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Capital Region International Airport Master Plan





Chapter 5

Facility Requirements

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5 Facility Requirements

5.1 Introduction

Future airport facility requirements, including the type, size, and quantity, are dependent on the aviation activity levels projected in the aviation demand forecasts discussed in **Chapter 4, Aviation Activity Forecast**. The need for new or expanded facilities often arises from opportunities to support forecasted growth and enhance an airport's ability to accommodate increasing demand. However, the requirements for new or improved facilities can also be driven by other circumstances, such as, updated standards which have been adopted by the FAA or another regulatory agency, an evolving strategic vision for the airport, the replacement of outdated or inefficient facilities that are prohibitively costly to maintain or modernize, or the desire to introduce new services and facilities. These factors significantly shape future facility needs and have been considered in this analysis to evaluate the current capacity of airport facilities in relation to projected aviation demand. This comparison helps identify deficiencies and constraints, along with their anticipated timelines.

5.2 Aviation Activity Forecast Summary

The aviation activity forecast for Lansing Capital Region International Airport (LAN or Airport) was based on demographic, economic, and geographic statistical analysis, producing three forecast scenarios (base, low, and high) relevant to LAN. This forecast covers the 20-year period from 2023 to 2043, with milestones set for 2028, 2033, and 2043 (Base Year (2023) +5, +10, and +20 years). Facility requirements are driven by aircraft operations and passenger enplanements, which may not align exactly with these milestones. To prevent linking demand levels to specific years, facility improvement thresholds are categorized into three Planning Activity Levels (PALs): PAL 1, PAL 2, and PAL 3. Facility development will be triggered when forecasted demand levels are met, rather than based on specific calendar or fiscal years. The PALs for the LAN Master Plan are defined as follows:

- **PAL 1:** Anticipated to be reached at the forecast demand levels for the year 2028, corresponding to the near-term planning horizon.
- **PAL 2:** Anticipated to be reached at the forecast demand levels for the year 2033, corresponding to the mid-term planning horizon.
- **PAL 3:** Anticipated to be reached at the forecast demand levels for the year 2043, corresponding to the long-term planning horizon.

The recommended Capital Improvement Program (CIP) detailed in **Chapter 8, Financial Feasibility and Implementation Plan** outlines specific projects and budget years; however, this chapter emphasizes PALs for determining facility requirements. This approach enables the timing of airport facility project implementation to be driven by demand deficiencies based on

forecasted activity levels, allowing airport operators to prepare for development needs more effectively before they escalate. **Table 5-1** summarizes the forecasted demand by PAL for passenger enplanements, aircraft operations, and based aircraft, and includes a high-growth scenario for PAL 3. For more details, see **Chapter 4, Aviation Activity Forecast**.

Table 5-1
Aviation Activity Forecast Summary by PAL

	Baseline (FY 2023)	Planning Activity Level			
		PAL 1	PAL 2	PAL 3 Base Case	PAL 3 High Growth
Total Passenger Enplanements	108,702	118,500	133,700	170,400	303,740
Total Aircraft Operations	32,225	32,900	34,500	37,900	40,800
Total Based Aircraft	65	66	66	69	69

Source: RS&H Analysis, 2024

5.2.1 Critical Aircraft

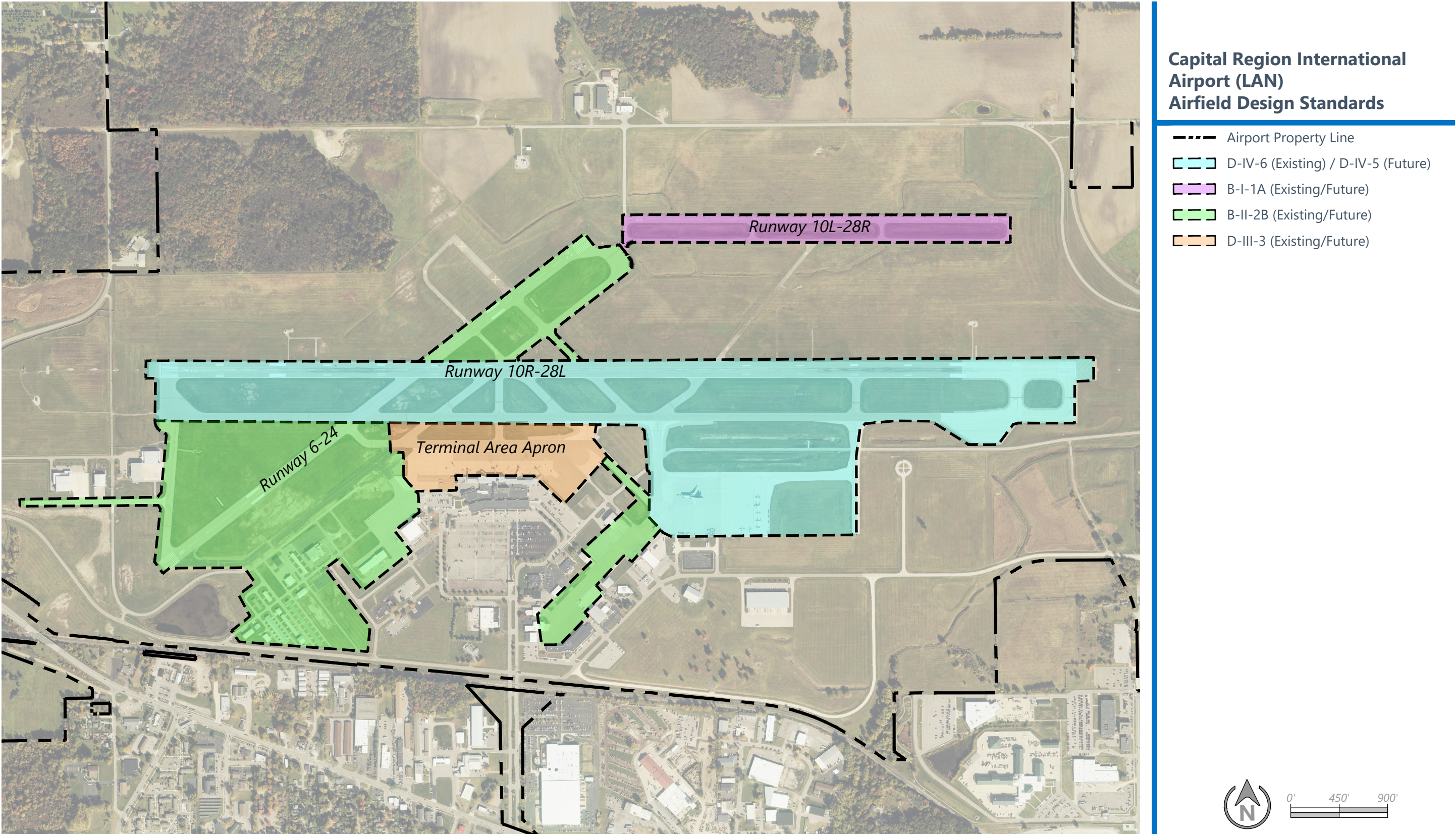
A key outcome of **Chapter 4, Aviation Activity Forecast** was the identification of both existing and future critical aircraft, which refers to the most demanding aircraft or group of aircraft that regularly use the airport (500 total annual operations, not including touch-and-go landings). FAA Advisory Circular (AC) 150/5300-13B, *Airport Design - Change 1* categorizes critical aircraft based on three parameters:

- **Aircraft Approach Category (AAC):** Relates to aircraft landing speeds, represented by letters A through E.
- **Airplane Design Group (ADG):** Relates to airplane wingspan and height, represented by Roman numerals I through VI.
- **Taxiway Design Group (TDG):** Relates to the configuration and wheelbase of aircraft landing gear as affecting the aircraft’s ability to negotiate turning movements, represented by numbers 1 through 6 (with 1 and 2 further divided into A and B).

Different areas of an airfield can have specific critical aircraft dependent upon the facilities being served. This practice helps prevent unnecessary investments that overbuild facilities for larger aircraft that only operate in certain parts of the airport. By identifying the appropriate critical aircraft for specific areas of the airport, facilities can be designed to meet the required service levels and qualify for federal funding. For this reason, FAA allows and encourages the use of multiple critical aircraft throughout an airport, as appropriate, to enable practical and efficient facility design based on the intended uses at an airport. Critical aircraft determinations at LAN

were made for four distinct areas: one for each runway (10R-28L, 10L-28R, 6-24) and the directly supporting taxiway system, and one specific to the terminal area apron, as shown in **Figure 5-1**. **Table 5-2**, at the end of this section, shows the critical aircraft determination for each identified area of LAN.

Figure 5-1
Airfield Design Standards



Note: Design standards based on existing/future critical aircraft (see **Table 5-2**).
Source: RS&H, 2024

5.2.1.1 Runway 10R-28L

Runway 10R-28L, the primary runway at LAN, is 8,506 feet long by 150 feet wide. It is designed to meet D-IV design standards. **Chapter 4, Aviation Activity Forecast** identified the Boeing (Douglas) MD-11, a D-IV-6 cargo aircraft, as the existing critical aircraft for Runway 10R-28L. The MD-11, primarily used by United Parcel Service (UPS), was identified as the most demanding aircraft operating at LAN having 500 or more annual operations based on FAA Traffic Flow Management System Counts (TFMSC) data from 2022.

Beginning in 2023, UPS began replacing its national fleet of MD-11 aircraft with the more fuel-efficient Boeing 767-300 (C-IV-5)¹. Like the MD-11, the B767-300 operates exclusively on Runway 10R-28L at LAN. This transition was completed at LAN in late 2024. Similarly, LAN's commercial aircraft, including the B737-800, CRJ-900, and CRJ-200, exclusively use Runway 10R-28. These aircraft are all AAC D and collectively exceed 500 annual operations. The combination of the most demanding cargo aircraft (B767-300) and commercial service aircraft (B737-800) using Runway 10R-28L results in a hybrid future critical aircraft, with an AAC of the 737-800 (Category D) and the ADG and TDG of the 767-300 (Group 5).

5.2.1.2 Runway 6-24

Runway 6-24 is 5,003 feet long by 120 feet wide and serves as a crosswind runway for smaller general aviation traffic at LAN. Originally constructed to serve C-II aircraft, the runway does not meet current FAA C-II design criteria outlined in AC 150/5300-13B. Consequently, operations for Runway 6-24 are limited to B-II aircraft meaning it does not currently serve larger commercial service aircraft currently operating at LAN. Regardless, a variety of B-II aircraft still make use of the runway and justify continued protection for that critical aircraft category. Runway 6-24 currently meets B-II design standards, and this classification is forecast to remain through the planning period.

5.2.1.3 Runway 10L-28R

Runway 10L-28R, at 3,601 feet long by 75 feet wide, is a parallel runway to the primary runway (10R-28L) and serves small general aviation traffic. The existing and future critical aircraft for this runway have historically been classified as a variety of B-I aircraft. This determination was validated and carried forward for the purposes of this Master Plan.

At 75 feet wide, Runway 10L-28R meets B-II design standards. However, its length and weight-bearing capacity are better suited for a variety of B-I aircraft. As of 2024, no improvements to increase the runway's weight-bearing capacity are included in the LAN Capital Improvement

¹ Kulisch, Eric. (2023, February 2). UPS begins phaseout of older MD-11 cargo jets. *FreightWaves*. <https://www.freightwaves.com/news/ups-begins-phaseout-of-older-md-11-cargo-jets>

Program. Therefore, the future critical aircraft defining facility requirements for Runway 10L-28R remains a mix of B-I aircraft.²

5.2.1.4 Terminal Area Apron

In addition to the critical aircraft designated for the runways at LAN, the commercial terminal airside warrants a specific critical aircraft for air carrier aircraft using the terminal apron and supporting taxiway connectors. **Chapter 4, Aviation Activity Forecast** demonstrates the need to accommodate the Boeing 737-800 (D-III-3) as the most demanding critical aircraft for the terminal apron. This designation will influence the layout and design of the terminal apron, particularly in relation to gates serving international flights, the apron taxilane, and connector taxiways entering the apron.

Table 5-2
Critical Aircraft Determination

	Critical Aircraft	AAC	ADG	TDG
Runway 10R-28L				
Existing Critical Aircraft	Boeing (Douglas) MD-11	D	IV	6
Future Critical Aircraft	Boeing 767-300/737-800	D	IV	5
Runway 10L-28R				
Existing Critical Aircraft	Variety of B-I Aircraft	B	I	1A
Future Critical Aircraft	Variety of B-I Aircraft	B	I	1A
Runway 6-24				
Existing Critical Aircraft	Variety of B-II Aircraft	B	II	2B
Future Critical Aircraft	Variety of B-II Aircraft	B	II	2B
Terminal Area Apron				
Existing Critical Aircraft	Boeing 737-800	D	III	3
Future Critical Aircraft	Boeing 737-800	D	III	3

Source: RS&H Analysis, 2024

5.3 Airfield Capacity

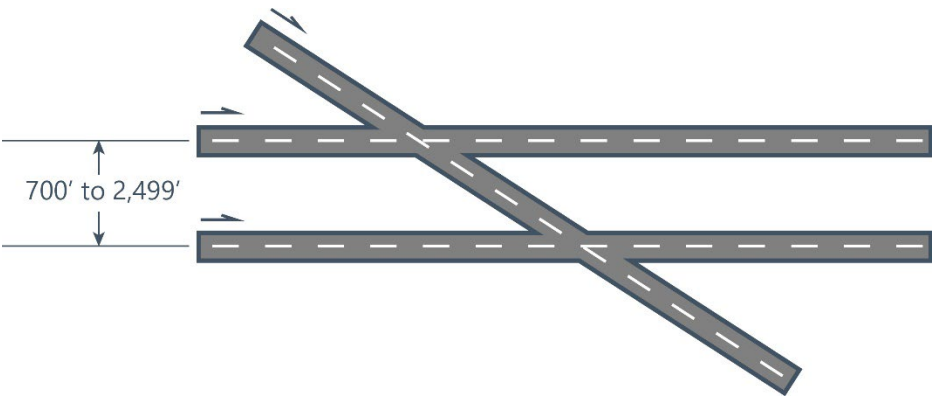
Airfield capacity, or throughput capacity, is defined as a measure of the maximum number of aircraft operations that can be accommodated at an airport in an hour. To determine airfield capacity and associated aircraft delays at a planning level for LAN, the methodology of FAA AC 150/5060-5, *Airport Capacity and Delay* was used for this analysis. As shown in **Figure 5-2**, LAN

² Small Aircraft: An aircraft with a maximum certificated takeoff weight of 12,500 lbs. or less (14 CFR 1.1)

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operates as a three-runway system comparable to the No. 10 configuration depicted in this Advisory Circular.

Figure 5-2
AC 150/5060-5 No. 10 Diagram - Typical Three-Runway Configuration



Source: FAA AC 150/5060-5, *Airport Capacity and Delay*, Graphic prepared by RS&H, 2025

The FAA recognizes the Annual Service Volume (ASV) methodology as a reasonable estimate of an airport’s annual capacity. ASV accounts for several key factors including runway configuration, weather, the percentage of large and heavy aircraft operations compared to total annual operations as the fleet mix, and the number of touch-and-go operations. **Table 5-3** presents a comparison between forecasted aircraft operations and the estimated ASV ratio for the existing airfield.

Table 5-3
Comparison of Forecast Operations and Annual Airfield Capacity

	Baseline (FY 2023)	Planning Activity Level			
		PAL 1	PAL 2	PAL 3 Base Case	PAL 3 High Growth
Total Aircraft Operations	32,225	32,900	34,500	37,900	40,800
Existing ASV	260,000	260,000	260,000	260,000	260,000
ASV Ratio (Existing ASV / Aircraft Operations)	12%	13%	13%	15%	16%

Source: FAA CountOps, RS&H Analysis, 2024

The ASV for the current runway configuration is estimated at 260,000 operations, which significantly surpasses the forecasted operation levels. Therefore, at the projected activity levels, no additional runway capacity will be required during the planning period. It should be noted

that under the same conditions, even a single-runway system at LAN could still accommodate up to 205,000 operations, which remains well above the forecasted operation levels.

According to industry standards³, planning for additional runway capacity should commence when the ASV ratio reaches 60 percent (156,000 operations), with upgrades to be implemented at 80 percent (208,000 operations) of the ASV. This level is not forecasted to occur until well after the 20-year planning horizon.

5.4 Airfield Requirements

This section outlines the airfield facility needs for LAN over the next 20 years. These requirements have been developed in accordance with current FAA Advisory Circulars and other regulations to ensure compliance and effectively meet future capacity and demand requirements.

5.4.1 Runway Requirements

Analysis of the runways addresses the geometric ability of the LAN runways to meet FAA design standards based on the FAA-approved critical aircraft (see **Section 5.2.1, Critical Aircraft**). Elements examined in this section include geometric and separation standards, runway protection zones, length, orientation, designation, and pavement strength.

5.4.1.1 Geometric and Separation Standards

To be eligible for federal AIP funds, airfield projects at LAN must either meet FAA design standards or receive approval from the FAA under a Modification of Standards (MOS), which permits exceptions to specific design standards under certain circumstances. Even airfield elements approved under a MOS must be linked to a plan to address any deficiencies identified on the FAA-approved Airport Layout Plan (ALP).

To establish the design standards for each runway, it is essential to first identify the Runway Design Code (RDC). The RDC is a three-component code that incorporates the AAC, ADG, and approach visibility minimums. The format is *RDC: AAC-ADG-RVR*, where the AAC and ADG relate to the critical aircraft, and the Runway Visual Range (RVR) indicates the minimum visibility required for approaches. The RDC serves as a reference for the relevant criteria outlined in AC 150/5300-13B that must be considered when assessing compliance with runway design standards.

The following analysis identifies nonstandard conditions related to each of the runways at LAN (see **Table 5-4**, **Table 5-5**, and **Table 5-6**).

³ To aid in planning and development, FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems*, outlines guidelines for funding projects aimed at increasing airport capacity. Specifically, an airport becomes eligible for project funding once it reaches sixty percent of its current capacity.

