MSP Airport
2040 Long-Term Plan

Metropolitan Council Determination - March 2024

Final MAC Adoption - May 2024

Volume 1 of 2 - Narrative Report

Executive Summary

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Executive Summary

ES 1. INTRODUCTION

This executive summary provides a concise overview of the key findings and recommendations from the 2040 Long-Term Plan (LTP) for the Minneapolis-Saint Paul International Airport (MSP). The 2040 LTP should be consulted for additional information on the technical analyses, assumptions, and methodologies supporting the findings and recommendations. A glossary of airport planning terms and acronyms are provided in Appendix H of this document.

The 2040 LTP is a crucial planning document for airport management and operations, as it sets the course for the airport's future growth and development within a strategic framework that reflects the Metropolitan Airports Commission's (MAC) priorities, the operational characteristics of the airport, anticipated use, and other relevant factors. The LTP serves as a roadmap to accommodate aviation demand efficiently over the foreseeable future while maintaining the adaptability necessary to respond to changing industry conditions, the regulatory environment, and the characteristics of airport activity.

The 2040 LTP provides a blueprint for the long-range infrastructure development necessary to accommodate the growth in commercial aviation demand at MSP through 2040, while prioritizing safety, efficiency, and environmental sustainability. The 2040 LTP addresses the Airport's commercial air passenger terminal, airfield, and landside facility requirements to maintain an acceptable level of service (LOS). The plan's long-term concept supports logical and purposeful development to meet the Airport's needs efficiently and safely, minimizing the likelihood of incompatible or conflicting development. Preserving future development areas, both in size and functional/operational location, allows the MAC to make prudent development decisions as demand or other conditions dictate or as opportunities are presented.

The previous MSP Airport long-term plan (2030 LTP) was completed in 2010 and used 2030 as the forecast horizon. Since that time, aviation has changed significantly. These changes include the evolution of airline aircraft fleets, growth in non-traditional airline companies, the development of the ride-share industry, changes in passenger characteristics and travel patterns, and the need for flexibility in development plans to accommodate demand. These factors were considered in the 2040 LTP to define a future development plan that accommodates forecast demand, both in magnitude and characteristics, while providing flexibility for the MAC to respond to future changes.

1.1.1 History

As a result of passenger demand growth throughout the 1970s and 1980s in the Minneapolis-St. Paul region, the Minnesota Legislature passed the Metropolitan Airport Planning Act in 1989, which established the Dual Track Airport Planning Process. Managed by the MAC and the Metropolitan Council (Met Council), the almost seven-year planning process analyzed various options for either providing adequate air service capacity and facilities within the region or building a new airport to meet demand.

After completing the analysis and submitting recommendations to the Minnesota Legislature in 1996, the *Long-term Comprehensive Plan Minneapolis-St. Paul International Airport Act* was passed on April 2, 1996, recommending the expansion of the existing airport instead of moving to a new location. The MAC thus ceased further study of a new airport development and implemented the MSP 2010 LTP. The LTP included more than an estimated $3.1 billion in Airport developments and improvements for gates, automobile parking, rental car facilities, and a new runway, Runway 17-35, opened in 2005 because of the 2030 LTP.

The 2030 LTP recommended the reassignment of airlines between Terminal 1 (T1) and Terminal 2 (T2) to balance passenger demand and improve efficiency and customer service of both facilities through 2030. The 2030 LTP recommended utilizing T1 to accommodate Delta Air Lines and its partner airlines while relocating all other airlines to T2. Specific terminal capital programs were recommended based on this terminal re-assignment.

In 2019, the MAC launched a process to complete the 2040 LTP, which reflects upon previous planning studies/findings and adapting them to changes in the Airport's existing and future needs.

1.1.2 2040 LTP Objectives

Met Council guidelines require regular updates to the LTP to integrate pertinent information regarding the planning, development, and operation of the region's airports for compatibility with the surrounding areas. The primary objectives for the 2040 LTP are the following:

- **Objective 1:** Plan for future facilities that will meet forecast Planning Activity Levels (PALs) in a manner that maintains and enhances customer service, while facilitating a seamless "one-journey" experience.
- **Objective 2:** Produce a development plan that positions the MAC to meet future demand levels, enhances financial strength, leverages environmental stewardship, and infuses sustainable thinking.
- **Objective 3:** Conduct the planning process in a manner that includes meaningful stakeholder engagement.

