areas used for maintenance functions, such as temporary ramp space when moving aircraft around. The aprons at VGT are multi-use, meaning local and itinerant aircraft will both use the aprons – typically at the direction of the fixed base operator (FBO) line services – to maximize apron utilization. There is approximately 489,000 square yards (sy) of apron pavement at VGT; however, that total apron area includes taxilanes in hangar areas and other surfaces not used for aircraft parking. Counting only apron areas that are used for aircraft parking, there is approximately 275,800 sy of apron space available for aircraft parking at VGT, including 238 individual aircraft tiedowns for both locally based aircraft and transient aircraft. The apron area in the vicinity of the terminal building is used primarily for transient aircraft, while other aircraft parking areas on the west side of the airfield are used primarily by locally based aircraft. The east side of the airfield also has two large apron areas adjacent to the ATCT, which are used primarily for transient aircraft during peak periods.

Table 3.20 presents the forecasted apron area needs based on standard industry models. Local tiedown positions are estimated as 20 percent of based small single- and multi-engine piston aircraft, plus 10 more positions to address any intermittent spike in utilization. The area needed for local positions is estimated at 1,000 sy per aircraft (typically, single-engine aircraft parking space plus movement space).

Table 3.20 | Aircraft Apron Requirements

	Current	FORECAST			
		2028	2033	2038	2043
Local Apron Positions	–	113	121	128	136
Local Apron Area (sy)	–	112,800	120,600	128,200	136,000
Transient Apron Positions	–	136	144	152	160
Piston Transient Positions	–	102	105	108	109
Turbine Transient Positions	–	34	39	44	51
Transient Apron Area (sy)	–	176,800	190,800	204,800	221,200
Total Apron Area (sy):	**275,800**	**289,600**	**311,400**	**333,000**	**357,200**
New Apron Needed (sy):	**–**	**13,800**	**21,800**	**21,600**	**24,200**

Source: Coffman Associates analysis

Transient apron needs are a function of design day itinerant operations and the assumption that up to 30 percent of those aircraft would need apron parking space at any one time. Transient apron space is estimated for both small aircraft (1,000 sy) and larger turboprops and business jets (2,200 sy). The model then assumes that, over time, a higher percentage of the aircraft using transient apron space will be large aircraft.

The apron model results in a long-term need for a total of 357,200 sy of apron space to meet the needs of both local based aircraft and transient aircraft.

This apron model is based off design day activity, which does not account for peak periods throughout the year when apron needs spike. These are usually centered around large events, such as Formula One (F1) races, National Football League (NFL) football games, or major concerts and events.

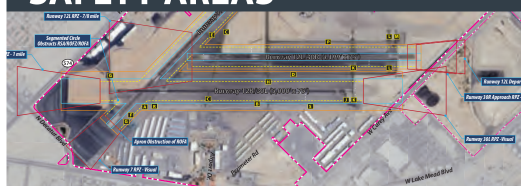
3.4.12 AIRSIDE FACILITY REQUIREMENTS SUMMARY

Figure 3.10 provides a summary of airside facility requirements identified in the previous sections. Requirements are summarized for the ultimate condition. The ultimate condition refers to the 20-year planning period.

RUNWAYS

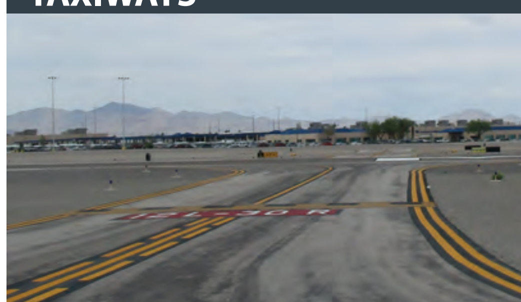
	AVAILABLE	ULTIMATE CONDITION
Runway 12R-30L		
	RDC C-II-5000	Consider RDC D-III-5000
	5,000' x 75'	Consider extension to 6,000'+ and widen to 100'
	160,000 lbs S | 165,000 lbs D | 270,000 lbs 2D | 670,000 lbs 2D/2D2	Maintain
Runway 12L-30R		
	RDC B-II-5000	Consider RDC D-III-5000
	4,199' x 75'	Consider extension to 6,000'+ and widen to 100'
	40,000 lbs S | 60,000 lbs D | 110,000 lbs 2D	Strengthen to 100,000 lbs D
Runway 7-25		
	RDC B-II-VIS	RDC B-II-VIS
	5,005' x 75'	Maintain
	160,000 lbs S | 199,000 lbs D | 320,000 lbs 2D | 762,000 lbs 2D/2D2	Maintain