Table 5-4
Runway 10R-28L Design Standards

		Runway 10R (D-IV-2400)			Runway 28L (D-IV-2400)		
		Standard (ft)	Actual (ft)	Adequate (✓) or Deficient (✗)	Standard (ft)	Actual (ft)	Adequate (✓) or Deficient (✗)
Runway Design							
	Runway Width	150'	150'	✓	150'	150'	✓
	Shoulder Width	25'	0'	✗	25'	0'	✗
	Blast Pad						
	Width	200'	150'	✗	200'	200'	✓
	Length	200'	100'	✗	200'	200'	✓
Runway Protection							
	Runway Safety Area (RSA)						
	Length Beyond Departure End	1,000'	1,000'	✓	1,000'	1,000'	✓
	Length Prior to Threshold	600'	600'	✓	600'	600'	✓
	Width	500'	500'	✓	500'	500'	✓
	Runway Object Free Area (ROFA)						
	Length Beyond Runway End	1,000'	1,000'	✓	1,000'	1,000'	✓
	Length Prior to Threshold	600'	600'	✓	600'	600'	✓
	Width	800'	800'	✓ ¹	800'	800'	✓ ¹
	Runway Obstacle Free Zone (ROFZ)						
	Length Beyond Runway End	200'	200'	✓	200'	200'	✓
	Width	400'	400'	✓	400'	400'	✓
	Runway Precision Obstacle Free Zone (POFZ)						
	Length	200'	200'	✓	200'	200'	✓
	Width	800'	800'	✓	800'	800'	✓
Runway Separation							
	Runway Centerline to:						
	Parallel Runway Centerline	700'	1,400'	✓	700'	1,400'	✓
	Holding Position	250'	≥260'	✓	250'	≥260'	✓
	Parallel Taxiway Centerline	400'	440'	✓	400'	440'	✓
	Aircraft Parking Area	400'	≥760'	✓	400'	≥760'	✓

Notes: (1) Supplemental wind cone located 260 feet south of Runway 10R-28L centerline, within ROFA; relocation recommended but not required. (2) All standards based on visibility minimums of less than 3/4 mile.
Source: FAA AC 150/5300-13B, *Airport Design - Change 1*, RS&H Analysis, 2024

Table 5-5
Runway 10L-28R Design Standards

		Runway 10L (B-I Small-VIS)			Runway 28R (B-I Small-VIS)		
		Standard (ft)	Actual (ft)	Adequate (✓) or Deficient (✗)	Standard (ft)	Actual (ft)	Adequate (✓) or Deficient (✗)
Runway Design							
	Runway Width	60'	75'	✓	60'	75'	✓
	Shoulder Width	10'	0'	✗	10'	0'	✗
	Blast Pad						
	Width	80'	0'	✗	80'	0'	✗
	Length	60'	0'	✗	60'	0'	✗
Runway Protection							
	Runway Safety Area (RSA)						
	Length Beyond Departure End	240'	240'	✓	240'	240'	✓
	Length Prior to Threshold	240'	240'	✓	240'	240'	✓
	Width	120'	120'	✓	120'	120'	✓
	Runway Object Free Area (ROFA)						
	Length Beyond Runway End	240'	240'	✓	240'	240'	✓
	Length Prior to Threshold	240'	240'	✓	240'	240'	✓
	Width	250'	250'	✓	250'	250'	✓
	Runway Obstacle Free Zone (ROFZ)						
	Length Beyond Runway End	200'	200'	✓	200'	200'	✓
	Width	250'	250'	✓	250'	250'	✓
	Runway Precision Obstacle Free Zone (POFZ)						
	Length	N/A	N/A	✓	N/A	N/A	✓
	Width	N/A	N/A	✓	N/A	N/A	✓
Runway Separation							
	Runway Centerline to:						
	Parallel Runway Centerline	700'	1,400'	✓	700'	1,400'	✓
	Holding Position	125'	≥125'	✓	125'	≥125'	✓
	Parallel Taxiway Centerline	150'	200'	✓	150'	200'	✓
	Aircraft Parking Area	125'	≥2,600'	✓	125'	≥2,600'	✓

Notes: (1) All standards based on visual visibility minimums.
Source: FAA AC 150/5300-13B, *Airport Design - Change 1*, RS&H Analysis, 2024

Table 5-6
Runway 6-24 Design Standards

		Runway 6 (B-II-3200)			Runway 24 (B-II-4000)		
		Standard (ft)	Actual (ft)	Adequate (✓) or Deficient (✗)	Standard (ft)	Actual (ft)	Adequate (✓) or Deficient (✗)
Runway Design							
	Runway Width	75'	120'	✓	75'	120'	✓
	Shoulder Width	10'	0'	✗	10'	0'	✗
	Blast Pad						
	Width	95'	0'	✗	95'	0'	✗
	Length	150'	0'	✗	150'	0'	✗
Runway Protection							
	Runway Safety Area (RSA)						
	Length Beyond Departure End	300'	300'	✓	300'	300'	✓
	Length Prior to Threshold	300'	300'	✓	300'	300'	✓
	Width	150'	150'	✓	150'	150'	✓
	Runway Object Free Area (ROFA)						
	Length Beyond Runway End	300'	300'	✓	300'	300'	✓
	Length Prior to Threshold	300'	300'	✓	300'	300'	✓
	Width	500'	500'	✓	500'	500'	✓
	Runway Obstacle Free Zone (ROFZ)						
	Length Beyond Runway End	200'	200'	✓	200'	200'	✓
	Width	400'	400'	✓	400'	400'	✓
	Runway Precision Obstacle Free Zone (POFZ)						
	Length	N/A	N/A	✓	N/A	N/A	✓
	Width	N/A	N/A	✓	N/A	N/A	✓
Runway Separation							
	Runway Centerline to:						
	Parallel Runway Centerline	N/A	N/A	✓	N/A	N/A	✓
	Holding Position	200'	≥255'	✓	200'	≥255'	✓
	Parallel Taxiway Centerline	240'	440'	✓	240'	440'	✓
	Aircraft Parking Area	250'	≥1,025'	✓	250'	≥1,025'	✓

Notes: (1) All standards based on visibility minimums of not lower than 3/4 mile.
Source: FAA AC 150/5300-13B, Airport Design - Change 1, RS&H Analysis, 2024

Based on this analysis, the only identified deficiencies in runway design standards at LAN, as shown in **Table 5-4**, **Table 5-5**, and **Table 5-6**, are related to runway shoulders and runway blast pads. The following sections provide a more detailed description of these specific deficiencies. Additionally, a potential improvement to protect the Runway 10R-28L ROFA is outlined to enhance safe aircraft operations.

5.4.1.1.1 Shoulder Width

Most of the runway edges at LAN do not have shoulders. Only the first roughly 1,050 feet of Runway 28L have shoulders that were constructed during a previous runway extension. Runway shoulders are an important airfield feature to aid in the resistance of propeller and jet blast erosion. It is recommended that Capital Region Airport Authority (CRAA) add standard-width shoulders along the full length of each runway. Based on the critical aircraft, Runway 10R-28L (ADG-IV) would require 25-foot-wide paved shoulders, while 10-foot-wide stabilized⁴ shoulders would be needed for Runway 10L-28R (ADG-I) and Runway 6-24 (ADG-II).

5.4.1.1.2 Blast Pad (Width and Length)

Runway blast pads are essential for mitigating jet blast erosion beyond runway ends. Currently, the Runway 10R blast pad is 50 feet too narrow and 100 feet too short. It is recommended that the Runway 10R blast pad be brought up to the standard dimensions of 200 feet by 200 feet. The blast pad for Runway 28L meets the required standards.

Runway 6-24 and Runway 10L-28R lack blast pads. To conform to B-II runway design standards for Runway 6-24, blast pads measuring 95 feet in width and 150 feet in length should be constructed on both ends. For Runway 10L-28R, which accommodates B-I aircraft, the FAA standard dimensions for a blast pad are 80 feet wide by 60 feet long. It is recommended that CRAA plan for the construction of blast pads at each runway end that meet FAA standards.

Paved blast pads are recommended to be installed for runways accommodating critical aircraft classified as ADG-IV or larger. Runway 10R-28L meets this criterion. For runways serving critical aircraft of ADG-I, ADG-II, or ADG-III, such as Runway 10L-28R and Runway 6-24, stabilized blast pads are recommended.

5.4.1.1.3 Runway Object Free Area (ROFA)

A supplemental wind cone is situated 260 feet south of the centerline of Runway 10R-28L, within the ROFA. According to FAA AC 150/5300-13B, *Airport Design*, "supplemental wind cones may be located within the ROFA, provided there is no wingtip conflict when the outer main gear of the RDC aircraft is positioned at the RSA boundary." While the current placement does not

⁴ Acceptable stabilization options include turf (see AC 150/5370-10, *Standard Specifications for Construction of Airports*) or stabilizing soil treatments (see AC 150/5370-10, *Airport Construction Standards*).

technically present a deficiency, it is recommended that CRAA consider relocating the wind cone outside of the ROFA during any future projects affecting that area of the airfield to avoid any potential future conflicts and ensure optimal alignment with FAA guidance.

5.4.1.2 Runway Length

Runway length is determined by the performance characteristics (takeoff or landing) for both existing and future critical aircraft or the composite family of aircraft represented by the critical aircraft. The elevation of the airport and prevailing weather conditions also play a crucial role in this determination. Generally, the takeoff length (which encompasses the takeoff run, takeoff distance, and accelerate-stop distance) tends to be the more critical factor in establishing the required runway length. **Table 5-7** provides the existing lengths of all three runways at LAN.

Table 5-7
Existing Runway Lengths

Runway	Existing Length (ft)
10R-28L	8,506'
6-24	5,003'
10L-28R	3,601'

Source: Airport Master Record, 2024

5.4.1.2.1 Runway 10R-28L

The longest runway at LAN, Runway 10R-28L, measures 8,506 feet and was designed to meet the operational needs of the most demanding primary users. In the 2006 LAN Master Plan, a runway length analysis determined that Runway 10R-28L (7,251 feet long at that time) needed to be extended to at least 8,500 feet. This extension would allow for reasonably unrestricted departures for most aircraft under both wet and dry conditions. The runway extension, largely driven by Allegiant MD-80 flights to LAS, supported both domestic and international markets.

The length of Runway 10R-28L should be determined by the operational requirements of its most demanding primary users. During the planning period, these included UPS cargo operations utilizing the Boeing 767-300F and commercial air carrier operations with the Boeing 737-800. **Table 5-8** outlines planning-level runway length requirements, including both wet and dry takeoff and landing distances, of these aircraft.

Table 5-8
Runway Length Requirements for 10R-28L

Aircraft	Maximum Takeoff Weight (MTOW)	Takeoff Length (ft)		Landing Length (ft)	
		Dry	Wet	Dry	Wet
Commercial					
Boeing 737-800	172,500 lbs.	8,000'	8,400'	4,900'	5,700'
Cargo					
Boeing 767-300F	412,000 lbs.	9,900'	11,400' ²	5,900'	6,800'

Notes:

(1) Lengths based on the following assumptions:

Elevation: 861 feet (MSL)

Average Maximum Mean Temperature: 82° F (27.8° C)

(2) No wet landing length identified in aircraft performance manual; 15% additional landing length used.

(3) All takeoff and landing distances rounded up to nearest hundred.

Source: Capital Region International Airport Runway 6-24 Environmental Assessment, Table C3, Mead & Hunt, Inc., 2015; Compiled by RS&H, 2024

As shown in **Table 5-8**, Runway 10R-28L is generally capable of handling the most demanding commercial aircraft (Boeing 737-800) at its Maximum Takeoff Weight (MTOW) in both wet and dry conditions. However, for the most demanding cargo aircraft, like the Boeing 767-300F, payload restrictions may be necessary at MTOW, particularly during the hotter summer months when temperatures exceed standard conditions and when operating in wet runway conditions. At such a time that aircraft or user-specific requirements change, or if restrictions become more frequent or severe, further studies should be conducted to ensure that the length of Runway 10R-28L continues to meet the needs of its most demanding users.

5.4.1.2.2 Runways 10L-28R and 6-24

Runways 10L-28R and 6-24 both primarily accommodate small general aviation aircraft with a MTOW of less than 12,500 pounds (lbs.). Runway 6-24 also serves occasional corporate aircraft, and larger piston aircraft exceeding 12,500 lbs, although with less frequency. Due to the availability of Runway 10R-28L, the prevailing winds at LAN, and a general lack of capacity constraints on the airfield, Runway 6-24 is not used extensively.

FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, provides general runway length recommendations based on factors such as the average maximum temperature of the hottest month at the airport, the airport's elevation above sea level, aircraft approach speed, the number of passenger seats, and the maximum difference in runway centerline elevations. The runway length recommendations in this Advisory Circular, derived from performance data curves and tables, are designed to meet the operational requirements of a specified percentage of composite fleet mixes. **Table 5-9** outlines the FAA-recommended runway length requirements

for Runways 10L-28R and 6-24 based on varying aircraft categories. It is important to note that FAA runway length assumptions are based on a generic fleet mix, not the specific fleet operating at LAN. As such, the recommended runway lengths provided by the FAA serve as general guidelines and should be used for planning purposes only.

Table 5-9
Runway Length Requirements for Runways 10L-28R and 6-24

Aircraft Category	FAA Recommended Runway Length (ft)
Small Airplanes with approach speeds of less than 50 knots	870'
Small Airplanes (< 10 seats)	
75% of Fleet	2,750'
95% of Fleet	3,270'
100% of Fleet	3,890'
Small Airplanes ($\geq$ 10 seats)	4,340'
Large Airplanes (12,501 lbs - 60,000 lbs)	
75% of Fleet @ 60% Useful Load	5,460'

Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, FAA Airport Design Microcomputer Program 4.2D, RS&H Analysis, 2023

Based on readily available runway usage data and operational trends, Runway 10L-28R best aligns with the "Small Airplanes (<10 seats)" category, which includes general aviation aircraft such as the Cessna 172. At its existing length of 3,601 feet, Runway 10L-28R is expected to accommodate up to 95 percent of the fleet mix in this category throughout the planning period, which is considered adequate for supporting the operational needs of most small general aviation aircraft anticipated to operate at LAN.

Runway 6-24 serves a slightly different role than Runway 10L-28R. Runway 6-24 is best compared to both the *Small Airplanes ($\geq$ 10 seats)* category and the *Large Airplanes (12,501 lbs - 60,000 lbs)* category due to its accommodation of larger single-engine and multi-engine aircraft that fall at the upper limits of the *Small Airplanes* classification, as well as the occasional use of corporate aircraft exceeding 12,500 lbs. Although Runway 6-24 exceeds the minimum length requirements for the *Small Airplanes ($\geq$ 10 seats)* category, it falls approximately 450 feet short of the recommended minimum for *Large Airplanes (12,501 lbs - 60,000 lbs)*. As a result, while Runway 6-24 can handle occasional larger aircraft operations, these may come with payload restrictions, which encourage operators to use the primary runway instead. Since no existing or future airfield capacity issues have been identified (see **Section 5.3**), having a slight shortfall in

length for Runway 6-24 has a very limited impact on the airfield's overall ability to handle larger corporate aircraft. Therefore, the length is considered adequate to handle most of the general aviation aircraft that typically operate on Runway 6-24.

5.4.1.3 Runway Protection Zones (RPZs)

Defined in FAA AC 150/5300-13B, Runway Protection Zones (RPZs) were established by the FAA to protect people and property on the ground in the instance of an aircraft runway overrun or undershoot during landing or takeoff. This designated area is intended to enhance aviation safety by preventing the intrusion of objects and obstacles that could pose risks to aircraft operations near the end of a runway. The RPZ has a trapezoidal shape and is made up of two components: the approach RPZ and the departure RPZ. Each RPZ is defined by the Runway Design Code and visibility minimums for the instrument approach procedures serving the specific runway. The approach RPZ extends 200 feet from the runway threshold, while the departure RPZ extends 200 feet from the runway end. As a result, both RPZs typically start at the same point unless the threshold of the runway is displaced.

The FAA recommends that airport owners' control and keep RPZs clear of all obstructions. Acquiring the appropriate property interests, such as fee title or easements, offers a substantial level of control. Airport-compatible zoning/land use regulations also provide a level of control for restricting any future incompatible development, but ownership of the land is the best means of preventing incompatible development. When full ownership, easements, or complete obstruction clearing is not feasible, airport owners are advised to actively promote plans, regulations, and policies that support maintaining an RPZ clear of any facilities that support incompatible activities.

FAA AC 150/5190-4B, *Airport Land Use Compatibility Planning*, describes FAA guidance regarding identification of incompatible land uses within the RPZ and expectations for airport sponsors to resolve any issues. The FAA expects airport sponsors to seek all possible opportunities to eliminate, reduce, or mitigate existing incompatible land uses through an evaluation process. Although the AC does not explicitly indicate what is considered compatible, FAA identifies the following land uses that require no further evaluation:

- **Farming** that meets airport design clearance standards and guidance as outlined in AC 150/5200-33, *Hazardous Wildlife Attractants on or near Airports*.
- **Irrigation channels** meeting the standards of AC 150/5200-33 and FAA/ United States Department of Agriculture manual, *Wildlife Hazard Management at Airports*.
- **Airport service roads** if they are not public roads and are directly controlled by the airport operator.
- **Underground facilities** if they meet other design criteria, such as RSA standards, as applicable.

Facility Requirements

- **NAVAIDs and aviation facilities** such as equipment for airport facilities considered fixed-by-function regarding the RPZ.
- **Above-ground fuel tanks** associated with back-up generators for unstaffed navigational aids.

An evaluation of the land uses within the existing RPZs at LAN identified several land uses that do not conform to any of the categories listed previously, indicating a need for further assessment. **Table 5-10** summarizes the existing RPZ dimensions for each runway end. **Figure 5-3, Figure 5-4, Figure 5-5, Figure 5-6, Figure 5-7, and Figure 5-8** show the existing approach and departure RPZs for each runway end and any identified incompatible land uses (as applicable).

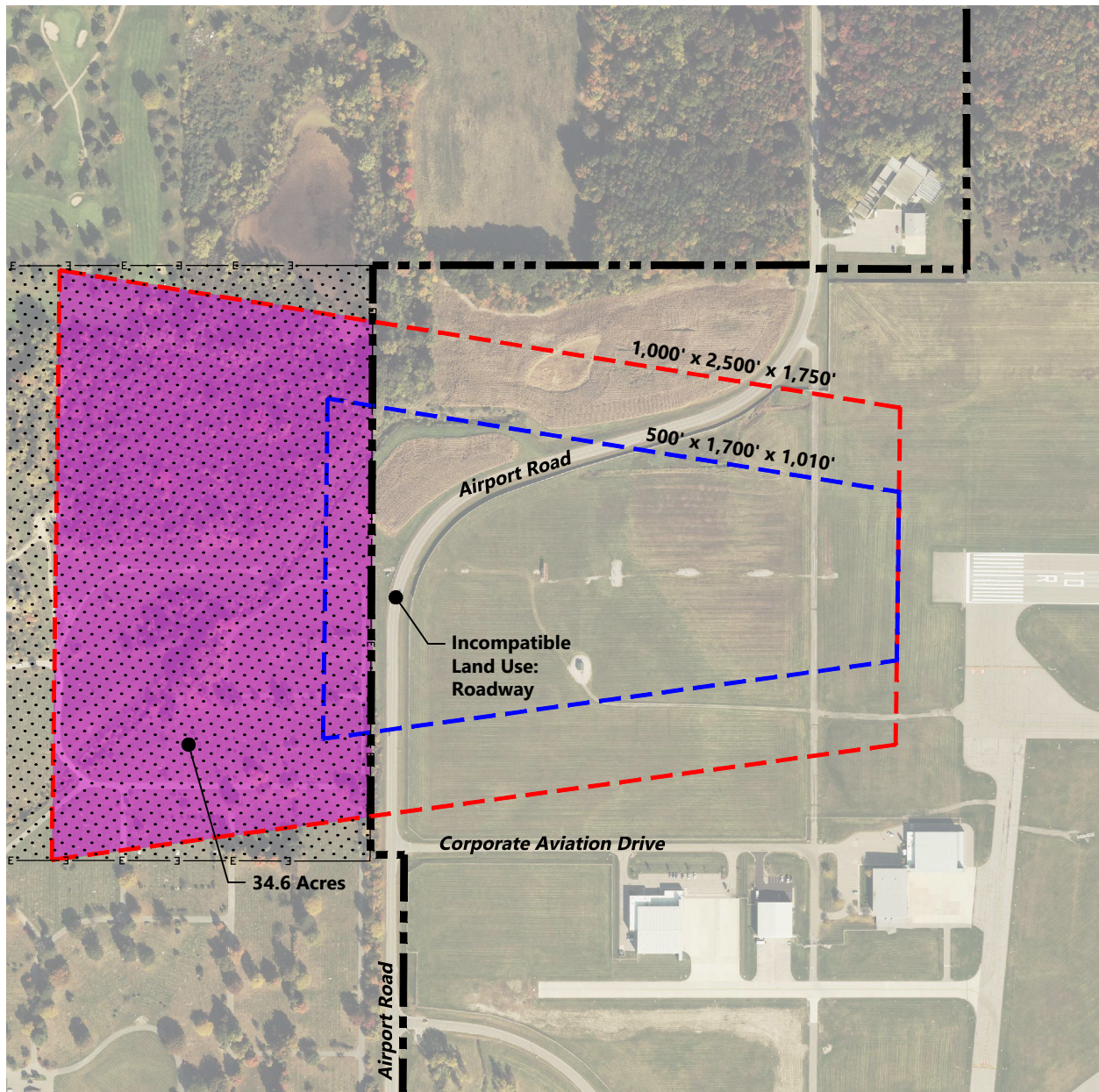
Table 5-10
Runway Protection Zone Requirements

	Runway					
	10R	28L	10L	28R	6	24
AAC-ADG	D-IV	D-IV	B-I	B-I	B-II	B-II
Visibility Minimums	1/2 mile	1/2 mile	N/A	N/A	3/4 mile	7/8 mile
Approach RPZ						
Standard Length	2,500'	2,500'	1,000'	1,000'	1,700'	1,700'
Standard Inner Width	1,000'	1,000'	250'	250'	1,000'	1,000'
Standard Outer Width	1,750'	1,750'	450'	450'	1,510	1,510
Airport Controls Entire RPZ	X	✓	✓	✓	X	✓
Departure RPZ						
Standard Length	1,700	1,700	1,000'	1,000'	1,000'	1,000'
Standard Inner Width	500'	500'	250'	250'	500'	500'
Standard Outer Width	1,010'	1,010'	450'	450'	700	700'
Airport Controls Entire RPZ	X	✓	✓	✓	X	✓

Source: FAA AC 150/5300-13B, *Airport Design - Change 1*, RS&H Analysis, 2024

Facility Requirements

Figure 5-3
Runway 10R RPZ Evaluation



- Existing Airport Property Line
- Approach RPZ
- Departure RPZ
- RPZ Outside Airport Property
- Avigation Easement