The 2040 LTP provides a blueprint for the long-range infrastructure development necessary to accommodate growth in commercial aviation demand at MSP through 2040, while prioritizing safety, efficiency, and environmental sustainability. The 2040 LTP addresses the airport's commercial air passenger terminal, airfield, and landside facility requirements to maintain an acceptable level of service (LOS). The purpose of the 2040 LTP is to update the recommended capital improvements proposed in the MSP 2030 LTP, reflecting updated aviation forecasts, industry trends, and stakeholder expectations.

ES 2. PROCESS

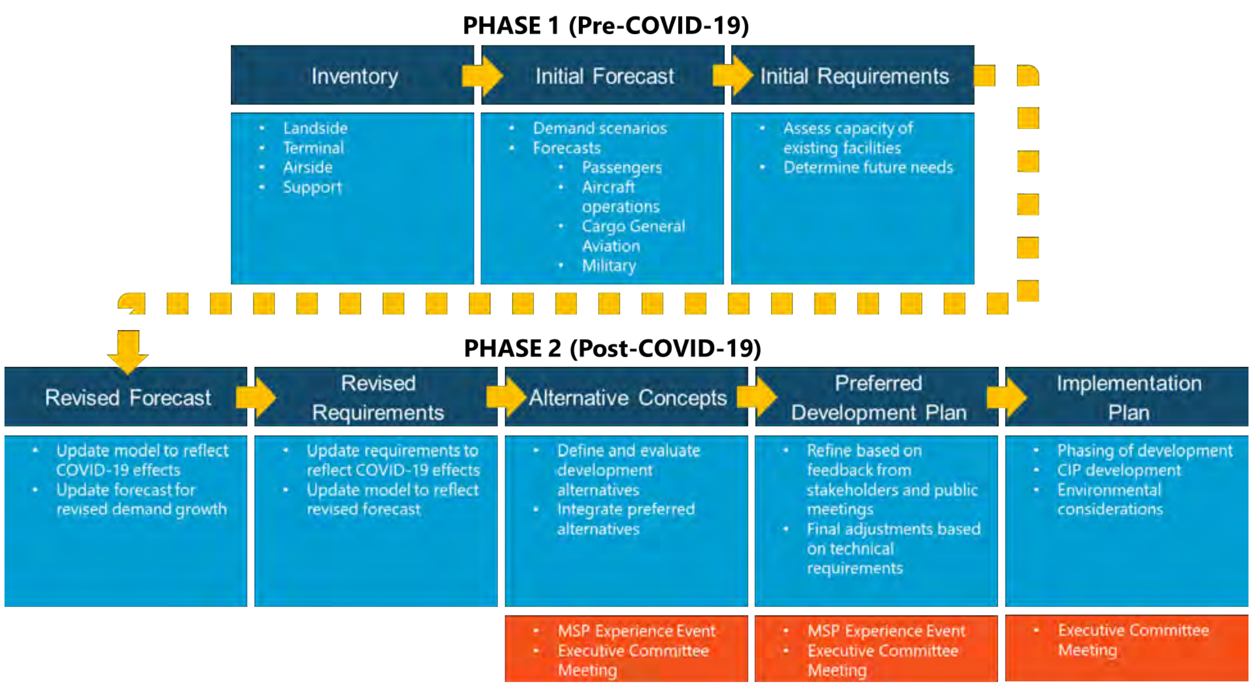
The 2040 LTP was completed in two phases, which included an approximate 15-month pause of analysis due to COVID-related impacts. The intent of the 2040 LTP was to assess future Airport needs by presenting a 20-year plan that would address near-term, mid-term, and long-term needs of airport infrastructure. The first phase of development for the 2040 LTP included a surveying existing Airport infrastructure; assessing the capacity of the current gate and Airport facilities; developing the aircraft and passenger demand forecasts; developing an airfield simulation and capacity; conducting a passenger facility gap analysis; and determining aircraft gating requirements.

Preliminary tasks in the 2040 LTP included an inventory of airfield conditions, aviation activity forecasts, and an airfield capacity simulation study. In March of 2020, COVID-19 hit the United States and subsequently the MAC paused the planning process.