SAFETY AREAS



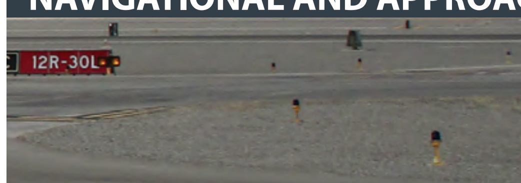
AVAILABLE	ULTIMATE CONDITION
B-II RSA standards met on 12L-30R/7-25; C-II RSA (12R-30L) obstructed by Taxiway B, perimeter road/fencing, and West Carey Ave.	Meet D-III RSA standards
B-II ROFA - Segmented circle and apron pavement obstruct the 7-25 ROFA; C-II ROFA (12R-30L) obstructed by West Cheyenne Ave., perimeter road/fencing, and public roads	Meet D-III ROFA standards
ROFZ - Segmented circle obstructs 12R-30L & 7-25 ROFZ	Relocated segmented circle
RPZs - public roads and buildings in existing RPZs	Meet D-III-5000 RPZ standards

TAXIWAYS



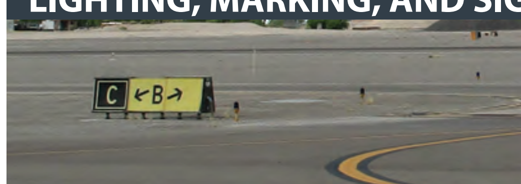
AVAILABLE	ULTIMATE CONDITION
ADG II and TDG 2A for all taxiways	Improve to TDG 2B standards
All taxiways at least 35' wide	Maintain
Parallel taxiways available for each runway; minimum 240' separation from runway centerline	Consider adding north parallel taxiway for 7-25; increase separation to 400' for D-III runway
2 exit taxiways per runway in target areas	Consider additional exits to enhance airfield capacity
Hot Spots 1-4*	Implement corrective measures
8 direct access points	Implement corrective measures
2 high-energy runway crossings	Implement corrective measures
5 wide expansive pavement areas	Implement corrective measures
1 aligned taxiway	Implement corrective measures
5 run up aprons; 3 do not meet TOFA standards	Improve/expand run up aprons and consider new run up aprons to compliment runway expansions

NAVIGATIONAL AND APPROACH AIDS



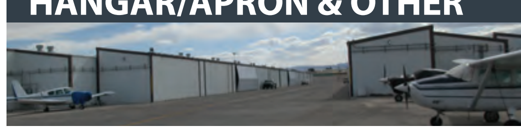
AVAILABLE	ULTIMATE CONDITION
ILS or LOC - Runway 12L (ADG A/B only) | RNAV-GPS - Runway 12R (ADG A-D)	Consider adding ADG C/D capability to ILS or LOC
ASOS	Maintain
ATCT	Consider increasing height to a minimum of 150 feet AGL
Lighted windcone/segmented circle	Relocate outside ROFA/ROFZs
PAPI-4s - all runways	Maintain
REILs - all runways	Maintain

LIGHTING, MARKING, AND SIGNAGE



AVAILABLE	ULTIMATE CONDITION
Precision markings - Runway 12L	Maintain
Non-precision markings - Runways 12R, 30L	Maintain
Basic markings - Runways 7, 25, 30R	Maintain
MIRL - all runways	Consider gradual replacement with LED fixtures
MITL - all taxiways	Consider gradual replacement with LED fixtures
Holding position markings - 200' from all runway centerlines	Increase separation to 272 feet for D-III runway

HANGAR/APRON & OTHER



AVAILABLE	ULTIMATE CONDITION
1,153,000 sf of storage hangar capacity	Increase capacity to 1,608,500 sf
275,800 sy of apron	Increase capacity to 357,200 sy
18 helicopter helipads/parking spaces	Consider locations for vertiport development and supporting solar farm

*Note: Since the original publishing of this chapter, the FAA has eliminated hot spots 5 and 6 resulting in four total hot spots at VGT.

KEY

ADG - Airplane Design Group
AGL - Above Ground Level
ASOS - Automated Surface Observing System
ATCT - Airport Traffic Control Tower
MIRL/HIRL - Medium/High Intensity Runway Lighting
MITL - Medium Intensity Taxiway Lighting
PAPI - Precision Approach Path Indicator
RDC - Runway Design Code
REIL - Runway End Identification Lights
ROFA - Runway Object Free Area
ROFZ - Runway Obstacle Free Zone
RPZ - Runway Protection Zone
RSA - Runway Safety Area
TDG - Taxiway Design Group
VIS - Visual

Figure 3.10
AIRSIDE FACILITY REQUIREMENTS SUMMARY

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3.5 LANDSIDE FACILITIES

The following is an evaluation of landside facilities, including the GA terminal building, vehicle access, and parking. The requirements found in these subsections are based on the forecasted total and peak hour demands. Further refinements may be required to account for the unique circumstances at VGT – specifically, the large number of special events that increase itinerant demand in the Las Vegas area and at the airport.