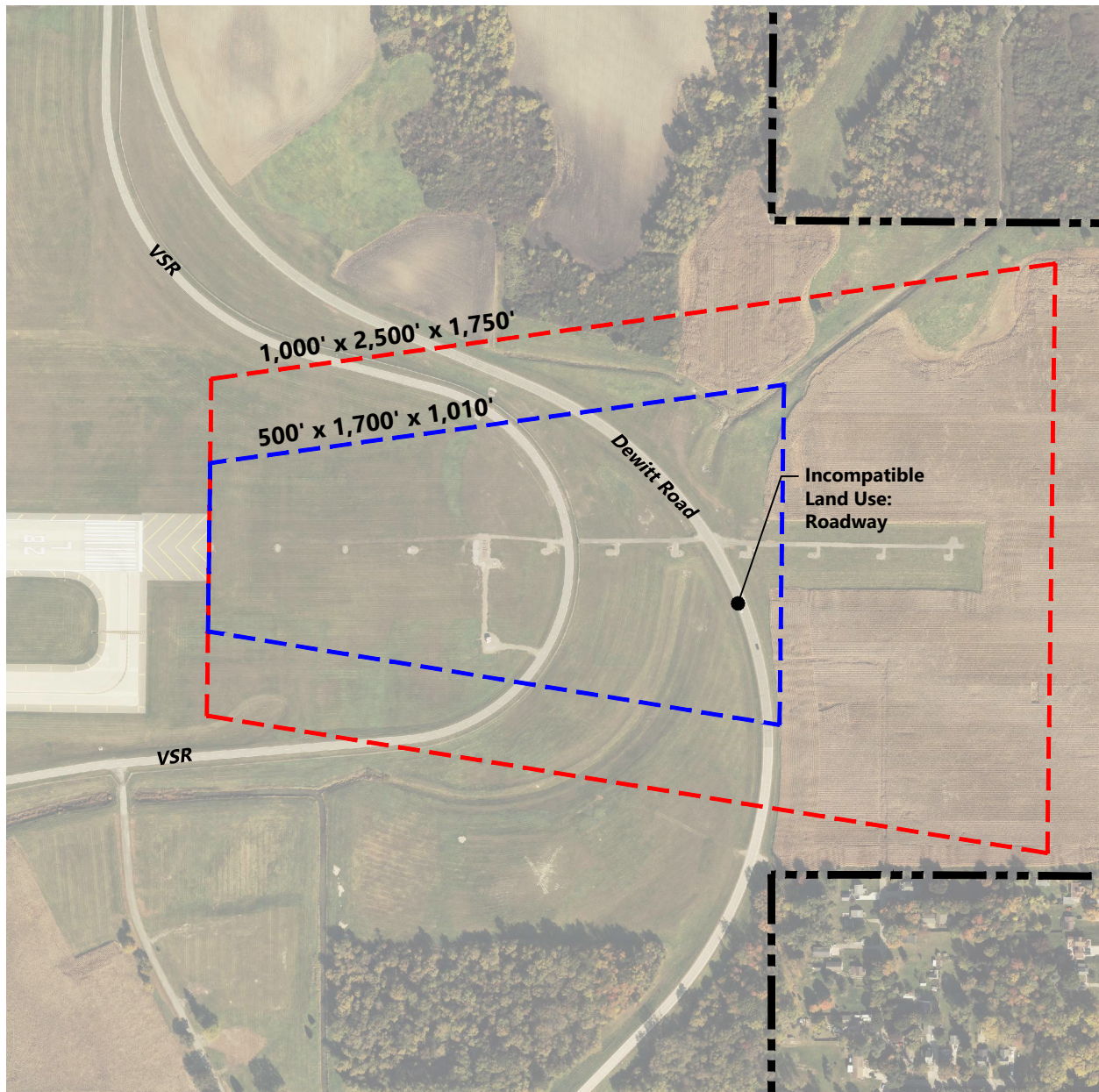


0' 250' 500'

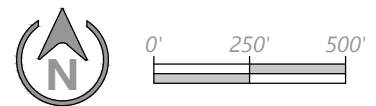
Source: RS&H, 2024

Facility Requirements

Figure 5-4
Runway 28L RPZ Evaluation



- Existing Airport Property Line
- Approach RPZ
- Departure RPZ



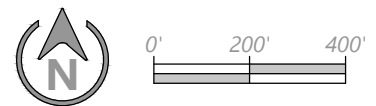
Source: RS&H, 2024

Facility Requirements

Figure 5-5
Runway 10L RPZ Evaluation



- Existing Airport Property Line
- Approach/Departure RPZ



Note: Approach and departure RPZ have same dimensions (B-I Small-VIS).
Source: RS&H, 2024

Facility Requirements

Figure 5-6
Runway 28R RPZ Evaluation



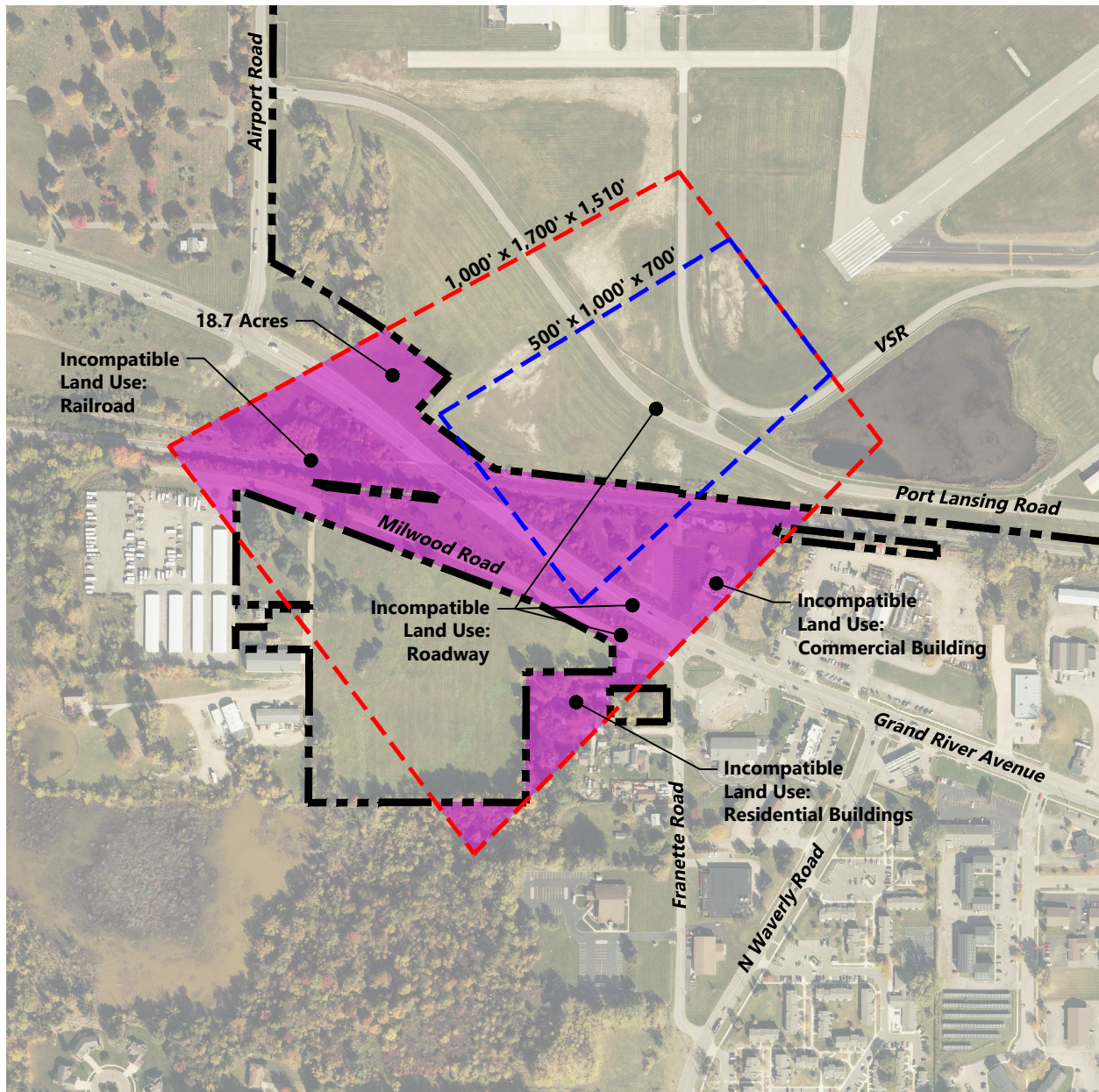
- Existing Airport Property Line
- Approach/Departure RPZ



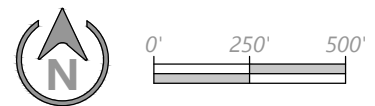
0' 200' 400'

Note: Approach and departure RPZ have same dimensions (B-I Small-VIS).
Source: RS&H, 2024

Figure 5-7
Runway 6 RPZ Evaluation



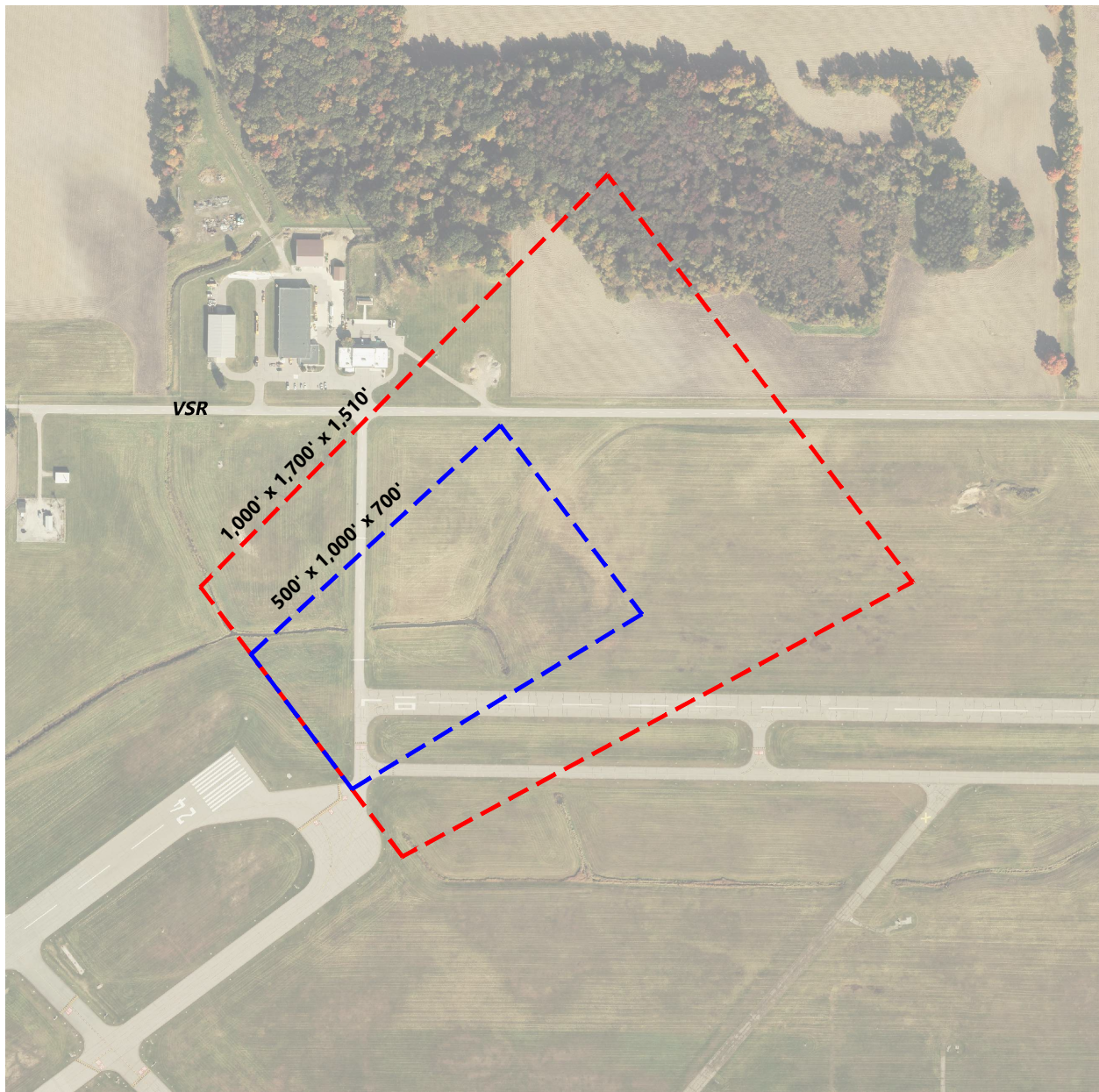
- Existing Airport Property Line
- Approach RPZ
- Departure RPZ
- RPZ Outside Airport Property



Source: RS&H, 2024

Facility Requirements

Figure 5-8
Runway 24 RPZ Evaluation



- Existing Airport Property Line
- Approach RPZ
- Departure RPZ



0' 250' 500'

Source: RS&H, 2024

Based on the evaluation of LAN RPZs, the following deficiencies were identified:

Runway 10R

- Airport Road passes through both the approach and departure RPZ.
- The approach and departure RPZs extend off airport property, covering a total of 34.6 acres. This land contains a cemetery and a small fragment of a golf course, both of which are places where structures could be built, and people may gather in crowds. However, all land areas within the RPZ are controlled by the CRAA via aviation easements.

Runway 28L

- Dewitt Road passes through both the approach and departure RPZ.

Runway 28R

- Dewitt Road passes through both the approach and departure RPZ.

Runway 6

- Grand River Avenue, Port Lansing Road pass through both the approach and departure RPZ.
- Milwood Road passes through the approach RPZ.
- Railroad tracks pass through both the approach and departure RPZ.
- Residential and commercial buildings are in the approach RPZ.
- The approach and departure RPZs extend off airport property, covering a total of 18.7 acres.

Chapter 7, Development Alternatives evaluates and describes options to mitigate risk associated with the deficiencies in RPZ protection at the Airport.

5.4.1.4 Orientation

FAA AC 150/5300-13B states that an airport's primary runway should be orientated in the direction of the prevailing winds and recommends that an airport's runway system provide a minimum of 95 percent wind coverage. The following runway wind coverage analysis considers ten years of meteorological data (2014 through 2023) from the National Climactic Data Center for wind speed and direction in All Weather, VFR, and IFR conditions. The allowable crosswind component is 20 knots for Runway 10R-28L, 10.5 knots for Runway 10L-28R, and 13 knots for Runway 6-24.⁵

⁵ FAA AC 150/5300-13B, *Airport Design - Change 1*, Appendix B, Table B-1

Table 5-11 summarizes the wind coverage for each runway direction and the overall runway system by showing the percentages of time when crosswind components fall below an acceptable velocity over a ten-year period. This analysis demonstrates that the combined runway system at the Airport exceeds the FAA’s minimum 95 percent wind coverage threshold across all analyzed weather conditions and crosswind component levels.

Table 5-11
Wind Coverage Analysis

All Weather Wind Data				
Runway(s)	Crosswind Component			
	10.5 Knots	13 Knots	16 Knots	20 Knots
10R-28L / 10L-28R	90.11%	95.04%	98.85%	99.82%
6-24	91.83%	96.07%	99.24%	99.89%
Combined	96.25%	98.61%	99.78%	99.99%
IFR Wind Data				
Runway(s)	Crosswind Component			
	10.5 Knots	13 Knots	16 Knots	20 Knots
10R-28L / 10L-28R	89.47%	94.85%	98.86%	99.83%
6-24	90.32%	95.08%	98.91%	99.81%
Combined	95.53%	98.29%	99.73%	99.99%
VFR Wind Data				
Runway(s)	Crosswind Component			
	10.5 Knots	13 Knots	16 Knots	20 Knots
10R-28L / 10L-28R	90.14%	95.02%	98.83%	99.82%
6-24	92.06%	96.25%	99.30%	99.90%
Combined	96.35%	98.66%	99.79%	99.99%

Note: VFR = Visual Flight Rules; IFR = Instrument Flight Rules
 Station: CAPITAL CITY AIRPORT; Data Range: 2014-2023
 Source: NOAA Integrated Surface Database (ISD), Compiled by RS&H, 2024

Although Runway 10R-28L is designated as the primary runway at LAN, **Table 5-11** shows that Runway 6-24 offers slightly better wind coverage for all crosswind components (10.5, 13, 16, and 20 knots) under both All Weather and VFR conditions, and for IFR conditions below 20 knots. This finding does not advocate for Runway 6-24 to take over the primary runway designation. Instead, it is better designated as a secondary runway, as Runway 10R-28L is longer, possesses a greater load-bearing capacity (see **Section 5.4.1.6**), and is consequently more capable of accommodating the largest aircraft currently in operation at LAN and those forecasted for the

future fleet mix. Additionally, significant investments have already been made in acquiring and maintaining the Instrument Landing System (ILS) equipment that supports the precision instrument approaches for Runway 10R-28L.

5.4.1.5 Designation

Every runway has two associated directional headings: a true heading and a magnetic heading⁶. Runway designations are provided on each runway to provide visual reference to pilots of the orientation according to the magnetic compass bearing. Due to the slow drift of the magnetic poles on the Earth's surface, the magnetic bearing of a runway can change over time and runway designations must occasionally be updated. It is industry standard that a runway designation be considered when the runway magnetic heading shifts more than 5 degrees from the runway marking designation.

The rate of magnetic variance at LAN is 6.54 degrees west $\pm$ 0.39 degrees, as of October 2024. The current rate of change is 0.02 degrees west per year.⁷ As shown in **Table 5-12**, the designations for all runways at LAN are not forecast to change during the planning period.

⁶ A true heading is the direction toward which a runway is physically oriented. This will not change unless the runway is realigned. A magnetic heading is the runway's true heading corrected for magnetic declination (the angle between magnetic north and true north).

⁷ NOAA National Centers for Environmental Information. *Magnetic Declination Calculator*. Retrieved October 18, 2024, from <https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml>

Table 5-12
Runway Designation

Runway	Existing (2023)			
	True Bearing	Magnetic Bearing	Runway Heading	Runway Designation
10R	90° 37' 11.60"	97° 9' 35.60"	97°	10R
28L	270° 37' 11.60"	277° 9' 35.60"	277°	28L
10L	90° 38' 6.48"	97° 10' 30.48"	97°	10L
28R	270° 38' 6.48"	277° 10' 30.48"	277°	28R
6	53° 25' 37.38"	59° 58' 1.38"	59°	6
24	233° 25' 37.38"	239° 58' 1.38"	239°	24

Runway	Future (2043)			
	True Bearing	Magnetic Bearing	Runway Heading	Runway Designation
10R	90° 37' 11.60"	97° 33' 35.60"	97°	10R
28L	270° 37' 11.60"	277° 33' 35.60"	277°	28L
10L	90° 38' 6.48"	97° 34' 30.48"	97°	10L
28R	270° 38' 6.48"	277° 34' 30.48"	277°	28R
6	53° 25' 37.38"	60° 22' 1.38"	60°	6
24	233° 25' 37.38"	240° 22' 1.38"	240°	24

Source: NOAA National Centers for Environmental Information Magnetic Declination Calculator, RS&H Analysis, 2024

5.4.1.6 Pavement Strength

Evaluating the load-bearing capacity of runway pavement at LAN is essential for operational safety and future growth. Currently, pavement strength at LAN is defined using the ACN-PCN methodology, but that methodology was recently replaced by the updated ACR-PCR system in AC 150/5335-5D, *Standardized Method of Reporting Airport Pavement Strength - PCR*. The PCR method uses a five-part code to express pavement strength, like the ACN-PCN system, but without specifying a particular aircraft. The FAA requires airports to assign PCR data for pavements as part of federally funded projects, with the updated reporting method set to be enforced by FAA effective November 28, 2024. Any future pavement strength improvements should be assessed using this updated methodology. The following analysis will validate the existing ACN-PCN classifications, but it is recommended that values be updated to align with the new FAA PCR methodology during future pavement assessment studies.

The ACN-PCN method for determining load-bearing values of runways is based on two key elements:

- 1.) **Aircraft Classification Number (ACN):** This reflects the stress an aircraft applies to the pavement, considering factors such as weight, landing gear configuration, and the distribution of the aircraft's load.
- 2.) **Pavement Classification Number (PCN):** This represents the load-bearing capacity of the runway pavement, which is determined by its structure (flexible or rigid), the materials used, and the supporting capability of the subgrade.⁸

5.4.1.6.1 Runway 10R-28L

The ACN-PCN methodology primarily applies to the primary runway at LAN (10R-28L), as it consistently handles large aircraft operations. This makes it essential to assess its pavement strength to support these heavier and more frequent movements. **Table 5-13** lists the existing PCN values for Runway 10R-28L, while **Table 5-14** defines the associated PCN code letters for better understanding of these values.

Table 5-13
Runway 10R-28L PCN Classification and Specifications

Category	Runway 10R-28L
Pavement Classification Number	90
Pavement Type	R (Rigid)
Subgrade Category	B (Medium Strength)
Allowable Tire Pressure	W (No Pressure Limitation)
Determination Method	T (Technical Evaluation)

Source: Airport Master Record, Compiled by RS&H, 2024

⁸ FAA provides the COMFAA software for calculating runway PCN.

Table 5-14
PCN Classification and Specifications Definitions

Item	Description
Strength Rating	Numerical value representing the allowable load rating for the pavement, expressed as a whole number
Pavement Type	R: Rigid (typically concrete pavements) F: Flexible (typically asphalt pavements)
Subgrade Category	A: High strength (CBR > 13 for flexible or k-value > 300 for rigid) B: Medium strength (CBR 8-13 for flexible or k-value 120-300 for rigid) C: Low strength (CBR 4-7 for flexible or k-value 60-120 for rigid) D: Ultra-low strength (CBR < 4 for flexible or k-value < 60 for rigid)
Allowable Tire Pressure	W: No pressure limitation X: Up to 218 psi (1.5 MPa) Y: Up to 145 psi (1.0 MPa) Z: Up to 73 psi (0.5 MPa)
Determination Method	T: Technical evaluation U: Using experience or historical data

Notes: California Bearing Ratio (CBR) is measure of the strength of a road's subgrade and construction materials.