In October 2021, the MAC reengaged 2040 LTP efforts. The forecast completed at the beginning of the study was updated to incorporate COVID-19 pandemic impacts on aviation demand. Elements of the 2040 LTP completed after October 2021 included:

- a revision of the demand forecast to account for changes resulting from the pandemic;
- estimating the long-term (2040) infrastructure needs with activity-based evaluation points for the short-term and mid-term periods;
- evaluating potential alternative options;
- selecting a preferred plan; and
- outlining a general timeline for implementing enhancements and expansion projects at near-term, mid-term, and long-term points throughout 2040.

Exhibit ES-1: Process Flow



ES 3. FORECAST

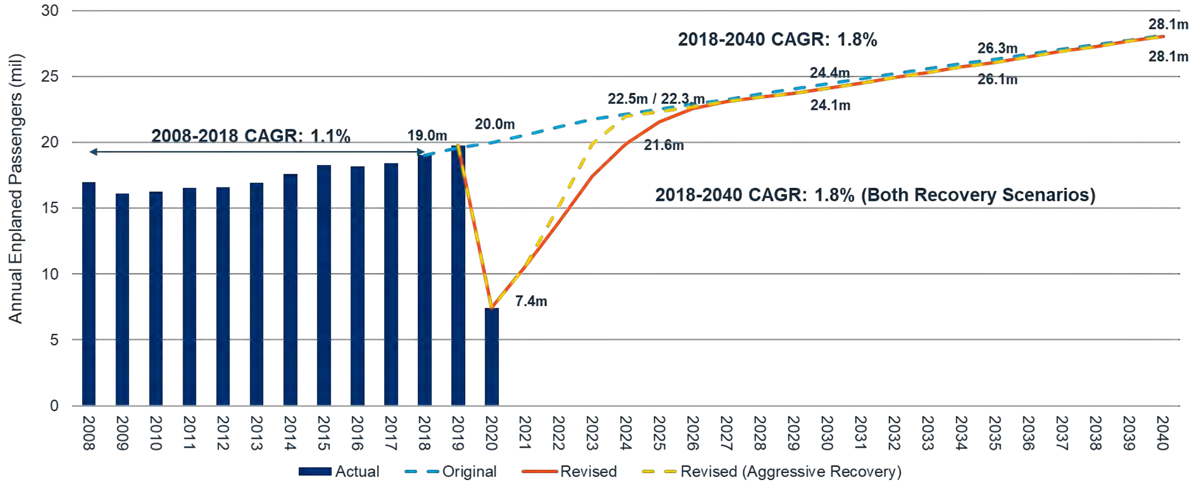
Both the original and COVID-updated forecasts were developed for passenger-related activity (passenger volumes and aircraft operations) and non-passenger-related activity (air cargo, general aviation (GA) / air taxi, and military aircraft operations) by year between 2018 and 2040. As the effects of the pandemic subside, passenger demand is expected to return to pre-pandemic levels. However, the return to that point will not be immediate, and the timing will depend on factors such as regional economic recoveries, seat capacity allocation decisions by airlines, and local or national travel restrictions. The return to pre-pandemic growth will likely be uneven across markets and passenger types. As such, pre-pandemic factors used in aviation activity forecasting were used rather than pandemic-related concerns. These factors included qualitative and quantitative elements regarding:

- airline capacity and load factor recovery at MSP;
- airline capacity recovery at airports served by MSP and in the industry overall;
- economic recovery projected for the region and in regions served from MSP;
- historical revenue produced by passengers in the individual markets served from MSP; and
- other forecasts developed for the Airport and the industry.

As modeled, pandemic-related influences continue to impact certain segments of passenger activity through 2026 (although growth continues during that period), after which a return to pre-pandemic activity prevails throughout the remainder of the forecast period. A more aggressive forecast of recovery was also developed that considered more favorable economic conditions and airline response. In the more aggressive scenario, pandemic-related influences were modeled to cease by the end of 2024. The more aggressive results are presented as the updated forecasts that serve as the basis of the Design Day Flight Schedule (DDFS) development. Comparisons of the pre-pandemic and post-pandemic forecasts are depicted in **Exhibits ES-2** through **ES-4**. A summary of the Revised Aggressive Recovery Results is included in **Table ES-1**.