3.5.1 GENERAL AVIATION TERMINAL BUILDING

VGT's terminal building is a two-level structure encompassing approximately 20,612 sf. The building was originally constructed in 1992 and renovated in 2019 and is located at the center of the west apron. The building houses VGT airport staff offices, FBO services, rental car agencies, restrooms, a lobby, a pilot lounge, a vending area, rental conference rooms, an observation deck, and a restaurant.

The methodology used in estimating GA terminal facility needs is based on the number of airport users expected to utilize these facilities during the design hour. GA space requirements are based on providing 125 sf per design hour itinerant passenger. Design hour itinerant passengers are determined by multiplying design hour itinerant operations by the estimated number of passengers on the aircraft (estimated to range between 2.0 and 3.5 passengers over the planning period).

The long-term projected terminal facility need is approximately 16,300 sf, which is less than the current capacity; however, feedback from the planning committee for the master plan indicated that additional services are needed in the terminal, including expanded pilot facilities (including showers). Consideration should be given to providing those facilities in future renovations of the building.

The terminal building is in the ideal location, central to the runway system and fronted by a large transient apron. Because the terminal building serves as the first introduction travelers may have to the region, it should be maintained as necessary.

3.5.2 SURFACE TRANSPORTATION

The following subsections summarize airport access, roadway network considerations, and vehicle parking requirements.

Airport Access Roadways

On-airport circulation roadways (Airport Drive and Perimeter Road) are anticipated to adequately serve development on the west side of the airport through the planning period. The combination of Citizen Avenue, Sky Haven Drive, and Thunderbird Field Road – which provide access to facilities on the east side of the airfield – currently provide adequate access but may need to be expanded as new developments occur in this area. Additionally, any future airport development should review the *City of North Las Vegas Comprehensive Plan* and any recent traffic impact studies in the vicinity of the airport and consider any planned roadway or intersection improvements.

Airport Parking

Airport planners should be cognizant of the need for vehicle parking space on GA airports. At the same time, parking needs are generally determined by hangar owners' needs. Those operating businesses may have a need for more parking, while private hangar owners may not have a need for any dedicated parking if they park in their hangars when utilizing their aircraft. This makes it inherently challenging to estimate future hangar vehicle parking needs.

Parking needs can be divided between transient airport users and locally based users. Transient users include visitors and those employed at the airport, while locally based users primarily include those attending their based aircraft. Ideally, both user types would have access to dedicated vehicle parking outside the fence; however, at GA airports, it is common for locally based aircraft owners to park in their hangars. Rather than attempt to determine a specific number of vehicle positions needed in the future, developers should include vehicle parking in their development plans, where necessary.

There are 248 publicly accessible vehicle parking spaces available at the terminal building. Projected vehicle parking space needs are based on accommodating design hour itinerant passengers; an estimated number of employees of the businesses located within the terminal; and a certain number for locally based pilots that may be visiting the terminal for FBO-related services. The existing number of vehicle parking spaces should be adequate through the long-term planning period; however, any new hangars should account for adequate parking in proximity to the facility.

3.5.3 LANDSIDE FACILITY REQUIREMENTS SUMMARY

Table 3.21 summarizes the landside requirements identified in the previous sections. As described in the sections above, the existing terminal building and associated vehicle parking lots exceed the projected long-term requirements; however, additional terminal services and renovations will be needed over the course of the planning period and new vehicle parking spaces should be added as new developments occur at the airport.

Table 3.21 | Landside Facility Requirements Summary

	Available	2028	2033	2038	2043
Terminal (sf)	20,612	7,900	10,500	13,300	16,300
Vehicle Parking Spaces	248	52	62	73	85

Source: Coffman Associates analysis

3.6 SUPPORT FACILITIES

The following describes the requirements for the airport's support facilities, including aviation fuel storage, maintenance and storage, and utilities.

3.6.1 AVIATION FUEL STORAGE

Fuel sales are managed by the CCDOA, which operates the FBO at VGT. The CCDOA maintains a fuel farm consisting of 50,000 gallons of Jet A storage and 40,000 gallons of 100LL (Avgas) fuel storage. Additional fuel storage capacity should be planned if the FBO is unable to maintain an adequate supply and reserve. An ideal reserve is typically 14 days for GA airports. For busier reliever airports with significant levels of turbine engine activity, a seven-day Jet A fuel supply may be adequate.