Psi = Pounds per square inch. MPa = Megapascals.

Source: FAA AC 150/5335-5C, *Standardized Method of Reporting Airport Pavement Strength – PCN*

The comparison of PCN and ACN values assesses whether Runway 10R-28L can accommodate the loads of current and forecasted aircraft throughout the planning period. **Table 5-15** outlines the ACN values for the most demanding commercial and cargo aircraft forecasted to regularly use Runway 10R-28L in the next 20 years. From a planning perspective, if a runway's PCN exceeds an aircraft's ACN, the pavement is considered capable of supporting regular operations of that aircraft without restrictions. The comparison confirms that the current runway load-carrying capacity is sufficient for the critical aircraft anticipated during the planning period.

Table 5-15
Runway 10R-28L Critical Aircraft ACN Values

Aircraft	Aircraft Classification Number (ACN)
Commercial	
Boeing 737-800	46
Cargo	
Boeing 767-300F	32

Source: Boeing Airplane Characteristics, 2023; RS&H Analysis, 2024

5.4.1.6.2 Runways 10L-28R and 6-24

The ACN-PCN methodology is not typically applied to runways that primarily support small aircraft operations. For these runways, simpler methods based on aircraft weight and classification are used to assess runway suitability. Since lighter aircraft cause less stress on the pavement, their operational demands on runway load-bearing capacity are less stringent.

For Runways 10L-28R and 6-24 at LAN, a more general comparison of load-bearing capacity is sufficient. These runways are primarily used by smaller B-I (for 10L-28R) and B-II (for 6-24) general aviation aircraft and are less frequently used by heavier aircraft. **Table 5-16** outlines the general load limits for these runways. Given the existing and forecasted aircraft operations, the runway strength is considered adequate to support smaller aircraft operations throughout the planning period.

Table 5-16
Runways 10L-28R and 6-24 General Load Bearing Capacity

	Runway	
	10L-28R	6-24
Single Wheel (S)	12,000 lbs	45,000 lbs
Dual Wheel (D)	N/A	65,000 lbs
Dual Tandem Wheel (2D)	N/A	100,000 lbs

Source: Airport Master Record, Compiled by RS&H, 2024

5.4.2 Taxiway Requirements

The following taxiway analysis focuses on meeting specific requirements regarding the capacity of the existing taxiways to handle both current and projected demand at the Airport. Taxiways must ensure safe and efficient airfield circulation while adequately supporting the size and weight of aircraft. An effective taxiway system maintains traffic flow with minimal speed changes for aircraft taxiing and minimizes points that could potentially confuse pilots and controllers. FAA design standards, per FAA AC 150/5300-13B, have been analyzed to determine which areas of the LAN airfield are nonstandard.

5.4.2.1 Geometric and Separation Standards

Taxiway design standards and dimensional criteria are based on the requirements of the most demanding aircraft that regularly operate on the pavement, known as the critical aircraft. The TDG of the critical aircraft defines the taxiway pavement and shoulder width, as well as the Taxiway Edge Safety Margin (TESM). The critical aircraft ADG is responsible for determining the Taxiway Safety Area (TSA), Taxiway Object Free Area (TOFA), and separation/clearance standards. Depending on the demand and specific usage of a particular area, portions of the airfield may include taxiways or taxilanes designed for aircraft types different from an airport's designated critical aircraft.

At LAN, the taxiway system is structured to support the operational needs of the primary aircraft types associated with each runway. Runway 10L-28R is designated exclusively for general aviation aircraft, while Runway 10R-28L and its associated taxiway infrastructure serve commercial air carrier and cargo operations. Runway 6-24 primarily supports general aviation activity and functions as both a crosswind runway and a secondary runway during periods when the primary runway is unavailable, such as during maintenance or pavement rehabilitation.

To identify both current and potential future deficiencies in the taxiway system at LAN, existing taxiways and connectors were evaluated against the design standards specified in FAA AC 150/5300-13B. **Table 5-17** presents this comparison, organized by the primary runway each taxiway serves. Standards are divided between those based on the ADG of the critical aircraft and the TDG. Non-compliant taxiway components are marked with a red X (X), while compliant taxiway components are indicated with a green checkmark (✓).

Table 5-17
Taxiway Design Standards

	Taxiway Safety Area (TSA)	Taxiway Object Free Area (TOFA)	Taxiway Centerline to Fixed or Movable Object	Taxiway Centerline to Parallel Taxiway Centerline	Taxiway Wingtip Clearance	Taxiway Width	Taxiway Edge Safety Margin (TESM)	Taxiway Shoulder Width
Runway 10R-28L	ADG IV (E/F)					TDG 6 (E) / TDG 5 (F)		
Requirement	171'	243'	121.5'	207'	36'	75'	14'	30'
Taxiway A	✓	✓	✓	N/A	✓	✓	✓	X
Taxiway B	✓	✓	✓	N/A	✓	✓	✓	X
Taxiway B1	✓	✓	✓	✓	✓	✓	✓	X
Taxiway C (South of Runway 10R-28L)	✓	✓	✓	N/A	✓	✓	✓	X
Taxiway D	✓	✓	✓	✓	✓	✓	✓	X
Taxiway F (South of Runway 10R-28L)	✓	✓	✓	N/A	✓	✓	✓	X
Taxiway H	✓	✓	✓	✓	✓	✓	✓	X
Taxiway J	✓	✓	✓	✓	✓	✓	✓	X
Taxiway M	✓	✓	✓	N/A	✓	✓	✓	X
Runway 10L-28R	ADG I (E/F)					TDG 1A (E/F)		
Requirement	49'	89'	44.5'	70'	20'	25'	5'	10'
Taxiway E	✓	✓	✓	N/A	✓	✓	✓	X
Taxiway E1	✓	✓	✓	✓	✓	✓	✓	X
Taxiway E2	✓	✓	✓	✓	✓	✓	✓	X
Runway 6-24	ADG II (E/F)					TDG 2B (E/F)		
Requirement	79'	124'	62'	101.5'	22.5'	35'	7.5'	15'
Taxiway C (North of Runway 10R-28L)	✓	✓	✓	N/A	✓	✓	✓	X
Taxiway C1	✓	✓	✓	N/A	✓	✓	✓	X
Taxiway F (North of Runway 10R-28L)	✓	✓	✓	N/A	✓	✓	✓	X
Taxiway G	✓	✓	✓	N/A	✓	✓	✓	X
Taxiway L	✓	✓	✓	N/A	✓	✓	✓	X

Abbreviations: (E) = Existing, (F) = Future
Source: FAA AC 150/5300-13B, *Airport Design - Change 1*, RS&H Analysis, 2024

As shown in **Table 5-17**, the only design standard deficiencies identified in the LAN taxiway system pertain to shoulder widths. FAA standards specify that TDG 5 and 6 taxiways justify having 30-foot shoulders, TDG 1A taxiways should have 10-foot shoulders, and TDG 2B taxiways should have 15-foot shoulders. It is recommended that taxiway shoulders be constructed along the full length of each taxiway, as appropriate, to align with the long-term airfield development layout. For taxiways supporting ADG-IV and larger aircraft, paved shoulders should be provided, while stabilized shoulders (e.g., turf or soil treatments) are suitable for taxiways supporting smaller category aircraft.

5.4.2.2 Nonstandard Conditions

In addition to the design standard deficiencies highlighted in **Table 5-17**, the taxiway system at LAN was analyzed in accordance with FAA AC 150/5300-13B, *Section J.5.2*, which outlines pavement configurations that pose safety risks at airports. This analysis also includes an assessment of hot spots and Runway Incursion Mitigation (RIM) locations at LAN (see **Section 5.4.2.3**). The identified nonstandard conditions are discussed in more detail below and illustrated in **Figure 5-9** at the end of this section.

Middle Third Runway Crossing

FAA design standards recommend that runway crossings be placed in the outer thirds of a runway, as the middle third is designated a "high energy" zone. This zone is characterized by aircraft arriving or departing at high speeds, making it difficult for pilots to perform evasive maneuvers to avoid a collision in the event of a runway incursion. At LAN, the middle third crossings include Taxiways C, D, F, and M on Runway 10R-28L, as well as Taxiways B and C1 on Runway 6-24.

Nonstandard Angle Taxiway

The FAA recommends that runway and taxiway intersections be designed perpendicular to runway intersections, with an exception for high-speed exits that are necessary to maximize airfield capacity at the nation's busiest airports. Right-angle taxiways offer pilots the best visual perspective when approaching an intersection and provide the optimal orientation for clear visibility of runway holding position signs. At LAN, Taxiways C and G have nonstandard intersection angles at the south end of Runway 6-24, while Taxiway C is also at a nonstandard angle at the north end of Runway 6-24.

Direct Access

Taxiways that provide direct access from the apron to the runway can increase the risk of runway incursions due to a loss of situational awareness for pilots and vehicle operators. According to FAA design standards, it is recommended that either the apron or runway entrance be offset so that pilots must make a series of turns before entering the runway from the apron. At LAN,

Taxiway M and Taxiway C1 provide direct access from the terminal area apron to Runways 10R-28L and 6-24, respectively, while Taxiway A and Taxiway J connect the cargo apron directly to Runway 10R-28L.

Wide Expanse of Pavement at Runway-Taxiway Intersection

Large areas of taxiway pavement extending into or along a runway can lead to a loss of situational awareness for pilots and vehicle operators, as accurate visual perception is crucial to understanding aircraft location and position of the runway. A wide expanse of pavement at a runway-taxiway intersection is present at Taxiway B on the west end of Runway 10R-28L and Taxiway C at the north end of Runway 6-24.

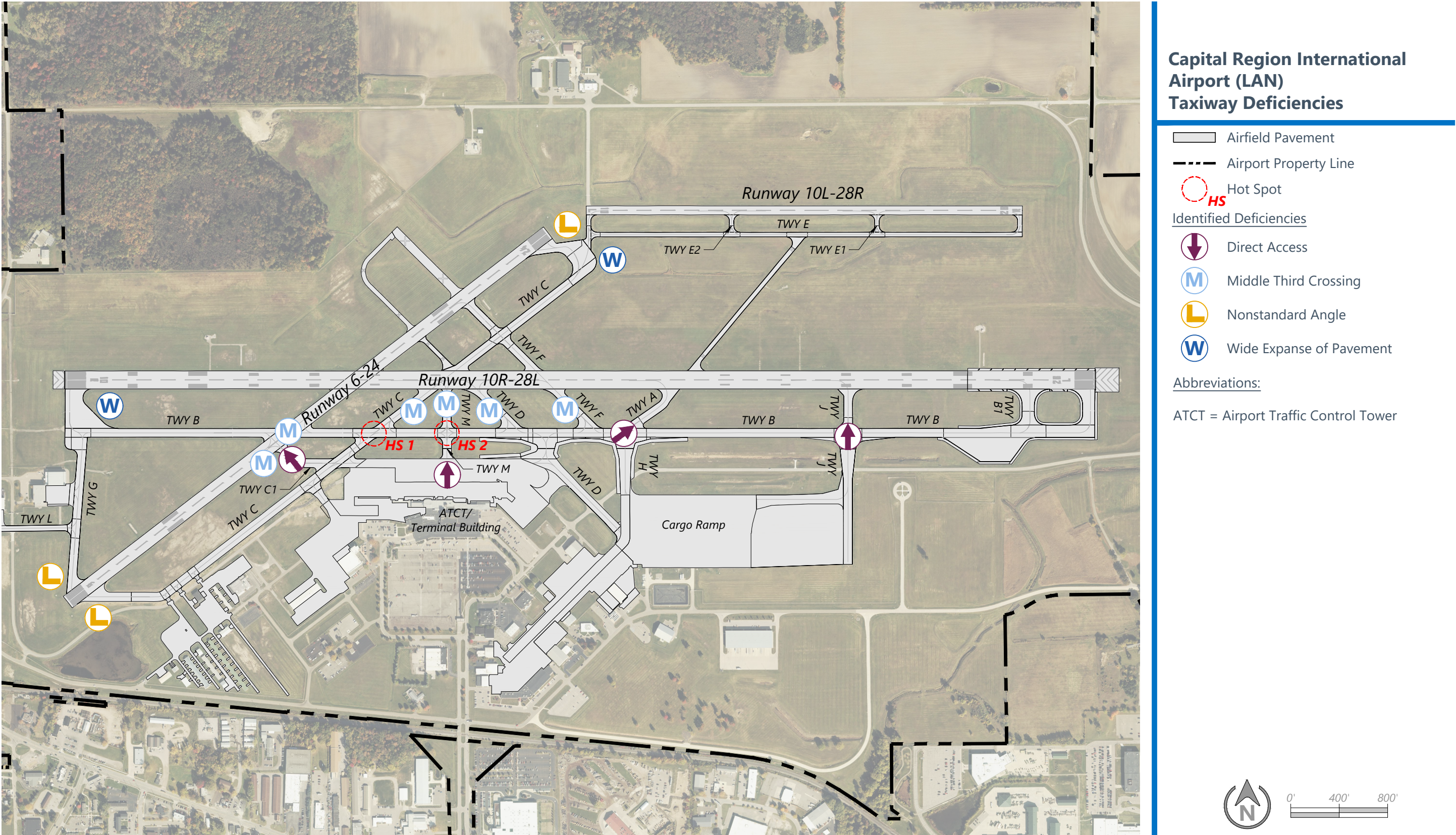
5.4.2.3 Runway Incursion Mitigation (RIM) and "Hot Spots"

In 2015, the FAA launched a pilot program aimed at enhancing runway safety at airports. Known as the Runway Incursion Mitigation (RIM) program, it identified areas of heightened risk for runway incursions at specific airfield intersections. Utilizing runway incursion data, the FAA compiled a list of locations experiencing a higher-than-average frequency of these incidents. Locations where three or more runway incursions occurred within a single year, or where more than ten incursions were recorded over the evaluation period, were identified and published on the RIM Inventory List. According to the FAA RIM Inventory list, effective December 31, 2023, LAN does not have any designated RIM locations.

The FAA also identifies "hot spots" on airfields to alert users to areas with a higher risk of pilot confusion and potential runway incursions. Hot spots and RIM locations share similarities but differ in their identification criteria. Hot spots are pinpointed based on feedback from local stakeholders and users' perceptions of potentially problematic areas on the airfield, whereas RIM locations are identified according to specific standards set by the FAA. LAN currently has two identified hot spots (see **Section 2.4.3, Hot Spots** in **Chapter 2, Inventory of Existing Conditions**). Both areas have received this designation because pilots taxiing to Runway 10R frequently overlook the hold short markings. The complexity of the intersection, combined with signage positioned in nonstandard locations, contribute to this issue. Addressing hot spot locations will be a consideration in development of airfield alternatives.

Figure 5-9 depicts the nonstandard taxiway conditions identified at LAN.

Figure 5-9
Taxiway Deficiencies



Note: Geometric and separation standard deficiencies not depicted, see **Section 5.4.2.1**
Source: RS&H, 2024

5.5 Navigational Aids and Lighting Requirements

Navigational aids (NAVAIDs) and airfield lighting are essential to LAN operations to assist pilots in safely navigating to, from, and around an airport. At LAN, these NAVAIDs are classified into three types: visual, electronic, and meteorological, as described in **Chapter 2, Inventory of Existing Conditions**. The following section describes these NAVAID categories and identifies current deficiencies present at LAN.

5.5.1 Visual and Electronic Aids

Visual aids are vital to safe airport operations because they aid pilots of aircraft within sight of the airport. At LAN, visual aids include lighting for the runways and approaches, as well as those that serve the entire airfield. Electronic aids include the technical on-airport equipment necessary to provide aircraft instrument approaches. The visual and electronic aids at LAN are sufficient to meet airport needs, as detailed in **Table 5-18**.

Though no deficiencies in visual or electronic aids were identified at LAN, one recommendation is proposed: the addition of a segmented circle. A segmented circle serves as a centralized point for various indicators, such as wind direction and traffic patterns, aiding pilots in their navigation and situational awareness while approaching or departing from an airport. Per 14 CFR Part 139.323, *Traffic and Wind Direction Indicators*, a segmented circle is required at airports with a right-hand traffic pattern that accommodate air carrier operations and either lacks an Airport Traffic Control Tower (ATCT) or has one that temporarily closes. LAN is not required to have a segmented circle since it does not feature a right-hand traffic pattern and the ATCT operates 24 hours a day.

5.5.2 Meteorological Aids

LAN has one meteorological aid, an Automated Surface Observing System (ASOS), which provides real-time weather updates to air traffic control personnel and pilots, along with recorded data for the National Weather Service (NWS). An analysis of the existing equipment and the Airport's needs indicates that there are no deficiencies in meteorological aids, as the ASOS is expected to remain adequate throughout the planning period.

Table 5-18
Visual and Electronic Aids

NAVAID	Runway 10R-28L	Adequate (✓) or Deficient (✗)	Runway 10L-28R	Adequate (✓) or Deficient (✗)	Runway 6-24	Adequate (✓) or Deficient (✗)
Visual Aids						
Approach Lighting	MALSR	✓	No	✓	REIL	✓
Lighting System	HIRL	✓	No	✓	MIRL	✓
Runway Markings	Precision	✓	Basic	✓	Non-Precision	✓
Runway Wind Cone	Yes	✓ ¹	No	✓	Yes	✓
Runway Centerline Lighting	No	✓	No	✓	No	✓
Runway Touchdown Zone Lighting	No	✓	No	✓	No	✓
Visual Slope Indicator	P4L (10R) / P4R (28L)	✓	No	✓	P4L	✓
Rotating Beacon	Yes ²	✓	Yes ²	✓	Yes ²	✓
Segmented Circle	No ²	✓ ³	No ²	✓ ³	No ²	✓ ³
Electronic Aids						
ILS	Yes	✓	No	✓	No	✓
Localizer	Yes	✓	N/A	✓	N/A	✓
Glideslope	Yes	✓	N/A	✓	N/A	✓
DME	No (10R) / Yes (28L)	✓	N/A	✓	N/A	✓
RNAV (RNP or GPS)	Yes	✓	No	✓	Yes	✓
VOR	No	✓	No	✓	No	✓

Notes: (1) Supplemental wind cone located 260 feet south of Runway 10R-28L centerline, within ROFA; relocation recommended but not required. (2) Not specific to any runway end. (3) Installation of a segmented circle recommended but not required.
Abbreviations: DME = Distance Measuring Equipment, GPS = Global Positioning System, HIRL = High-Intensity Runway Lights, ILS = Instrument Landing System, MALSR = Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights, MIRL = Medium-Intensity Runway Lights, P4L/P4R = Precision Approach Path Indicator (4 Light) on Left/Right Side of Runway, REIL = Runway End Identifier Lights, RNAV = Area Navigation, RNP = Required Navigation Performance, VOR = Very High-Frequency Omnidirectional Range
Source: Airport Master Record, RS&H Analysis, 2024

5.6 Passenger Terminal Requirements

The terminal building at LAN, originally built in 1959 and last renovated in 2008, is facing significant modernization and maintenance challenges due to industry changes over the past 25 years. To qualify for federal funding through the FAA's Airport Improvement Program (AIP), a comprehensive facility assessment is required. An on-site inspection conducted in April 2023, **Appendix X, Terminal Facility Assessment** evaluated the architectural, mechanical, electrical, and safety systems of the LAN terminal to understand existing conditions and identify necessary/recommended improvements. The assessment revealed numerous issues, including infrastructure inadequacies, code non-compliance, and security concerns.

Recognizing the rising maintenance costs and outdated infrastructure of the LAN terminal, key stakeholders have acknowledged the necessity for strategic investment. With many terminal elements nearing the end of their useful life, limited passenger amenities, and a lack of modern conveniences, the terminal study demonstrated that a comprehensive improvement plan for the terminal was warranted. To address these issues and ensure the terminal meets future demands, **Appendix X, Terminal Area Plan** was developed. The following sections summarize the findings of the Terminal Area Plan.

5.6.1 Passenger Demand Forecast

Peak hour passenger demand was utilized to evaluate the existing terminal's capacity against both current and future needs. This method calculates passenger flow during the busiest hour to identify necessary facility improvements and ensure optimal service levels. Forecasted airline schedules were analyzed to determine future peak hour demands. Four passenger enplanement scenarios were developed based on the baseline year (2023) covering forecasted years in 5-, 10-, and 20-year increments (2028, 2033, and 2043), along with an additional high-growth scenario for 2043. The high-growth scenario was selected to conservatively assess future terminal needs, site requirements, constraints, and phasing strategies. **Table 5-19** details each activity level and the corresponding aircraft associated with peak hour passenger demand.