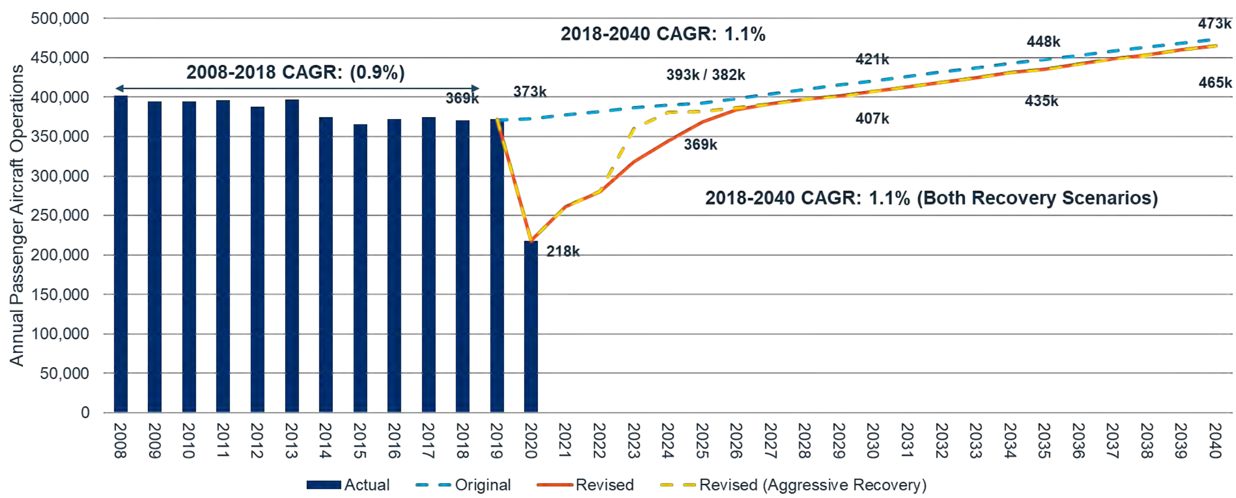
Annual forecasts are often used to create planning timelines that correlate improvement projects with specific calendar years. Using Planning Activity Levels (PALs) instead of forecast years removes timeframes from the analysis and focuses on implementing projects when the Airport reaches certain activity levels. For most planning purposes, the timing for capacity-related improvements should correlate to activity levels. Actual activity may vary from the forecasts as the result of unforeseen events or changes in the operational characteristics of MSP, airline business changes, or economic uncertainties in the region or nation.

Exhibit ES-2: Comparison of Original and Updated Enplaned Passengers Forecasts



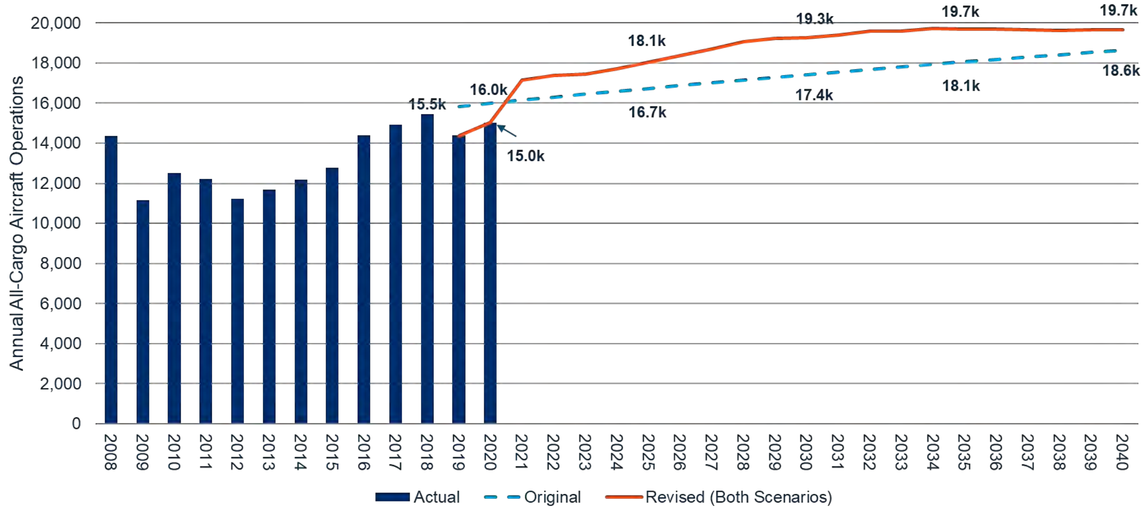
NOTES: CAGR – Compound Annual Growth Rate;
The Federal Aviation Administration's Terminal Area Forecasts reflect the federal fiscal year (October through September).
SOURCES: MAC Activity Reports (actual); Ricondo & Associates, Inc., 2021 (Long-Term Plan forecasts); U.S. Department of Transportation, Federal Aviation Administration, 2022 Terminal Area Forecast, 2023