Based on fuel sales records, a volume of nearly 1,390,346 gallons of Jet A fuel was sold in 2023. This works out to approximately 150 gallons sold for every turbine engine operation. By applying a modest growth rate to the forecast years to account for increasing activity by larger jets with higher fuel capacities, the airport is projected to sell 5.9 million gallons of Jet A fuel within the 20-year planning horizon. By the short-term planning period (the next five years), the airport is projected to begin realizing a constraint on fuel storage capacity, if maintaining a seven-day reserve. By the long-term planning period, the airport would need an additional 64,000 gallons of Jet A capacity. Avgas storage needs are based on an average of 3.5 gallons sold per piston operation. This ratio is kept constant through the planning period. The results show available Avgas capacity is sufficient through the planning period. **Table 3.22** documents the fuel storage capacity analysis.

Table 3.22 | Fuel Storage Requirements

	Current Capacity	FORECAST			
		2028	2033	2038	2043
Jet A Gallons per Operation[1]	**50,000 gal**	**150 gal/op**	**155 gal/op**	**160 gal/op**	**170 gal/op**
Annual Usage (gal)		2,696,300	3,429,700	4,381,300	5,943,200
Daily Usage (gal)		7,387	9,396	12,004	16,283
7-Day Storage (gal)		51,700	65,800	84,000	114,000
Avgas Gallons per Operation[1]	**40,000 gal**	**3.5 gal/op**	**3.5 gal/op**	**3.5 gal/op**	**3.5 gal/op**
Annual Usage (gal)		631,300	670,100	710,900	751,600
Daily Usage (gal)		1,730	1,836	1,948	2,059
14-Day Storage (gal)		24,200	25,700	27,300	28,800

Source: [1]Coffman Associates estimate based on airport fuel flowage records

3.6.2 AIRPORT MAINTENANCE AND STORAGE

The airport's 12,500-sf maintenance building is located south of the main terminal on the perimeter road, adjacent to a water tank and the West Wind Las Vegas Drive-In. The maintenance building and adjoining 33,200-sf yard house various equipment, including sweepers, dump trucks, and lifts. These facilities should continue to adequately serve the needs of the airport through the planning period.

3.6.3 UTILITY INFRASTRUCTURE

The ability of existing utility infrastructure to accommodate future development needs to be considered for long-term planning at the airport. No field investigations were conducted to assess utility conditions for the purposes of this master plan. As developments occur on the airport, additional utility infrastructure will be required. Coordination with the CCDOA and the City of North Las Vegas is required prior to starting any development at the airport. The alternatives analysis will consider high-level utility infrastructure needs, based on proposed developments.

3.7 AIRPORT SECURITY

In cooperation with the GA community, the Transportation Security Administration (TSA) has developed guidelines to enhance security at GA airports. *Security Guidelines for General Aviation Airport Operators and Users* was released in June 2021. The guidance places a large emphasis on risk-based security by evaluating hazards/threats, vulnerabilities, and consequences. Risk-based security helps ensure resources and requirements are focused on the areas where the greatest risks are present. TSA security recommendations for various types of airport infrastructure are included in **Table 3.23**.

Table 3.23 | TSA Airport Infrastructure Security Recommendations

INFRASTRUCTURE	RECOMMENDATION
Hangars	• Hangars should be properly marked and numbered for ease of emergency response. • Install security and informational signs. • Avoid keyed hangar locks. If keyed, locks should be rekeyed with every new tenant. • Ensure proper lighting around hangar areas. • Equip hangars with electric bypass switches and/or alarm and intrusion detection systems for enhanced security.
Locks	• Combination locks – may not be suitable for outdoor use if they are exposed to precipitation or freezing temperatures. Change lock combinations frequently. • Cipher (push button) locks – limit use to controlling access in manned areas because lock codes can be given to unauthorized users and the presence of other personnel could deter the unauthorized use of the code. Change lock codes frequently. • Keyed locks – best for outdoor use. Locks should be rekeyed, replaced, or discarded when a tenant moves out. • Advanced electronic key technologies – provide airport management with the ability to immediately disable access on keys that are lost or stolen. Also provide a record of users' movements throughout the airport area. • Deadbolt locks, built-in door handle locks, or padlocks and metallic keys should be considered to secure an access point, particularly those that are perceived or presumed to be low-risk, low throughput, or significantly distant from the main areas of concern.
Key Control	• Where key-cutting codes and equipment are used, measures should be taken to protect them against loss or misuse. • Limit key issuance authority to as few personnel as possible to minimize improper distribution. • Issue keys to personnel based on operational need and not as a convenience. • Retrieve keys when personnel leave the airport by transfer, dismissal, resignation, or lease expiration. • Lost keys should be reported promptly to the appropriate airport personnel. • Unissued locks and keys should be properly safeguarded. • Keys should be stamped or engraved with "Do Not Duplicate." • The key issuance system should be periodically (at least annually) audited to ensure accountability for all keys.