Table 5-19
Design Activity Level Summary

Scenario	Aircraft Type	Passenger Seats	Peak Enplaning Passengers	Peak Deplaning Passengers (Domestic)	Peak Deplaning Passengers (International)
Existing 2023	Boeing 737-800	189	140	160	150
	Bombardier CRJ-700	65			
	Bombardier CRJ-900	76			
	Embraer 145	50			
Base 2028	Boeing 737-800	189	440	560	260
	Bombardier CRJ-700	65			
	Bombardier CRJ-900	76			
Base 2033	Airbus A220-100	109	450	560	260
	Boeing 737-800	189			
	Bombardier CRJ-700	65			
	Bombardier CRJ-900	76			
Base 2043	Airbus A220-100	109	460	570	270
	Boeing 737-800	189			
	Bombardier CRJ-700	65			
	Bombardier CRJ-900	76			
High 2043	Airbus A220-100	109	460	570	270
	Boeing 737-800	189			
	Bombardier CRJ-700	65			
	Bombardier CRJ-900	76			

Source: RS&H Analysis, 2023

5.6.2 Terminal Area Programming Requirements

Based on the passenger demand forecast and planning parameters designed to meet the desired level of service, **Appendix X, Terminal Area Plan** established terminal space program requirements in square feet for various functional areas of the terminal (see **Table 5-20**).

Table 5-20
Terminal Building Program Requirementsde

Terminal Components	Existing (FY 2023)	Baseline Forecast				Surplus / (Deficiency)			
		Base 2028	Base 2033	Base 2043	High 2043	Base 2028	Base 2033	Base 2043	High 2043
Airline Spaces	7,800	5,500	5,500	5,500	5,500	2,300	2,300	2,300	2,300
Airport Spaces	41,900	41,900	41,900	41,900	41,900	0	0	0	0
Baggage Services	25,800	25,400	26,000	26,200	29,100	500	(200)	(400)	(3,300)
Building Systems	22,100	5,500	5,600	5,700	6,200	16,600	16,500	16,400	16,000
Concessions	7,200	3,500	3,700	4,600	4,900	3,800	3,500	2,700	2,400
Customs and Border Protection (CBP)	17,900	20,600	20,600	20,700	21,300	(2,700)	(2,700)	(2,900)	(3,500)
Ground Transportation	1,400	2,100	2,300	2,800	3,300	(800)	(900)	(1,400)	(2,000)
Holdrooms/Gates	20,600	13,100	13,500	13,500	16,800	7,600	7,200	7,200	3,900
Public Spaces	30,900	13,000	13,200	13,900	15,800	18,000	17,800	17,000	15,100
Restrooms	5,400	4,400	4,800	4,800	5,000	1,100	700	700	400
Transportation Security Administration (TSA)	5,800	5,900	5,900	5,900	5,900	(100)	(100)	(100)	(100)
Total	186,800	140,900	143,000	145,500	155,700	46,300	44,100	41,500	31,200

Notes:
(1) All values listed in square feet (sf) and rounded to nearest hundred. Some surplus/deficiency calculations appear to be incorrect, but this is only due to rounding.
(2) Specific space requirements may change prior to the design and construction phases of the preferred terminal alternative due to factors such as building codes, operational efficiency, sustainability, and architectural or engineering considerations.
Source: RS&H Analysis, 2023

5.6.3 Airside Components

Appendix X, Terminal Area Plan also analyzed airside components, including aircraft aprons and gates. Future requirements were determined based on the need for seven gate positions suitable for Boeing B737-900ER and Airbus A321neo aircraft, both classified as ADG III. The analysis concluded that the existing apron space is adequate for the planning period. If terminal development options were to retain the current airside orientation, angled parking would remain necessary due to tail height restrictions for Runway 10-28 which allow compliance with FAA Object Free Area (OFA) design standards. Conversely, relocating the terminal could facilitate perpendicular parking by increasing the distance from these restrictions.

5.6.4 Landside Components

Landside components of the passenger terminal include the terminal roadway loop, terminal curb, and vehicle parking areas. These landside areas and roadways must be adequately sized to ensure safe design/operations, intuitive user access, sufficient service capacity, and effective management of vehicle parking and terminal curb activities. While landside components at LAN were generally deemed adequate to meet existing and future passenger demand, specific areas for potential improvement have been identified. In the terminal analysis, landside facilities are treated as a trailing planning element, meaning they do not influence the design solutions for the terminal. Details on LAN landside planning requirements are in **Section 5.7, Landside Requirements**.

5.6.5 Preliminary Program Concepts

Appendix X, Terminal Area Plan presents and discusses three conceptual alternatives for the new terminal program alongside a "no-action" option:

- **Option 0 – No Action:** Taking no action to address needs is an option to evaluate all proposed options against.
- **Option 1 – Renovation:** Full refurbishment and enhancement of the existing facility, including the replacement of the curbside canopy structure.
- **Option 2 – Hybrid:** Combines demolition and new construction to remove the oldest, most deficient areas of the terminal and replace them with modern components.
- **Option 3 – New-Build:** A complete new-build, offering a "clean slate" for creating state-of-the-art facilities that optimize program space, passenger access during construction, and airfield safety.

Table 5-21 displays the total space requirements, in square feet, for options 1 through 3. See **Appendix X, Terminal Area Plan** for the conceptual floor layouts for each alternative.

Table 5-21
Terminal Alternatives Square Footage Summary

Terminal Alternative	Area (sf)
Option 1 – Renovation	229,409
Option 2 – Hybrid	213,687
Option 3 – New-Build	208,214

Note: sf = square feet
Source: RS&H Analysis, 2024

5.6.6 Terminal Area Programming Summary

The LAN passenger terminal building faces significant challenges in meeting both current and future demand in a cost-effective manner. While the existing terminal has sufficient aggregate space for current passenger activity, the allocation of this space is inadequate to address both existing and future needs. Furthermore, some key infrastructure and equipment have surpassed their useful life and require near-term, if not immediate, replacement.

Considering the current use and condition of the facilities, major renovations are essential to improve safety, security, and efficiency for users now and in the future. As discussed in **Appendix X, Terminal Area Plan** it is recommended that LAN consider either constructing a new commercial passenger facility or renovating the existing one to achieve the ideal level of service for current and future passengers. Based on forecasted passenger demand and airline operations, it is recommended to plan for a total programmed facility space of 155,700 square to meet the high-growth demand scenario in 2043. The actual constructed size of the terminal space would vary dependent upon specific layout and design elements.

5.7 Landside Requirements

Landside requirements include elements that facilitate vehicle access and egress, circulation, and vehicle storage in the public areas surrounding an airport. This section provides an analysis of regional access, the terminal curbside, public and employee parking, and rental car ready/return lot requirements at LAN.

5.7.1 Regional Access

LAN is accessible through various regional access points, including highways, local roads, transit routes, and limited pedestrian and bicycle paths, which facilitate users' connections to on-airport circulation routes, the terminal building, on-site commercial establishments, parking areas, and rental car services. **Appendix X, Regional Access** details existing conditions for the following regional access elements:

- Highway and interstate access

Facility Requirements

- Local access roads
- On-airport access roads
- Bicycle and pedestrian access
- Pavement conditions
- Public parking
- Wayfinding and signage
- Ground transportation
- Curbside management
- Business access

5.7.1.1 Regional Access Analysis

The review of airport access and circulation roadways focused on both the primary and secondary roads used by travelers to and from the terminal. The primary access roads include Capital City Boulevard, Airport Road, DeWitt Road, and Port Lansing Road, while the secondary access roads are Grand River Avenue and W Stoll Road. Airport Road and DeWitt Road provide connections to I-69. In total, 14 intersections and 18 road segment pairs were analyzed for traffic volumes and Level of Service (LOS) under both base and future conditions.

To inform the selection of a preferred landside alternative, traffic forecasts for landside mobility were developed. The forecasts used current road segment and intersection volumes from the 2023 *Clinton County Road Commission Capital Region International Airport Traffic Study* as a base. Road segment Annual Average Daily Traffic (AADT) and LOS forecasts were manually calculated, while intersection AADT and LOS forecasts were determined based on the 2023 Synchro model. The methodology of the Transportation Research Board's (TRB) ACRP Report 40, *Airport Curbside and Terminal Area Roadway Operations* was referenced; however, no modeling done using exact ACRP 40 methodologies during the study due to the regional access focus and the absence of terminal curb-specific data collection during peak passenger times.

The prior study utilized a 1 percent ambient annual background growth rate from the Tri-County Regional Planning Commission. However, this Master Plan adopts a compounded annual background growth rate of 0.5 percent. This lower rate was selected based on the City of Lansing's historical negative population growth since the 1970s, and DeWitt Township's slower growth rate (less than 0.5 percent annually) compared to its earlier growth in the 2000s. In addition to the background traffic rate, forecasts for passengers, cargo, and employees were also factored into the future roadway traffic volumes and levels of service calculations.

The following assumptions were approved by CRAA staff and used to develop the traffic forecasts:

- For traffic directly associated with LAN, it was assumed that the modal split consists of 50 percent passenger traffic, 25 percent cargo operations traffic, and 25 percent airport employee traffic.
- Growth rates for airport traffic were considered linear instead of exponential, as increases in airport traffic typically follow a linear pattern, and the airport's growth is limited by its planned capacity.
- Each vehicle arriving at or departing from LAN was assumed to have an average of two passengers, while vehicles associated with cargo operations and airport employees are expected to average one occupant per vehicle.
- The levels of service for airport roadways were assumed to align with those specified in the ACRP 40, *Airport Curbside and Terminal Area Roadway Operations*
- The peak roadway hours used were the same as those noted in the 2023 *Clinton County Road Commission Capital Region International Airport Traffic Study*, specifically from 7:15 AM to 8:15 AM and from 5:00 PM to 6:00 PM.
- It was assumed that existing traffic signals would remain unoptimized under both current and future conditions, using the existing signal timing for forecasts. However, for the period from 2028 to 2043, it was anticipated that the intersection of Capital City and Port Lansing would be upgraded to incorporate a new roundabout.

5.7.1.2 Regional Access Recommendations

Overall, access to LAN from the surrounding area functions adequately. However, there are opportunities for improvement to enhance ease and safety for individuals with varying mobility levels. Regional access recommendations from **Appendix X, Regional Access** were categorized into roadway, wayfinding, and multi-modal elements, and include:

Roadway Recommendations

- Development of a roundabout at the intersection of Capital City Boulevard and Port Lansing Road to better facilitate traffic flow.
- Reduction of the Port Lansing Road curve radius east of Capital City Boulevard.
- Extension of the existing airport loop road. The extension will reorient the road to head further south around an existing building and join with Capital City Boulevard approximately 100 feet north of the roundabout.
- Improved lighting on roadways on airport property.
- Continued support of recommendations outlined in the North Grand River Avenue Corridor Study. The placemaking, operational and aesthetic improvements recommended will benefit access to/from LAN.

- All the roadways within airport property and leading to the airport are rated either “Fair” or “Poor” in their Pavement Surface Evaluation and Rating (PASER) condition assessment.⁹ Grand River Avenue, near the Capital City Boulevard entrance, is rated “Poor” and should be prioritized first.
- Intersections shown to reach LOS E or worse under future conditions will need to be improved as part of other regional infrastructure projects by the public roadway agencies (i.e., MDOT, Road Commissions). Airport operations would benefit if those improvements were done prior to or in coordination with airport access roadway master plan improvements.

Wayfinding Recommendations

- Develop more uniform regional wayfinding signage designs.
- Add branded airport entrance signs at the DeWitt Road entrance and Airport Road entrance. DeWitt currently lacks an entrance sign. Although Airport Road features a directional sign, it does not serve as a branded entrance sign.
- Install a sign for motorists traveling eastbound on I-69 directing them to the Airport Road exit.
- Additional regional wayfinding signage is recommended along major roadways and highways near the airport, including Grand River Avenue from MSU’s campus to the airport.
- Add additional wayfinding signage on airport property to provide clear consistent messaging for airport patrons to navigate around the airport.

Multi-modal Recommendations

- The Capital Area Transportation Authority (CATA) offers daily fixed-route bus service to LAN, operating on Route #14. The Route #14 bus stop is about 500 feet from the terminal near the west parking lot entrance at the commercial terminal curb. The stop itself is located on top of a parking island landscaped with rocks. It should be relocated to an ADA accessible location that is connected to the terminal with safe pedestrian pathways. These improvements are essential for transit service at LAN.
- Coordinate with CATA to upgrade the existing regular fixed-route bus service to an Express bus.
- Curbside management at the terminal entrance will need updating with any changes to the terminal building and would include channelized lanes for modes of travel.

⁹ The PASER system is a visual survey method used to assess the condition of roads. Michigan's Transportation Asset Management Council (TAMC) has adopted the PASER system to measure pavement conditions across the state.

Additionally, safety improvements (such as markings, lighting, and signage) for passengers crossing to the parking areas should be prioritized.

- Bicycle routes near the airport should be clearly and consistently labeled.
- Coordinate with the Tri-County Regional Planning Commission (TCRPC) on development of a non-motorized pathway through the airport to increase airport visibility and access for non-motorized users.
- There are no bicycle facilities at the airport. Bicycle racks or bike lockers could be installed to provide airport employees with increased multi-modal commuting options.
- Dedicated rideshare staging areas could be implemented to better direct passengers to Uber/Lyft and taxi vehicles.

5.7.2 Terminal Curbside

The requirements for terminal curb roadways are influenced by both the physical and operational characteristics of the curbs. Physical factors include the length of the curb, the number and arrangement of lanes, and the width of crosswalks. However, operational characteristics play an even more significant role in determining capacity and level of service, thereby impacting facility requirements (see **Table 5-22**). Key operational factors affecting curb capacity and level of service include pedestrian crossing volumes and locations, traffic control measures (such as stop signs and crossing warning lights), vehicle volume and characteristics, and the management of landside operations by airport staff or police. Increases in vehicle volumes or longer dwell times for passenger service tend to reduce the capacity and level of service of the curb roadway(s).

Table 5-22
Level of Service Standards

LOS	Grade	Quality	Flow	Delay
A	Over Design	Excellent	Free Flow	None
B	Over Design	High	Reasonably Free Flow	Few
C	Optimum	Good	Stable Flow	Brief
D	Sub-Optimum	Adequate	Approaching Unstable Flow	Acceptable for Short Periods
E	Sub-Optimum	Inadequate	Unstable Flow	Unacceptable
F	Sub-Optimum	Unacceptable	Forced or Breakdown Flow	System Breakdown

Source: Highway Capacity Manual, ACRP 40, Compiled by RS&H, 2024

The terminal curbside at LAN is organized into five lanes across two curb segments. The "inner curb" features three lanes adjacent to the terminal, primarily designated for passenger pick-up and drop-off by Privately Occupied Vehicles (POVs) and Transportation Network Companies

(TNCs) like Uber and Lyft. Additionally, two lanes allow through access and facilitate returning rental car customers. The "outer curb" has two lanes dedicated to commercial ground transportation vehicles. The curbside serves a variety of vehicles, including:

- Private vehicles
- Pre-arranged regional shuttle services (CATA)
- Taxis
- Transportation Network Companies (i.e. Uber, Lyft)
- Pre-arranged limousines (Grand Limousine)
- Buses (Dean Trailways)
- Delivery and service vehicles

Peak-hour passenger forecast data from the terminal planning study (**Appendix X, Terminal Area Plan**) was used to evaluate and validate the adequacy of the level of service on both the primary passenger pick-up/drop-off curb road and the commercial service pick-up/drop-off curb road (see **Table 5-23**).

Based on observations,¹⁰ it was estimated that approximately 30 percent of airport users access the curb by vehicle, while 70 percent use parking. Among those accessing the curb, 85 percent utilize the inner curb, and 15 percent use commercial ground transportation at the outer curb. It is assumed that 70 percent of passengers who park do not access the curb road. This methodology, applied across PAL 1, PAL 2, and PAL 3 forecast demands, incorporates industry-standard planning assumptions, including vehicle class mix, linear occupied space, and average curb dwell times.

¹⁰ No passenger survey or vehicle operational data was collected; therefore, estimations of user data were made based on airport observations, industry best practices, and professional experience.

Table 5-23
Peak Hour Vehicles Accessing the Terminal Curb Road

	Baseline (FY 2023)	Planning Activity Level			
		PAL 1	PAL 2	PAL 3 Base Case	PAL 3 High Growth
Peak Hour Passengers	248	867	889	869	891
Total Peak Hour Vehicles	70	231	247	249	252
Passenger Curb Peak Hour Vehicles	60	196	210	212	214
Commercial Curb Peak Hour Vehicles	11	35	37	37	38

Note: No passenger survey, traffic counts, or curb study performed during master plan analysis. Planning assumptions made using airport observations, industry best practices, and professional experience to estimate curb demand and LOS.

Source: RS&H Analysis, 2023

The vehicle roadway capacity and level of service analysis in **Appendix X, Regional Access** indicates an overall LOS of "A" for all segments of the terminal curb roadway through PAL 3. Neither passenger or cargo growth, nor general regional growth, is expected to impact quality access on any on-airport roads, including Capital City Boulevard, Circle Drive, and Commerce Way. If peak periods were to start experiencing a decline in LOS over the planning period, practical measures could be implemented to address issues before making physical changes to the curb layout were necessary. For example, enforcement of active loading and unloading policies or reducing the number of curb crosswalks to three or fewer can provide additional curb capacity. It is worth noting that enforcing active loading and unloading is generally more effective when a cell phone waiting lot is available for drivers to wait for arriving passengers.

5.7.3 Vehicle Parking

LAN offers a variety of parking options, with requirements determined for:

- Public parking at the commercial terminal, including both short-term and long-term parking, with requirements assessed independently.
- Employee parking for airport staff and tenant staff, including airline, concessionaire, and ground service employees.
- A rental car ready/return lot, with opportunities identified for relocation or enhancement.

The evaluation of vehicle parking at the airport concentrated exclusively on the areas that directly serve the commercial terminal. Other parking facilities at LAN, such as those for the Fixed-Base Operator (FBO), various general aviation tenants, airport maintenance, and other non-aeronautical tenants, were not considered in this analysis as they are guided by tenant determined needs or were deemed adequate by CRAA staff during the study scoping process.

Parking demand increases alongside commercial passenger activity, and this demand has been incorporated into the three PALs by utilizing existing and forecast passenger demand data from the aviation demand forecast and terminal planning study. Short-term parking and rental car parking demand are closely tied to peak hour passenger demand, while long-term parking demand is more closely related to daily passenger activity. The requirements for airport and tenant employee parking are based on staffing needs, which generally align more closely with annual airport operation counts. The ratios in **Table 5-24** outline the anticipated growth in parking demand across the three PALs for various parking categories at LAN.

Table 5-24
Landside Vehicle Parking Forecast Growth Ratios

	Baseline (FY 2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Long-Term Parking	1.00	1.12	1.201	1.418
Short-Term Parking / Rental Car Parking	1.00	1.313	1.346	1.316
Employee Parking	1.00	1.204	1.237	1.335

Note: PAL 3 is for Base Case forecast. PAL 3 High Growth scenario was not considered in vehicle parking requirements analysis.
Source: RS&H Analysis, 2023

5.7.3.1 Public Parking

Data for the short-term and long-term parking lots were obtained from the Parking Revenue Control System (PRCS), which included information on parking lot occupancy, duration, and financial performance. With a total of 1,494 public parking spaces, LAN has sufficient capacity to meet forecast demand levels. **Table 5-25** illustrates the surplus of existing parking at LAN, detailing the number of spaces and estimated area available for the commercial terminal under the current short-term and long-term parking program.

Table 5-25
Commercial Terminal Parking Requirements

	Baseline (FY 2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Short-Term Parking				
Capacity (Spaces)	166	166	166	166
Required Spaces	106	140	143	140
Spaces Surplus / (Deficiency)	60	26	23	26
Total Area Requirement (sf)	75,000	63,000	65,000	63,000
Area Surplus / (Deficiency)	-	12,000	10,000	12,000
Long-Term Parking				
Capacity (Spaces)	1,328	1,328	1,328	1,328
Required Spaces	805	901	966	1,141
Spaces Surplus / (Deficiency)	523	427	362	187
Total Area Requirement (sf)	530,000	360,000	386,000	455,000
Area Surplus / (Deficiency)	-	170,000	144,000	75,000
Total Terminal Parking				
Capacity (Spaces)	1,494	1,494	1,494	1,494
Required Spaces	911	1,041	1,109	1,281
Spaces Surplus / (Deficiency)	583	453	385	213
Total Area Requirement (sf)	605,000	423,000	451,000	518,000
Area Surplus / (Deficiency)	-	182,000	154,000	87,000

Notes: PAL 3 is for Base Case forecast. PAL 3 High Growth scenario was not considered in vehicle parking requirements analysis.

sf = square feet. PAL area requirements rounded to nearest thousand. Space requirements include parking, vehicle and pedestrian circulation, and generous landscape buffers.