Exhibit ES-3: Comparison of Original and Updated Passenger Aircraft Operations Forecasts



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports (actual); Ricondo & Associates, Inc., 2021 (forecast).

Exhibit ES-4: Comparison of Original and Updated All-Cargo Operations Forecasts



SOURCES: MAC Activity Reports (actual); Ricondo & Associates, Inc., 2021 (forecast).

Table ES-1: Summary of Updated Forecast Results

	2018 Base Year	2025 PAL 1	2030 PAL 2	2040 PAL 3
Annual				
Passenger Aircraft Operations (000)	369	382	407	465
Total Aircraft Operations (000)	407	423	450	510
Total Passengers (mil)	38	44.7	48.2	56.1
Enplaned Passengers (mil)	19	22.3	24.1	28.1
Summer Design Day				
Daily Passenger Aircraft Operations	1,186	1,254	1,350	1,526
Peak Hour Passenger Aircraft Operations	99	102	103	124
Total Daily Passengers (000)	128	157	172	195
Total Peak Hour Passengers (000)	9.9	13.4	12.7	15.3
Spring Design Day				
Daily Passenger Aircraft Operations	1,113	1,154	1,256	1,406
Peak Hour Passenger Aircraft Operations	85	93	96	111
Total Daily Passengers (000)	119	142	157	179
Total Peak Hour Passengers (000)	9	10.8	12.1	14.3

NOTES: PAL – Planning Activity Level
The base year spring design day is in 2018.
Sources: MAC Activity Reports; U.S. Department of Transportation, 2021; Ricondo & Associates, Inc., 2021.

ES 4. EXISTING FACILITIES AND REQUIREMENTS

MSP is a commercial service airport that supports the Minneapolis-St. Paul metropolitan area. The Airport is located approximately 5.5 miles south of downtown Minneapolis, Minnesota, and approximately 6 miles southwest of downtown Saint Paul, Minnesota. The Airport property covers approximately 3,400 acres and is owned and operated by the Metropolitan Airports Commission (MAC).

MSP's primary function is to serve commercial and cargo aircraft traffic for the region while hosting both the United States Air Force and Minnesota National Guard. The airport serves most of the commercial operations through its two passenger terminals and four runways. The Airport includes Fixed Base Operator (FBO) facilities as well. Cargo facilities are located in several areas within the Airport's property boundary.

Both terminals include full landside facilities interconnected to Minneapolis' freeway network. Additionally, both terminal facilities are connected to Metro Transit via light rail stops.

The MAC also operates six general aviation (GA) reliever airports in the Twin Cities region. These airports support MSP by relieving some demand through attracting non-commercial and business traffic away from MSP and relieving some demand. All six of the reliever airports are within 35 miles of downtown Minneapolis and Saint Paul.

Exhibit ES-5: Metropolitan Airports Commission – Airport System

SOURCES: Google Earth, 2022 (aerial image); Metropolitan Airports Commission, 2022.

1.1.3 Landside Inventory

Landside facilities directly serving MSP passengers and visitors include terminal area roadways, terminal curbsides, parking facilities, rental car facilities, and commercial ground transportation areas at T1, T2, and other locations on the Airport campus.

The Airport is surrounded by a comprehensive highway network. State Highways MN 5 and MN 77 lie directly to the east and west of the Airport, respectively. State Highway MN 62 and Interstate 494 (I-494) run along the north and south borders of the Airport, respectively. The landside access for passengers is divided into two areas, one for T1 and another for T2. Primary access to T1 is provided via MN 5 and Glumack Drive. T2 is accessed from I-494 and 34th Avenue South, and it egresses via 72nd Street. Both terminals are also accessible via Metro Transit's light rail system and bus service.