(Continues on next page)

Table 3.23 | TSA Airport Infrastructure Security Recommendations (continued)

INFRASTRUCTURE	RECOMMENDATION
Perimeter Security	• Physical barriers (fencing, walls, electronic boundaries) can be used to deter and delay access of unauthorized persons into sensitive areas.
CCTV (Closed Circuit Television)	• Monitored CCTV systems are an effective method of perimeter security and – in conjunction with security fencing – can deter security breaches. • Consider outdoor security lighting and cameras to improve security of aircraft parking and hangar areas, fuel storage areas and fuel trucks, airport access control points, vehicle parking lots, fences, or obstructed areas.
IDS (Intrusion Detection Systems)	• Can replace the need for physical security personnel to patrol an entire facility or perimeter. • Monitored by a contracted company that notifies police, fire, and/or airport management in the event of an intrusion.
Fencing	• Most common means of securing a perimeter. • Low maintenance; provides clear visibility for patrols; deters animals from the airfield; and can be installed in almost any environment. • For best value, fencing should be used in conjunction with a “challenge” system or airport watch program.
Access Points	• The number of access points on perimeter controls should be minimized and their use and conditions should be regularly monitored. • Should control/prevent access, but also differentiate between an authorized and unauthorized user. • If an access point is not user-friendly, it may be abused, disregarded, or subverted and thus pose a security risk.
Gates	• Should have self-closures and be equipped so they can be secured, should enhanced security conditions require it. • All gates should be sufficiently lighted. • Should have no more than 4-6 inches of ground clearance beneath the gate and minimal gaps on both sides.
Vehicle Gates	• The chief concern with vehicle gates is tailgating. It is the responsibility of each authorized person to prevent tailgating in a safe and non-confrontational manner. Where prevention is not practical or safe, suspected unauthorized access should be reported. • Include signage to remind vehicle operators to confirm gate closure.
Lighting	• Security lighting should be connected to an emergency power source, if available. • Ensure lighting does not interfere with aircraft operations.
Signage	• Wording may include, but is not limited to, warnings against trespassing, unauthorized use of aircraft and tampering with aircraft, and reporting of suspicious activity. • Use concise language and include phone numbers of the nearest responding law enforcement agency, 9-1-1, or TSA’s 1-866-GA-SECUR, as appropriate.

Source: Security Guidelines for General Aviation Airport Operators and Users, June 2021

VGT is secured with a six-foot perimeter fence topped with three-strand barbed wire. There are six RFID card reader access gates located along the perimeter fence around the airport. There are 61 combined pedestrian and vehicle gates along the perimeter. As security needs change and as development occurs, the CCDOA should conduct an assessment based on current guidance and implement security measures, as appropriate.

3.8 SUMMARY

This chapter has outlined facility requirements for VGT for a 20-year planning period.

Consideration will be given in the development of various airfield alternatives to improving the airfield from RDC B-II-5000 design standards to meet higher RDC D-III-4000 design standards in the ultimate condition. Meeting higher design standards is in anticipation of increased operations by larger and faster business jets. The alternatives will need to weigh existing constraints to the airport and how they are impacted by the larger safety areas associated with the higher design standards.

The available runway dimensions at VGT can accommodate the core of small GA aircraft; however, during hot periods of the year, larger and faster business jets are weight-restricted or are unable to operate at VGT due to limited runway lengths. The runway length analysis conducted in this chapter identified a need to expand one runway at VGT to a minimum of 5,900 feet and to explore options to extend beyond 6,000 feet so that the airport can fulfill its role as a reliever to Harry Reid International Airport for larger business jets. The CCDOA system of airports is constrained and improving VGT's facilities to increase utility will minimize delays and benefit the National Airspace System.

In addition to runway improvements, the facility requirements identified a need for new aircraft storage hangar capacity and aircraft parking aprons. Major events – such as NFL football games, F1 car races, and other events attracting heavy aircraft traffic to Las Vegas – are becoming more frequent and are particularly burdensome on VGT facilities. Enhancing the airport's ability to accommodate these peak activity periods can further support the financial sustainability of the airport and relieve congestion at other CCDOA airports.

The following chapter will consider various layouts to address forecasted growth at VGT.