Source: RS&H Analysis, 2023

5.7.3.2 Employee Parking

The number of employee parking spaces can be estimated based on the annual operations, which generally correlate with staffing needs. At LAN, there are two designated parking lots for airport employees: one for CRAA staff, board members, tenant managers, and approved visitors, and another for all other tenant employees working in the terminal area. Analysis indicates that the land area allocated for these two lots is sufficient throughout the planning period. However, the layout of the CRAA lot will not adequately meet future demand and operational levels. In contrast, the tenant parking lot has a surplus of spaces. Fortunately, the two lots are located next to each other and could be reconfigured to address future needs without requiring

prohibitive levels of capital investment. **Table 5-26** outlines the future demand levels, along with areas of surplus and deficiency for employee parking at LAN.

Table 5-26
Employee Parking Requirements

	Existing Capacity	Baseline (FY 2023)	Planning Activity Level		
			PAL 1	PAL 2	PAL 3
Tenant Employee Lot					
Occupied Space Count	153	39	47	58	78
Percent Occupied	-	25%	31%	38%	51%
Spaces Surplus / (Deficiency)	-	114	106	95	75
CRAA Lot					
Occupied Space Count	36	25	30	37	50
Percent Occupied	-	69%	84%	103%	138%
Surplus / (Deficiency)	-	11	6	(1)	(14)
Total Combined Spaces					
Occupied Space Count	189	64	77	95	127
Spaces Surplus / (Deficiency)	-	125	112	94	62
Combined Percent Occupied	-	34%	41%	50%	67%
Combined Percent Available	-	66%	59%	50%	33%

Notes: PAL 3 is for Base Case forecast. PAL 3 High Growth scenario was not considered in vehicle parking requirements analysis.

Source: RS&H Analysis, 2023

5.7.4 Rental Car Parking

At LAN, rental car companies lease two locations on the airport landside: the rental car ready-return lot and the service/storage area. The ready-return area, which serves customers picking up and dropping off rental cars, contains 98 parking spaces. The service area includes four Quick Turnaround (QTA) facilities with storage for approximately 324 cars and is located about ¼ mile from the ready-return lot, southwest of the long-term parking lot. Rental car employees shuttle vehicles for cleaning, fueling, servicing, and storage using the terminal loop road, which has one-way traffic. As a result, cars transported to the service area travel ¼ mile, while cars returning to the ready-return lot must make a full loop, covering over ½ mile and crossing the terminal curb road to reach the ready-return area.

In the rental car industry, the overall space required for vehicle storage varies based on operational factors. A key consideration is ensuring that there are enough cars available for customers when they need them. A smaller ready-return lot typically necessitates more frequent

turnover and often requires additional staff to manage the movement of vehicles. As peak hour demand for arriving and departing passengers (the primary users of airport rental cars) increases, the need for customer-ready cars also rises. This leads to a greater requirement for shuttling vehicles from quick-turn around and storage facilities to replace those that have been rented. While there is a balance to be struck between lot size and operational strategy, the industry must also account for on-site vehicle storage during low-demand days. This analysis considered both the ready-return and service areas, focusing on balancing the operational needs for customer-ready vehicles, returned cars, and the storage of ready cars.

Historical rental car transaction data¹¹ was reviewed in aggregate to identify peak months and peak days within those months. Satellite imagery from April 9, 2023 was also reviewed along with airport observations of overall demand. The CRAA fiscal year 2024 peak period for rental car demand began in spring with April being the peak month for average daily transactions. April 2024 averaged 277 daily transactions. This translates to approximately 2.8 transactions per ready-return space during the peak month. Average daily demand gradually decreased over the summer months to 248 average daily transactions in September, reaching a minimum of 172 average daily transactions in January.

Forecasting future daily transactions per ready-return space, assuming no changes to operational efficiency factors, predicts a peak demand period of 3.7 transactions per ready-return space. To maintain the current rate of 2.8 transactions per day without implementing other operational strategies to improve efficiency, additional ready-return spaces would be required.

Table 5-27 outlines the space requirements for rental car facilities based on forecast demand levels. Currently, the ready-return lot has a slight shortfall, lacking two spaces. This deficiency is expected to increase to more than 30 spaces over the planning period. In contrast, the service area spaces are deemed adequate throughout the planning period.

¹¹ Rental car data for CRAA FY21-24 analyzed.

Table 5-27
Rental Car Parking Requirements

	Baseline (FY 2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Capacity and Demand				
Ready-Return Spaces	98	98	98	98
Service Area Spaces	324	324	324	324
Total Current Spaces	422	422	422	422
Effective Capacity ¹	412	412	412	412
Total Demand	294	386	395	386
Space Surplus / (Deficiency)	119	27	17	26
Required Rental Car Spaces				
Required Ready-Return Spaces	100	130	134	131
Space Surplus / (Deficiency)	(2)	(32)	(36)	(33)
Required Service Area Spaces	203	265	271	265
Space Surplus / (Deficiency)	121	59	53	59
Total Required Spaces	304	395	405	396

Notes: PAL 3 is for Base Case forecast. PAL 3 High Growth scenario was not considered in vehicle parking requirements analysis.

(1) Effective capacity assumes that at 90% full, ready-return lot is effectively full.

Source: RS&H Analysis, 2023

Trends in the adoption of electric vehicles and automated driverless vehicles are impacting the operational efficiency, profitability, and space requirements for rental car companies. Facility alternatives should consider the placement of vehicle charging stations at both the ready-return lot and the service area. To reduce labor operating costs, enhance profitability, and improve overall customer satisfaction, rental car companies are exploring the benefits of self-driving cars. While self-driving technology is still in development, eliminating the need for employees to shuttle cars to and from the service area could significantly enhance operational efficiency. The current rental car facilities and road configuration at LAN would require these vehicles to drive on public roads, which adds complexity to the ability for rental car companies to take advantage of self-driving technologies.

The possibility of introducing automated driverless rental car shuttles should be considered during the evaluation of alternatives. Ideally, these automatically shuttled driverless cars would operate on a segregated roadway rather than the terminal loop road, particularly in the early stages of implementation, to minimize CRAA liability in the event of an accident. Any implementation of this type of operation would need to be thoroughly vetted by CRAA legal advisors.

5.7.5 Parking Infrastructure Enhancement Opportunities

The current airport parking infrastructure at LAN is comparable to those at peer airports, but alternative options exist to better serve commercial air carrier customers. Maximizing operating revenues is beneficial for any airport and can be achieved by enhancing the use of its landside area and offering a mix of parking products that align with customer preferences.

To improve revenues, one approach is to optimize programmed spaces such as short-term, long-term, and hourly parking to prioritize those that generate higher revenue. Implementing premium parking services, like valet and specialty options, is another strategy. Before altering the LAN parking program, a market assessment should evaluate parking product options, especially those available at competitive airports. This process should involve a comprehensive cost-benefit analysis and benchmarking comparison of parking rates and other relevant metrics. Potential areas for LAN to explore for enhancing revenue production and customer experience related to parking and landside improvements include the following:

- Creating a premium covered parking lot to replace the short-term lot, with the possibility of installing solar panels on the roof for renewable energy generation, which could also lower airport energy costs.
- Installing automated entry and exit payment systems, such as credit in and credit out, to improve efficiency, reduce the footprint of the exit plaza, and increase overall future parking capacity.
- Replacing all or part of the short-term parking lot with true hourly parking, which has a smaller footprint and offers quicker turnover of parking spaces.
- Incorporating a consolidated rental car facility fully contained within the terminal loop road to enhance rental car operational efficiency and potentially improve the customer experience.
- Extending the terminal loop road to create additional space for future parking and integrating consolidated rental car facilities, such as ready-return and service, within the loop road, which would require a review of existing leases for implementation timing.
- Installing electric vehicle charging stations.
- Creating a cell phone waiting lot or designated entry curb area.

5.8 Air Cargo Requirements

Using information obtained from the forecast and inventory of cargo facilities, along with a review of previous cargo studies and interviews with airlines and cargo operators, an assessment of the adequacy of existing cargo facilities was conducted. Additionally, planning factors for estimating future cargo area requirements were developed. **Table 5-28** presents the baseline scenario of the LAN forecast for air cargo operations throughout the planning period. This forecast will serve as the foundation for determining cargo facility requirements.

Table 5-28
Air Cargo Operations Forecast

	Baseline (FY 2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Air Cargo Operations	3,477	3,900	4,300	5,200
Compound Annual Growth Rate	-	2.32%	2.15%	2.03%

Note: PAL 3 High Growth scenario for air cargo operations is identical to PAL 3, so it is not included in the air cargo requirements analysis.

Source: US DOT; Airport Records; RS&H Analysis, 2024

5.8.1 Air Cargo Facilities

LAN has facilities serving air cargo carriers such as United Parcel Service (UPS), Martinaire, Ameriflight, and various smaller all-cargo flight operators. Most air cargo operations are concentrated on the southeastern side of the airfield, where UPS occupies a 15,000-square-foot building with a sorting facility. UPS is the only air freight handler with sorting and warehousing facilities at the airport. Martinaire operates from a 13,000-square-foot hangar which is used for aircraft maintenance. Ameriflight is located off Taxiway L on the far west side of the airfield operating from an 11,000 square-foot hangar which is also used for aircraft maintenance. No cargo sorting or warehousing activities occur at the Martinaire or Ameriflight hangars, therefore Martinaire and Ameriflight facilities are not included in total airside cargo facility calculations. The Port Lansing Global Logistics Center, spanning approximately 48,000 square feet, is located off-airfield across Port Lansing Road from the cargo apron and is classified as a landside facility. Together, these facilities handle over 63 million pounds of cargo annually, with UPS accounting for the vast majority of LAN's air cargo tonnage, according to a 2021 air cargo assessment conducted by LAN.¹²

ACRP Report 143, *Guidebook for Air Cargo Facility Planning and Development* identifies the "area per annual ton ratio" as a key metric for evaluating cargo facilities. This ratio, based on average building throughput rates from various airport master plans, typically ranges from 1.0 to 2.5 square feet of building space per annual ton of cargo. A lower ratio of 1.0 square foot per annual ton reflects high facility utilization and may signal the need for near-term expansion, while a higher ratio of 2.5 square feet per annual ton suggests that tenants have surplus space.¹³ These rates, however, are all-inclusive, covering a broad spectrum of air cargo operators, such as passenger airlines, all-cargo carriers, integrated express carriers, and third-party providers, and should be interpreted within the specific context of the airport's unique operational conditions.

¹² Lansing Airport - LAN. (n.d.). *Air Cargo*. Retrieved October 30, 2024, from <https://www.flylansing.com/business/air-cargo>

¹³ National Academies of Sciences, Engineering, and Medicine. 2015. *Guidebook for Air Cargo Facility Planning and Development*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/21906>

Based on input and observations from CRAA staff, as well as professional judgment, it was decided to evaluate the airside and landside cargo facilities at LAN separately and apply different planning factors, both within the range of the ACRP recommendations. For airside facilities, a factor of 1.5 square feet per annual ton was used, reflecting the relatively high use of space within the existing airside cargo facilities. In contrast, a factor of 2.0 square feet per annual ton was applied to landside facilities, reflecting the preference to preserve additional space for future expansion or flexibility in accommodating new facilities when needed. However, landside planning is primarily driven by market conditions and the interest of potential tenants to lease/purchase land and build their own facilities, making it a more variable factor.

The analysis identified deficits in both airside and landside cargo facility space, which are expected to grow over the planning period (see **Table 5-29**). Although there are currently no plans to expand existing cargo facilities, LAN has reserved undeveloped land adjacent to the cargo apron for potential future airside cargo expansions. This land use will be considered and evaluated for cargo-related uses in the development alternatives process.

Table 5-29
Air Cargo Facility Requirements

	Baseline (2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Annual Cargo Volume (tons)	28,300	31,800	35,000	42,400
Airside				
Warehouse/Office Space Demand (sq ft)	42,450	47,700	52,500	63,600
Warehouse/Office Space (sq ft)	15,000	15,000	15,000	15,000
Warehouse/Office Space Surplus / (Deficit) (sq ft)	(27,450)	(32,700)	(37,500)	(48,600)
Landside				
Warehouse/Office Space Demand (sq ft)	56,600	63,600	70,000	84,800
Warehouse/Office Space (sq ft)	48,000	48,000	48,000	48,000
Warehouse/Office Space Surplus / (Deficit) (sq ft)	(8,600)	(15,600)	(22,000)	(36,800)

Notes:

(1) sf = square feet. (2) Annual cargo volume is rounded to nearest hundred and assumed to grow at the same compound annual growth rate as forecasted cargo operations. (3) Warehouse/Office Space Demand (sq ft) based on the following assumptions – Airside: 1.5 sq ft per annual ton, Landside: 2.0 sq ft per annual ton.

Source: Airport Records; RS&H Analysis, 2024

5.8.2 Air Cargo Apron

The air cargo apron space requirements at LAN were determined by considering the needs of the largest cargo aircraft, specifically the Boeing 767-300F. Including standard air cargo industry buffers, the 767-300F requires approximately 13,000 square yards of parking area. This space calculation ensures sufficient room for safe maneuvering, loading, and unloading operations, accounting for both the aircraft's size and the necessary operational buffers for efficient ground handling.

Since the start of the Master Plan in 2023, LAN has successfully undertaken a major expansion of the cargo apron. The original apron measured approximately 65,000 square yards, and the expansion added another 43,000 square yards, bringing the total to approximately 108,000 square yards of paved cargo apron. On site observations indicated that approximately 10 percent of this area is allocated for Ground Service Equipment (GSE) storage. The expansion has enabled LAN to efficiently accommodate a variety of UPS aircraft during the peak cargo season from November to February, including the MD-11, Airbus A-300, and Boeing 757 and Boeing 767 aircraft.

Based on the 13,000 square yard footprint requirement for the Boeing 767-300F, the expanded apron at LAN can safely accommodate up to seven Boeing 767-300F aircraft. However, it's important to consider that the apron is a shared space, also used by smaller turboprop cargo aircraft. This shared use may impact overall space utilization, particularly during peak periods when demand is high, requiring coordination to optimize use of available space.

5.9 General Aviation Requirements

This section assesses the current state of General Aviation (GA) facilities at LAN, including hangars, tie-downs, and fixed-base operators, focusing on their service levels. The evaluation includes inventory analysis, user interviews, and market-based planning to ensure a balance between demand and financial viability for potential new facilities. Future needs are forecasted based on aviation segment projections and existing deficiencies, guiding the identification of required new facilities while considering any necessary demolitions or replacements.

5.9.1 Fixed-Based Operator (FBO)

Avflight is the only FBO at LAN, located immediately southwest of the terminal. The facility is in good condition and effectively meets client needs. Avflight operates from a 34,000 square foot hangar and provides a range of services, including handling, fueling, deicing, on-call maintenance, and aircraft cleaning.¹⁴

¹⁴ Avflight. (n.d.). *Lansing (KLAN)*. Retrieved October 30, 2024, from <https://www.avflight.com/network/lansing-mi-klan/>

All general aviation and commercial aircraft fueling at LAN is managed by Avflight. However, Avflight's facility location currently presents a minor challenge in the fuel delivery process. To refill fuel trucks or service corporate and general aviation aircraft, Avflight must traverse the terminal apron to access the fuel farm located at the south end of the cargo apron. While the existing fuel storage is adequate, enhancing its accessibility for the FBO during the planning period would be advantageous. Additionally, with the FAA exploring a transition to unleaded aviation fuel for aircraft, new fuel tanks dedicated to unleaded fuel will eventually be necessary. These factors underline the importance of reserving space for additional fuel tanks, a topic that will be explored in **Chapter 7, Development Alternatives**.

5.9.2 Based Aircraft Storage and Parking

Several factors determine the quantity and type of hangar space needed, including the total based aircraft count, fleet mix, local weather conditions, airport security, user preferences, and market dynamics. This section outlines the requirements for T-hangars, conventional (box) hangars, and corporate hangars throughout the planning period. These terms refer to different styles and sizes of aircraft storage hangars. The following are general definitions for how each type of hangar space is categorized within the context of this Master Plan:

- **T-hangars:** Small hangars typically arranged so that small aircraft are “nested” next to each other in alternating directions within sections of a larger building. These are typically used for smaller single-engine and light multi-engine aircraft and generally range from approximately 1,000 to 2,000 square feet.
- **Conventional (Box) Hangars:** These facilities commonly accommodate one or more smaller aircraft. Conventional (box) hangars can vary widely in size, ranging from approximately 5,000 to 30,000 square feet. Additional paved space is generally integrated as apron frontage connecting the hangar to the airfield. Landside parking, buffers for access and landscaping, airfield safety area offsets, and various other site development elements should be considered in development of these hangars.
- **Corporate hangars:** The largest category of hangars, corporate hangars can accommodate one large jet or multiple aircraft. Corporate hangars often include ancillary spaces for offices, crew lounges, reception areas, restrooms, and various other amenities for business travelers. Corporate hangars vary in size but are generally 30,000 square feet and higher. An important element of planning for corporate hangars is ensuring proposed sites can accommodate vehicle parking, service access, landscaping, airfield safety area offsets, and adequate land for the ancillary building space.

The aviation activity forecast predicts slight growth in based aircraft by the end of the planning period, indicating a need for increased storage. Among the four aircraft types, a moderate rise in jets is anticipated, while single-engine aircraft may see a slight decrease, as detailed in **Table 5-30**. Beyond the quantitative storage projections, hangar demand may fluctuate throughout

the planning period, influenced not only by the number of based aircraft but also by aircraft type preferences in the market and emerging industry trends.

Table 5-30
Based Aircraft Forecast

Aircraft Type	Baseline (FY 2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Single Engine (Piston)	32	31	29	28
Multi-Engine	17	17	16	16
Jet	12	14	16	20
Helicopter	4	4	5	5
Total	65	66	66	69

Note: PAL 3 (High-Growth) scenario for based aircraft is identical to PAL 3, so it is not included in the parking and storage requirements analysis.

Source: RS&H Analysis, 2023

Using historical distributions of based aircraft at LAN and current industry trends, the projected square footage for each type of aircraft storage was calculated at each PAL. It is assumed that all based aircraft will be stored within either a T-hangar, conventional (box) hangar, or corporate hangar. Weather conditions, especially during winter, play a key role in this assumption, as they make indoor storage necessary to protect aircraft from harsh weather. Single-engine aircraft are generally housed in T-hangars, while conventional (box) hangars are typically used for multi-engine and small jet aircraft. Corporate hangars are primarily designated for large jets, although they can often accommodate multiple aircraft of varying sizes.

5.9.2.1 T-Hangars

LAN currently utilizes 52 T-hangar units for aircraft storage, with plans to demolish seven in the future (anticipated to be completed in PAL 1). There are also ten T-hangars located immediately southwest of the FBO that serve a combination of aircraft storage and airport ground service equipment storage needs. This facility is nearing the end of its useful life, and maintaining these hangars for aircraft storage would most likely not prove to be a cost-effective option. The potential for more efficient use of T-hangar space will be further analyzed in **Chapter 7, Development Alternatives**. Given these considerations, the T-hangar units currently used for aircraft storage are expected to result in a surplus, accommodating both existing and projected demand, as indicated in **Table 5-31**. Across all PALs, it is assumed that 70 percent of based single-engine aircraft be stored in T-hangars.

Table 5-31
T-Hangar Requirements

	Baseline (FY 2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
T-Hangar (Units)	52	45	45	45
T-Hangar Demand (Units)	22	22	20	20
Surplus / (Deficit) (Units)	30	23	25	25
T-Hangar Area (sf) ¹	73,000	63,000	63,000	63,000
T-Hangar Area Demand (sf) ¹	30,000	30,000	28,000	27,000
Surplus / (Deficit) (sf)¹	43,000	33,000	35,000	36,000

Notes: (1) Rounded to nearest thousand. (2) T-Hangars assumed to be 1,400 square feet. (3) sf = square feet
Source: RS&H Analysis, 2024

5.9.2.2 Conventional (Box) Hangars

To determine the required conventional (box) hangar space, an average hangar square footage was calculated based on the length and width of representative aircraft expected to be stored. This average square footage per aircraft was then multiplied by the anticipated number of aircraft to be housed in these hangars. Refer to **Table 5-32** for projected conventional (box) hangar unit and space requirements throughout the planning period. It is assumed that 20 percent of based single-engine aircraft will be stored in conventional hangars, along with all based multi-engine aircraft and jet aircraft not housed in corporate hangars, which represents approximately 66 percent of based jet aircraft. It is also anticipated that the facility directly west of the FBO, currently containing four conventional storage spaces, will be demolished in PAL 1 as currently scheduled. This project will reduce the number of conventional (box) hangar units from 24 to 21 (see **Figure 2-9** in **Chapter 2, Inventory of Existing Conditions**).

Table 5-32
Conventional (Box) Hangar Requirements

	Baseline (FY 2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Conventional (Box) Hangar (Units)	24	21	21	21
Conventional (Box) Hangar Demand (Units)	31	32	33	35
Surplus / (Deficit) (Units)	(7)	(12)	(13)	(15)
Conventional (Box) Hangar Area (sf) ¹	116,000	102,000	102,000	102,000
Conventional (Box) Hangar Area Demand (sf) ¹	152,000	156,000	159,000	168,000
Surplus / (Deficit) (sf)¹	(36,000)	(54,000)	(57,000)	(66,000)

Notes: (1) Rounded to nearest thousand. (2) Conventional (Box) hangars assumed to be 4,850 square feet. (3) sf = square feet

Source: RS&H Analysis, 2024

Analysis shows that LAN currently lacks sufficient conventional hangar space to meet forecasted demand. This deficit is expected to persist to the end of the planning period. As a northern climate airport, adverse seasonal weather conditions at LAN lead to a significant increase in demand for hangar space when compared to moderate climate airports, particularly for transient aircraft. Consequently, it is recommended that CRAA plan for space to accommodate 15 additional conventional hangars to meet forecast needs over the planning period.

5.9.2.3 Corporate Hangars

To estimate the required future corporate hangar space, the current distribution of based jet aircraft (approximately 33 percent in corporate hangars compared to conventional hangars) was used as the basis for analysis. Applying this methodology, demand for corporate hangars is not expected to exceed current levels until PAL 3, at which point a slight deficit is projected. However, this demand is subject to significant fluctuations driven by prospective tenants and remains highly sensitive to market conditions. See **Table 5-33** for anticipated corporate hangar units and space requirements throughout the planning period.

Table 5-33
Corporate Hangar Requirements

	Baseline (FY 2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Corporate Hangar (Units)	6	6	6	6
Corporate Hangar Demand (Units)	6	6	6	7
Surplus / (Deficit) (Units)	-	-	-	(1)
Corporate Hangar Area (sf) ¹	210,000	210,000	210,000	210,000
Corporate Hangar Area Demand (sf) ¹	210,000	210,000	210,000	245,000
Surplus / (Deficit) (sf)¹	-	-	-	(35,000)

Notes: (1) Rounded to nearest thousand. (2) Corporate hangar assumed to be 35,000 square feet. (3) sf = square feet
Source: RS&H Analysis, 2024

5.9.3 General Aviation Apron Requirements

The General Aviation (GA) apron areas discussed in this section include the transient GA apron located west of the terminal at the FBO and the southeast GA apron. The aircraft using the transient GA apron at LAN are a combination of based and visiting aircraft.

The transient GA apron, covering approximately 117,580 square feet, has seven tie-down locations, which are assumed to be 40-50 percent occupied at any given time based on historical airport observations. The southeast apron accommodates several corporate tenants and GA conventional hangars but does not include any tie-down areas. For the purposes of this study, it is assumed that all transient single-engine and multi-engine aircraft, as well as helicopters, will be stored on tie-downs on the GA apron, along with 10 percent of single-engine based aircraft (including flight training fleet which is also stored within hangars). For transient turboprop and jet aircraft, it is assumed that 10 percent will be stored in conventional hangars, with the remainder occupying tie-down spaces on the GA apron.

Analysis reveals an apron space deficit that is expected to worsen over the planning period and constrain the ability to accommodate both based and transient aircraft operations effectively (see **Table 5-34**).

Table 5-34
General Aviation Apron Requirements

	Baseline (FY 2023)	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Single/Multi Engine Aircraft Area Demand (sf)	-	60,000	60,000	53,000
Jet Aircraft Area Demand (sf)	-	74,000	93,000	123,000
Helicopter Area Demand (sf)	-	4,000	4,000	5,000
Total Apron Area Demand (sf)	-	138,000	157,000	181,000
Existing Apron Area (sf)	118,000	118,000	118,000	118,000
Surplus / (Deficit) (sf)	-	(20,000)	(39,000)	(63,000)

Notes: (1) All values rounded to nearest thousand. (2) Existing area demand (sf) not considered. (3) sf = square feet
Source: RS&H Analysis, 2024

5.10 Support Facility Requirements

The following sections detail the requirements and specifications for various support facilities that play a crucial role in ensuring CRAA can maintain safe and efficient airport operations.

5.10.1 Aircraft Rescue and Fire Fighting (ARFF)

Airports that accommodate both scheduled and unscheduled air carrier flights must have adequate firefighting facilities and equipment. The necessary Aircraft Rescue and Fire Fighting (ARFF) facilities are established according to the Code of Federal Regulations (CFR) Title 14 Part 139. This section assesses the ARFF Index and the requirements for ARFF stations.

5.10.1.1 ARFF Index Determination

The ARFF Index for an airport is determined by the length of air carrier aircraft and its level of operational activity. Currently, LAN is classified as an Index B airport based on the length (129.5 feet) and operational activity of the Boeing 737-800. LAN has voluntarily achieved Index E standards to ensure a safety margin for both passenger and military charters utilizing large air carrier aircraft. It is recommended that LAN continue to exceed Index B standards based on the fleet mix, critical aircraft, and future air carrier operations. With the MD-11 being replaced by the Boeing 767-300F (an index D aircraft), the Airport should maintain its equipment to meet a minimum of Index D standards moving forward.

5.10.1.2 ARFF Vehicle Requirements

Under 14 CFR Part 139.317, Index D airports must maintain specific equipment and agents to effectively respond to emergencies. The vehicle requirements for ARFF Index D are as follows:

— Three Vehicles

- One vehicle carrying 500 lbs of sodium-based dry chemical, halon 1211, or clean agent; or 450 lbs of potassium-based dry chemical and water with a commensurate quantity of Aqueous Film Forming Foam (AFFF) agent to total 100 gallons for simultaneous dry chemical and AFFF application; and
- Two vehicles carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 4,000 gallons.¹⁵

LAN's current ARFF vehicle fleet meets the requirements for both Index D and consists of two Oshkosh T1500s and one Rosenbauer Panther 6x6. Collectively, these vehicles can hold 6,170 gallons of water and 1,420 lbs of firefighting dry chemicals. The lifespan of ARFF equipment varies based on factors such as make, model, and usage frequency. According to AC150/5220-10E, *Guide Specification for ARFF Vehicles*, most ARFF vehicles typically have a service life of 10 to 12 years. If a vehicle is lightly used, it may remain in service longer. However, it is recommended to replace an ARFF vehicle when replacement parts become scarce or when annual operating expenses exceed 75 percent of its current estimated value. Given these considerations, the airport should consider replacing the Oshkosh T1500s at some point during the planning period.

5.10.1.3 ARFF Response Time Requirements

The existing ARFF facility complies with the requirements set forth in 14 CFR Part 139.319 regarding minimum vehicle response times. Located on the north side of the airport, the facility includes an 8,500 square foot fire station staffed by ten personnel with 1 to 3 individuals typically on duty at any given time. It features three bays for rescue trucks and is in good condition. Additionally, the facility has space that is equipped to serve as a reliable backup for the ATCT in the event of a terminal power failure.

5.10.1.4 PFAS Use in ARFF Equipment

Per- and Polyfluoroalkyl Substances (PFAS) are chemicals associated with significant health risks, such as cancer, and were officially designated hazardous substances by the EPA in April 2024. These substances have been widely used in firefighting foams since the 1940s, including those used by LAN, as federally mandated for airport operations under 14 CFR Part 139. The harmful environmental and health impacts of PFAS have driven a transition to safer alternatives, notably Fluorine-Free Foam (F3), as regulatory agencies work to mitigate risks and adopt sustainable firefighting solutions.

In December 2022, Congress directed the FAA to develop a plan for transitioning from current firefighting foams to F3. In response, the DoD released a new F3 military specification (MILSPEC),

¹⁵ 14 CFR 139.317

allowing manufacturers to submit F3 agents for qualification. Once approved, these foams will be added to the Qualified Product List (QPL), which the FAA recognizes as meeting Part 139 regulatory requirements.¹⁶ Until the transition to fluorine-free foam is complete, Part 139 airports may use both AFFF and fluorine-free foam. Certified F3 Products can be found on the DoD's Qualified Products Database.¹⁷

5.10.1.4.1 PFAS Destruction and Disposal

In 2024, the EPA updated its interim guidance on PFAS disposal, focusing on methods such as thermal destruction, landfills, and underground injection. The update clarifies scientific understanding and addresses uncertainties about these techniques. It also provides a framework for evaluating emerging PFAS disposal technologies, which is critical for managing contamination and improving disposal practices.¹⁸

Although not specific to airports, the EPA's interim guidance is aimed at decision-makers identifying effective methods for PFAS disposal. LAN can reference this document to evaluate PFAS destruction and disposal techniques as part of its environmental management strategies for PFAS-containing materials. This guidance can help LAN ensure compliance with disposal standards and explore emerging technologies for PFAS treatment.

5.10.2 Airport Traffic Control Tower (ATCT)

The Airport Traffic Control Tower is currently located on the fifth floor of the passenger terminal facility and operates continuously. While the tower remains in good condition, it is aging, and its long-term viability should be considered, especially as modifications to the terminal building proceed. **Chapter 7, Development Alternatives** will explore three potential sites for relocating the ATCT to address structural limitations that may arise as the facility ages and requires updates. These alternative sites will be evaluated against the criteria listed in FAA AC 6480.4A, *Airport Traffic Control Tower Siting Process*.

5.10.3 Airport Snow Removal Equipment (SRE) and Maintenance Facilities

LAN has two maintenance and SRE equipment storage buildings, located on the north side of the airfield, measuring approximately 11,000 and 21,000 square feet, respectively. Both buildings are currently in good condition. While both facilities feature garage doors at either end for convenient equipment access, they lack a true "drive-through" configuration. According to AC 150/5220-18A, *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment*

¹⁶ Federal Aviation Administration. (2024, November 15). *Fluorine-Free Foam (F3) Transition for Aircraft Firefighting*. U.S. Department of Transportation. https://www.faa.gov/airports/airport_safety/aircraft_rescue_fire_fighting/f3_transition

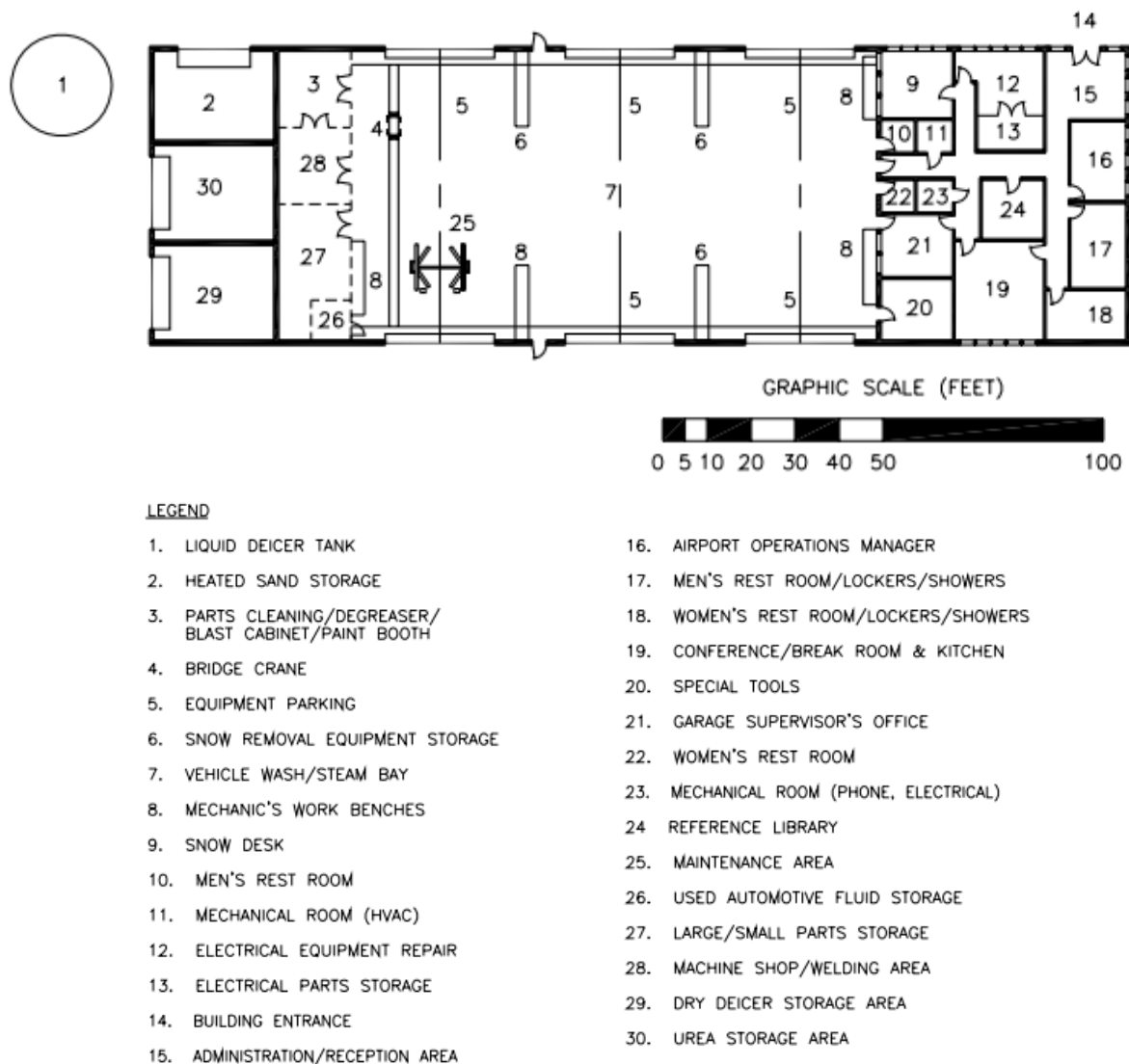
¹⁷ <https://qpldocs.dla.mil/search/parts.aspx?qpl=4513¶m=QPL-32725&type=256>

¹⁸ U.S. Environmental Protection Agency. (2024, April 8). *Interim Guidance on the Destruction and Disposal of PFAS and Materials Containing PFAS*. U.S. EPA. <https://www.epa.gov/pfas/interim-guidance-destruction-and-disposal-pfas-and-materials-containing-pfas>

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and Materials, a drive-through design is the most efficient layout for airports with small to medium equipment fleets, as it conserves space and reduces building costs. Additionally, drive-through bay designs are subjectively safer based on the ability for large equipment operators to pull directly in and out of the building without having to back up into parking positions. **Figure 5-10** illustrates an example of a maintenance/SRE storage facility employing a drive-through design.

Figure 5-10
Example of Drive-Through Maintenance/SRE Storage Facility Design



Source: FAA AC 150/5220-18A, *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials*, Figure 3-1, 2007

The layout of the existing buildings is less than ideal by current standards. Consideration should be given to both the location and layout of replacement facilities when the existing buildings reach the end of their useful life. Any new facility should maintain the current square footage with an additional buffer for future needs. Potential sites for an upgraded facility will be further discussed in **Chapter 7, Development Alternatives**.

5.10.4 Airline Deicing Agent Storage and Recovery Facility

The common area for deicing storage is situated in the southwest corner of the cargo apron. As noted in **Section 5.8.2**, LAN expanded the cargo apron in late 2023, which included the construction of a deicing containment facility. This expansion has ensured adequate recovery capacity to meet both current and forecasted demand throughout the planning period.

5.10.5 Fuel Storage

LAN has five fuel farm locations. The primary fuel farm is situated south of the existing cargo apron, off Port Lansing Road. Two additional fuel farms are located on the southeast apron, designated for refueling Michigan State Police (MSP) helicopters and Michigan Department of Transportation (MDOT) aircraft. The MSP fuel farm contains a 12,000-gallon Jet A tank and a 6,000-gallon 100LL tank, both underground, along with a 300-gallon tank for MDOT's automotive gas needs. Another fuel farm is found in the rental car quick turnaround compound, which houses four 1,000-gallon tanks of automotive gas. Lastly, the CRAA operates a fuel farm on the north side within the ARFF and SRE complex, featuring a 5,000-gallon automotive gas tank and a 15,000-gallon diesel tank. These fuel sites have adequate infrastructure and space to meet the fuel demands of aircraft and airport vehicles. As noted in **Section 5.9.1**, new unleaded aviation fuel tanks would be required once the FAA certifies its use in aircraft. Additional space is available, and should be preserved, at the main fuel storage site on the cargo ramp.

5.10.6 Aircraft Maintenance, Repair, and Overhaul Facility

LAN currently lacks an aircraft maintenance facility. The need for aircraft maintenance hangars or similar facilities is dictated by tenant business plans and cannot be fully anticipated based solely on changes in activity levels. Given past interest from operators in establishing a Maintenance, Repair, and Overhaul (MRO) facility, it is advisable to preserve land for this potential development on the Airport Layout Plan. Preserving a 10-acre site would adequately meet the needs for this type of development. A location for this type of facility will be considered as part of the facility alternatives development process.

5.10.7 Advanced Air Mobility (AAM) and Urban Air Mobility (UAM)

In Michigan, The Office of Future Mobility and Electrification (OFME) is leading implementation and agency coordination for statewide advancement of AAM. In July 2025, Michigan's Governor

Whitmer signed Executive Directive 2025-4¹⁹ establishing the Michigan Advanced Air Mobility (AAM) Initiative. This directive helps coordinate Advanced Air Mobility (AAM) and Urban Air Mobility (UAM) implementation across Michigan, supporting advancement through the Michigan Economic Development Corporation (MEDC) AAM Activation Fund to support elements such as healthcare drone delivery, emergency response, automotive industry logistics, and academic/research initiatives. This fund validates AAM project feasibility, generates critical data for policymaking, and enhances AAM readiness statewide.²⁰ MDOT is taking proactive measures to support AAM initiatives including developing a “repeatable blueprint for shared-use digital and physical infrastructure,” which can be implemented statewide to support Uncrewed Aerial Systems (UAS) and Electric Vertical Takeoff and Landing (eVTOL) operations.²¹

During the process of conducting this master plan study, LAN was selected as one of four Michigan airports to receive an electric aircraft charging station. Leveraging AAM Activation Funds, the charger was installed in 2025 near the AvFlight FBO.

5.10.7.1 FAA Guidance

In September 2022, the FAA released Engineering Brief 105, *Vertiport Design*, which provides guidance on planning vertiports for Electric Vertical Takeoff and Landing (eVTOL) aircraft. As eVTOL technology forms the backbone of UAM and AAM initiatives, this brief is an early framework for developing infrastructure that could enable the growth of these air transportation systems. The brief emphasizes that, due to insufficient validated performance data for eVTOL aircraft at the time of publication, the FAA is adopting a “prescriptive and conservative approach” in its recommendations regarding vertiport design and pad location.

Table 5-35, adapted from Engineering Brief 105, outlines the specifications for the reference aircraft used to determine eVTOL pad space requirements for the purposes of this Master Plan.

¹⁹ Michigan.gov, (2025, July 17), <https://www.michigan.gov/whitmer/news/state-orders-and-directives/2025/07/17/executive-directive-2025-4-establishing-the-michigan-advanced-air-mobility-initiative>

²⁰ Michigan Economic Development Corporation. *Funding & testing resources*. Retrieved November 1, 2024, from <https://www.michiganbusiness.org/mobility-funding>

²¹ Airspace Link, Inc. (2023, October 24). *MDOT UAS Connected Corridor Feasibility Analysis Final Report*. Michigan Department of Transportation. <https://www.michigan.gov/MDOT/-/media/Project/Websites/MDOT/Programs/Research-Administration/Final-Reports/SPR-1718-Report.pdf>

Table 5-35
eVTOL Engineering Brief 105 Reference Aircraft

Design Characteristics	Criteria
Propulsion	Electric battery driven, Utilizing distributed electric propulsion
Propulsive Units	2 or more
Battery Systems	2 or more
Maximum Takeoff Weight	12,500 lbs. or less
Aircraft Length	50 feet or less
Aircraft Width	50 feet or less

Source: Engineering Brief 105, Table 1-1, September 21, 2022; Adapted by RS&H, 2024

The controlling dimensions of eVTOL aircraft are defined as the length and width, specifically the diameter of the smallest circle that can enclose the aircraft's projection on a horizontal plane during takeoff or landing, with rotors or propellers in motion if applicable. The design and geometry of a vertiport are based on the Touchdown and Liftoff (TLOF)²² area, Final Approach and Takeoff (FATO)²³ area, and Safety Area (SA).²⁴ **Figure 5-11** illustrates these controlling dimensions and the spatial relationships among TLOF, FATO, and safety area.

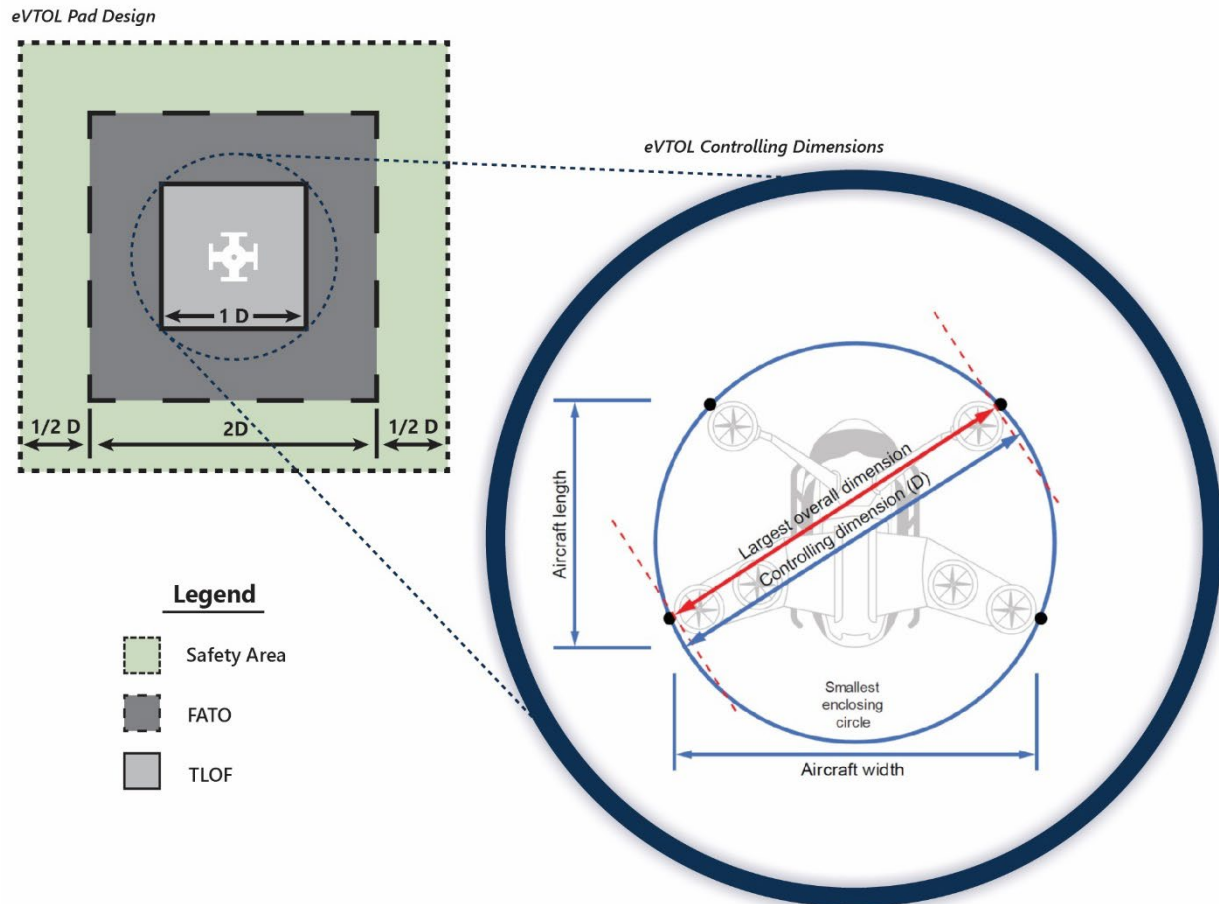
²² Touchdown and Liftoff (TLOF) = A load bearing, generally paved area centered in the FATO, on which the aircraft performs a touchdown or liftoff.

²³ Final Approach and Takeoff (FATO) area = A load-bearing area over which the aircraft completes the final phase of the approach, to a hover or a landing, and from which the aircraft initiates takeoff.

²⁴ Safety Area = A defined area surrounding the FATO intended to reduce the risk of damage to aircraft accidentally diverging from the FATO.

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Figure 5-11
Controlling Dimensions for eVTOL Planning



Note: "D" is equal to the diameter of the smallest circle enclosing the VTOL aircraft projection on a horizontal plane, while the aircraft is in the takeoff or landing configuration, with rotors/propellers turning, if applicable.
Source: Adapted by RS&H from Engineering Brief 105, *Vertiport Design*, September 21, 2022

Engineering Brief 105 also includes guidance on the recommended separation distances between vertiports and runways. For VFR operations, the brief outlines the minimum recommended distance between a vertiport's FATO center and the runway centerline to ensure safe operations. However, the document does not provide specific recommendations for IFR operations. **Table 5-36** shows these VFR separation distances for planning purposes.

Table 5-36
Recommended Minimum Distance Between Vertiport FATO Center to Runway Centerline for VFR Operations

Airplane Size	Distance from Vertiport FATO Center to Runway Centerline
Small Airplane (12,500 lbs. or less)	300 feet
Large Airplane (12,500-300,000 lbs.)	500 feet
Heavy Airplane (Over 300,000 lbs.)	700 feet

Source: Engineering Brief 105, Table 5-1, September 21, 2022; Adapted by RS&H, 2024

Although the future of AAM development at LAN is uncertain, it is recommended that CRAA consider planning for AAM infrastructure, including space for future vertiport facilities and necessary utility infrastructure to support battery charging and computer peripherals. Based on current AAM aircraft designs and space requirements, a typical vertiport is expected to need around 20,000 square feet. **Chapter 7, Development Alternatives** will explore potential vertiport locations around LAN that align with the guidelines outlined in this section.

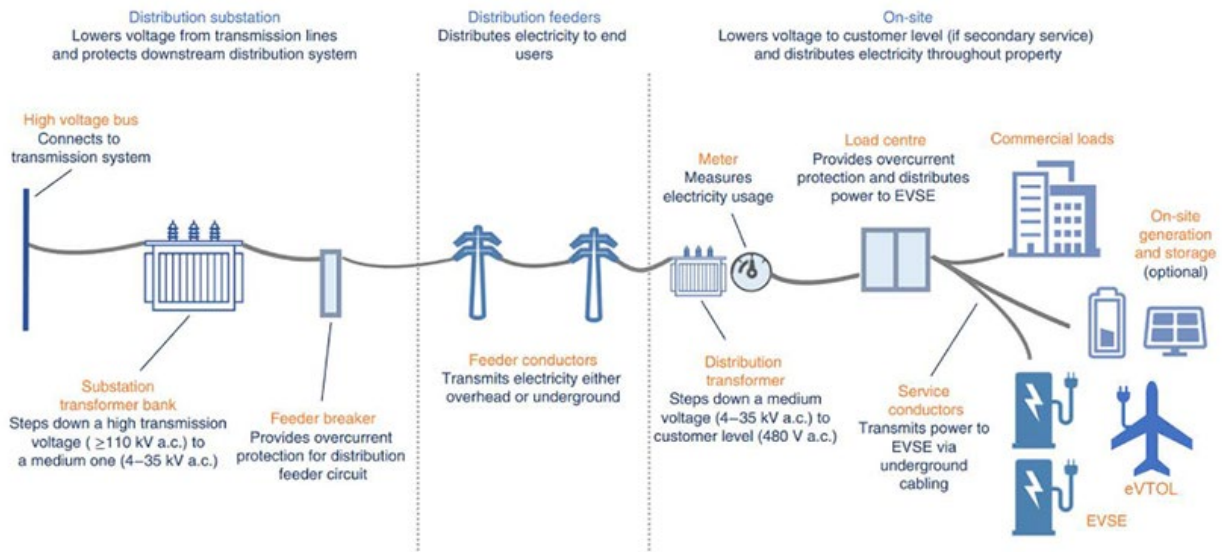
5.10.7.2 eVTOL Electricity Requirements

Electricity at LAN, supplied by Consumers Energy (north portions of airport) and the Lansing Board of Water and Light (south portion of airport), currently meets the Airport's needs, but it is prudent to consider a rising demand driven by the interest in electric aircraft and the impact on utility infrastructure. The FAA's Engineering Brief No. 105, *Vertiport Design* focuses on site design, but also points to extensive electrical support as essential for vertiports within AAM infrastructure, including the necessary power for eVTOL charging stations and operational systems.

UDOT's AAM study, mentioned earlier in this section, provides a valuable model by demonstrating how a shared-grid system, like Utah's, can enhance power accessibility to meet the growing demands of AAM infrastructure. However, the study underscores the necessity for substation upgrades to handle increased load capacity as demand rises. This serves as a crucial insight for LAN's planning efforts, emphasizing the need to strategically enhance power infrastructure to support the expected increases in electrical demand associated with AAM, particularly in relation to eVTOL operations. **Figure 5-12** provides a reference diagram of the typical electrical distribution infrastructure network from the high voltage bus to the end user.

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Figure 5-12
Electric Distribution Infrastructure from Supply to End User



Source: National Renewable Energy Laboratory (NREL), 2024

Calculating the increase in electrical demand associated with eVTOL activity is extremely difficult to assess at the master plan level. Estimation of an electrical demand increase is associated with the type of aircraft charging, the number of aircraft charging at one time, the type/model of the charging equipment, charging rates, and the overall peak electrical demand. Despite these unknowns, the high-level planning requirements for implementing aircraft charging facilities at LAN can be assumed as the following:

- Any improvement creating substantial additional demand on the electrical grid must be coordinated with the local utility provider and the aircraft manufacturer as early as practical.
- High-level estimates²⁵ of power demand per charging station by generic aircraft are:
 - Small electric aircraft (short-range single/two seats): 200 – 400 kW per charge
 - Medium electric aircraft (regional range): 500 kW – 1MW per charge
 - Large electrical aircraft (future concept commuter): 1 – 5 MW per charge
- Battery swapping, off-peak charging, and slow charge stations can spread charging operations over time and during off-peak periods to reduce strains on the grid.

²⁵ Charging estimates adapted from two sources. 1) *Analysis of Electrical Grid Capacity by Interconnection for Urban Air Mobility*, David P. Thippavong, NASA Ames Research Center, Retrieved from https://ntrs.nasa.gov/api/citations/20220006834/downloads/20220006834_Thippavong_Aviation2022_manuscript_final.pdf, November 2024. And 2) *Impacts of Regional Air Mobility and Electrified Aircraft on Airport Electricity Infrastructure and Demand*, Jordan Cox, Tom Harris, Kathleen Krah, James Morris, Xiangkun Li, and Scott Cary, National Renewable Energy Laboratory, February 2023, Retrieved from <https://www.nrel.gov/docs/fy23osti/84176.pdf>, November 2024

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- Integration of renewable energy generation systems (such as solar) can supplement energy and reduce overall demand on the electrical grid. Some airports have constructed microgrids on-airport to allow for operations independent of the electrical grid.

Shown in **Table 5-37**, the National Renewable Energy Laboratory provides a high-level summary table to model assumptions for infrastructure needs and costs to support electric demand for regional air mobility.

Table 5-37
Summary of Infrastructure Modeling Assumptions

Category	Item Type	Item	Description	Cost
Charging Infrastructure	Charging ¹ Stations	50 kW Level 3	Equip, Materials, and Install	\$52,250
			Annual O&M	\$3,200
		150 kW Level 3	Equip, Materials, and Install	\$191,250
			Annual O&M	\$3,200
		350 kW Level 3	Equip, Materials, and Install	\$684,850
			Annual O&M	\$3,200
		3 MW Level 3	Equip, Materials, and Install	\$900,000
			Annual O&M	\$3,200
	Dedicated ² distribution transformers	1.5 MVA		\$37,200
		1.0 MVA		\$28,900
		500 kVA		\$20,000
Utility and On-site Electrical Distribution	Utility Grid Supply	3 MW	Overhead-to-underground riser, new primary meter	\$2,070,000 ³
		6 MW	New overhead feeder back to utility distribution substation, overhead-to underground riser, new primary meter	\$4,130,000 ³
		10 MW	New substation and all needed downstream infrastructure	\$7,750,000 ³
	On-Site Distribution	Underground feeder		
On-Site Renewable Generation and Storage	Generation	PV ⁴	Capital Cost	\$1,600/kW
			Annual O&M Cost	\$17/kW
	Storage	BESS ⁵	Power Capacity Capital Cost	\$840/kW
			Storage Capacity Capital Cost	\$420/kWh

Notes: (1) Charging stations include EVSE cost, installation, wiring, concrete, and miscellaneous costs. The number of chargers and capacities are determined as needed per charging case. (2) Dedicated distribution transformers costs include concrete pad mounts and least-cost combination as needed per charging case. (3) Cost rounded to nearest ten thousand. (4) PV=Photovoltaic, Assumed 6 acres/MW, 25-year finance period at 5%. (5) BESS=Battery Energy Storage System, Assumed 25-year finance period at 5%.

Source: Adapted from *Impacts of Regional Air Mobility and Electrified Aircraft on Airport Electricity Infrastructure and Demand*, Jordan Cox, Tom Harris, Kathleen Krah, James Morris, Xiangkun Li, and Scott Cary, National Renewable Energy Laboratory, February 2023

Integrating electrical utility improvements with existing Electric Vehicle (EV) infrastructure initiatives could streamline development and lower costs, especially in urban areas where both EVs and eVTOLs are likely to operate concurrently. Such coordination would not only facilitate smoother implementation but also reduce the potential for disruptions. By proactively investing in scalable energy solutions, such as microgrids or on-airport power generation, LAN can effectively meet the power requirements of AAM while also catering to the current operational needs of the airport. This forward-thinking approach aligns with best practices suggested by various studies in the field and ensures that infrastructure development keeps pace with technological advancements in aviation and transportation. The location of these facilities will be included as part of the development alternatives analysis.

5.10.8 Utilities

Understanding the availability and capacity of utilities at an airport is essential for its daily operations and its ability to support future expansion. The following section details the expected utility requirements at LAN throughout the planning period. A list of service providers is included below:

- **Electric/Gas:** Consumers Energy (north airport), Lansing Board of Water and Light (south airport)
- **Water:** Lansing Board of Water and Light
- **Sanitary Sewer:** City of Lansing Service Department
- **Telecommunications:** AT&T, Comcast

5.10.8.1 Electric/Gas

Consumers Energy provides gas and electricity services to the northern section of the airport, which includes the maintenance and ARFF station areas, while the Lansing Board of Water and Light manages the southern portion. Currently, both the electrical and gas supply is sufficient to meet demand throughout the planning period. However, various electrical infrastructure upgrades should be considered to support future developments, especially as the airport prepares for advancements in technology and potential increases in demand due to electrification trends, including electric aircraft. To assess and plan for these future needs, the airport could conduct an airport electrification master plan, ensuring it is well-prepared for emerging technologies in aviation.

To facilitate the growth of AAM and the electrification of aircraft, it is advisable for LAN to plan for the installation of charging stations²⁶ on the apron and at future hangar and FBO facilities. While specific requirements for aircraft charging stations are still being established, it is

²⁶ During the process of conducting the master plan study, LAN installed its first electric aircraft charging station. A ribbon cutting event celebrating the new charging station was held July 30, 2025. <https://www.flylansing.com/about/news/capital-region-international-airport-and-beta-technologies-install-states-first-electric>

expected that new electric aircraft models will necessitate a high AC voltage connection along with a high AC grid current. See **Table 5-37** for planning level infrastructure model estimates.

Another electrical infrastructure initiative that the Airport should consider is the implementation of covered parking equipped with solar panels. This upgrade has become increasingly popular among airports across the country, providing both environmental and economic benefits. In 2018, the FAA published guidelines (*Technical Guidance for Evaluating Selected Solar Technologies on Airports*) to help airports assess the feasibility and effectiveness of solar installations.

Integrating solar energy systems reflects a strong commitment to environmental sustainability and presents an opportunity to lower operational costs significantly. By leveraging solar power, airports can reduce their dependence on traditional energy sources, aligning with broader sustainability goals while potentially decreasing energy expenditures.

5.10.8.2 Water

Water is provided by the Lansing Board of Water and Light. No immediate concerns for water availability were identified during the master plan study. Development of the southern portion of airport land has access to public water infrastructure, however, no lines currently extend to the north portion of the airport. Providing access to water utilities to the north portion of the airport would help support future development.

5.10.8.3 Sanitary Sewer

The City of Lansing Public Service Department is responsible for managing sanitary sewer services that extend from the southern end of the Airport. The ARFF and maintenance facilities located in the northern portion of the airport rely on an on-site well and septic system for their water and sewer needs. Current projections indicate that the existing sanitary sewer service will be sufficient to meet demand throughout the planning period.

5.10.8.4 Telecommunications

AT&T and Comcast serve as the telecommunications providers for the Airport, delivering reliable services that meet the airport's communication needs effectively. Their established infrastructure and capabilities ensure that the demands of airport operations are adequately supported.

5.10.8.5 Utility Expansion

Chapter 6, Airport Land Use Vision explores potential development areas around the Airport that align with LAN's long-term growth strategy. These areas are identified as valuable opportunities for future expansion, capable of supporting evolving operational demands. The chapter underscores the importance of preserving these areas for various airport-related uses. To properly support the development of these areas, proactive assessments of utility

expansions, including electrical, sanitary sewer, and telecommunications infrastructure, are necessary to plan for and accommodate future growth.

5.11 Facility Requirements Summary

The airport facility requirements that will be carried forward into the airport development alternatives analysis are summarized in **Table 5-38**.

Table 5-38
Facility Requirements Summary

Element	Description of Need and/or Recommendation
Airfield	
Runways	
Geometric and Separation Standards	
Shoulder Width	Install standard-width shoulders along the entire length of each runway.
Blast Pad	Install paved blast pads for Runway 10R-28L and stabilized blast pads for Runways 10L-28R and 6-24.
Runway Object Free Area (ROFA)	Consider relocating the supplemental wind cone currently situated within the ROFA south of Runway 10R-28L.
Runway Protection Zones (RPZs)	Several incompatible land uses were identified within the existing RPZs at LAN. It is recommended CRAA have full control of development within all the RPZ land.
Taxiways	
Geometric and Separation Standards	Install standard-width shoulders along the entire length of each taxiway, as appropriate, to align with the long-term airfield development plan.
Nonstandard Conditions and Hot Spots	14 nonstandard conditions and two hot spots were identified and should be addressed in the long-term airfield development plan.
Navigational Aids and Lighting	
Visual and Electronic Aids	CRAA should consider installing a segmented circle to enhance pilot situational awareness and improve overall operational safety.
Landside	
Passenger Terminal	Based on forecasted passenger demand and airline operations, it is recommended to plan for a total facility space of 155,700 square feet to meet the high-growth demand scenario in 2043. The amount of total programmed space may vary dependent upon the selected alternative (i.e., renovation, new build, or hybrid). See Appendix X, Terminal Area Plan
Regional Access	Generally, the overall ability to access LAN is adequate for vehicles. However, some improvements are recommended to enhance ease and safety across multi-modal uses and address roadway capacity constraints at key locations. (See Appendix X, Regional Access).
Vehicle Parking	Reconfigure the CRAA and tenant parking lots to address future demand.
Cell Phone Waiting Lot	Construct a cell phone waiting lot to relieve curb congestion during peak arrival/departure times. Maximize the number of available spaces within the selected preferred location.
Rental Car Parking	Expand the ready-return lot to accommodate need (33 additional spaces) over the planning period.
Parking Infrastructure Enhancement Opportunities	Parking spaces should be optimized to prioritize high-revenue areas, with consideration given to adding premium services like valet and covered parking. A market assessment, including cost-benefit analysis and benchmarking, should be conducted before making changes to the parking program.
Air Cargo	
Air Cargo Facilities	There are deficits in both airside and landside cargo facility space, which are expected to grow over the planning period. Undeveloped land areas adjacent to the cargo apron should be preserved for potential future expansions.

(Table continued on following page)

Element	Description of Need and/or Recommendation
General Aviation	
Fixed-Based Operator (FBO)	Additional space at the main fuel storage site on the cargo ramp should be preserved for future fuel tanks.
Based Aircraft Storage and Parking	Space should be planned to accommodate 15 additional conventional hangars to meet forecast demand and to account for a potential deficit in corporate hangar space in PAL 3, based on market fluctuations.
General Aviation Apron Requirements	The expected apron space deficit should be addressed to ensure the Airport can effectively accommodate both based and transient aircraft operations over the planning period.
Support Facilities	
Aircraft Rescue and Fire Fighting (ARFF)	Maintain ARFF equipment to meet a minimum of Index D requirements. The condition of the ARFF vehicles should be monitored throughout the planning period to ensure compliance and program replacement purchases.
Airport Traffic Control Tower (ATCT)	While the tower is in good condition, its aging status warrants evaluation of its long-term viability, especially with terminal modifications. Three potential relocation sites should be identified, evaluated per FAA AC 6480.4A criteria.
Airport Snow Removal Equipment (SRE) and Maintenance Facilities	The maintenance and SRE equipment storage buildings should be replaced when they reach the end of their useful life, ensuring the new facilities maintain current square footage with additional space for future needs and incorporate a drive-through design.
Airline Maintenance, Repair, and Overhaul Facility	Land (approximately 10 acres) should be preserved on the Airport Layout Plan for a potential Maintenance, Repair, and Overhaul (MRO) facility.
Advanced Air Mobility (AAM) and Urban Air Mobility (UAM)	CRAA should proactively plan for AAM/UAM infrastructure, including space for future vertiport facilities and the necessary utility infrastructure to support battery charging and computer systems.
Utilities	Utility expansions, including electrical, sanitary sewer, and telecommunications infrastructure, should be proactively assessed to accommodate future growth.

Source: RS&H Analysis, 2025