Terminal curbside facilities for T1 use Glumack Drive in front of the T1 passenger terminal which is divided into an upper- and lower-level roadway. The upper-level roadway curbside provides drop-off space for originating passengers (departures) and some commercial vehicle operations. The west upper-level roadway supplies 830 linear feet of departures curbside. The west lower-level roadway provides 700 linear feet of pick-up space for terminating passengers (arrivals).

Terminal curbside facilities for T2 use Humphrey Drive in front of T2, which provides 1,200 linear feet of curbside, a shared drop-off space for originating passengers (departures) and pick-up space for terminating passengers (arrivals).

Curbside for both terminals have deficits in both PAL 1 and PAL 3. PAL 1 depicts the near-term need to expand T1 curbside. PAL 3 curb requirements increase substantially over PAL 1 which depicts the long-term need for curbside expansion at both terminals.

Table ES-2: T1 and T2 Curbside Requirements

	Existing	PAL 1	Surplus / (Deficit)	PAL 3	Surplus / (Deficit)
T1 Departures	830'	840'	(10')	1,130	(300')
T1 Arrivals	700'	815'	(115')	1,130'	(430')
T2 Departures	700'	440'	260'	690'	10'
T2 Arrivals	450'	715'	(265')	940'	(490')

NOTES:
PAL – Planning Activity Level
SOURCE: Kimley-Horn and Associates, Inc., 2022.

The Airport provides parking spaces in nine parking ramps distributed between T1 and T2. The parking ramps also include rental car facilities at both terminals. T1 has 5 parking ramps: Gold/Brown Ramp, Green/Pink Ramp, Red Ramp, Blue Ramp, and Silver Ramp. The parking facilities are connected to T1 with an underground walkway area and/or the Hub Tram. T2 has two parking ramps: Orange Ramp and Purple Ramp. The parking facilities are connected to T2 with the elevated skyway and an at-grade crosswalk. Parking facilities will need to be expanded to achieve PAL 3 requirements.

Table ES-3: Airport Parking Facilities

Facility	All Airport Parking	PAL 1	PAL 2	PAL 3
Airport Parking Spaces	33,220	29,410	31,560	36,100
Surplus/(Deficit)	-	3,810	1,660	(2,880)

SOURCE: Kimley-Horn and Associates, Inc., 2021.

Each terminal has its own set of nearby rental car facilities. The Customer Service Building (CSB) at T1 is located on Level 1 of the Silver Ramp. The Silver Ramp also houses the T1 ready/return area on Levels 2 through 5. The rental car facilities in the Silver Ramp are accessed via the Hub Tram and underground walkways. The T1 Quick Turn Around (QTA) facilities are located on Level 1 of the Red and Blue Ramps.

The T2 customer service operations and ready/return area occupy a portion of Level 1 and the Mezzanine Level of the Purple Ramp. The QTA facility is located on the south side of East 72nd Street near the Purple and Orange Ramps.

Commercial operators at MSP include taxis, limousines, Transportation Network Companies (TNCs), Airport-operated shuttles, private shuttles, buses, and public transit. Most of these functions are located within the T1 Ground Transportation Center (GTC). This area serves taxis, TNCs, limousines, Quick Ride Ramp shuttles, and various hotel and regional shuttles. The Transit Center, located on Level 1 of the Silver Ramp, serves charter buses, employee shuttles, Metro Transit buses, and off-site rental car and parking shuttles.

T2 has a similar mix of commercial ground transportation operators, which are consolidated on Level 1 of the Purple Ramp. Dedicated parking areas on Post Road provide additional space for commercial vehicle staging.

Table ES-4: Rental Car Facilities

		Surplus/(Deficit)			
Facility	**Existing Supply**	**Base Year**	**PAL 1**	**PAL 2**	**PAL 3**
Customer Service Counter Positions	77	22	16	9	2
Ready/Return Stalls	2,715	1,065	860	725	440
Fueling Positions	100	8	(2)	(9)	(25)
Wash Bays	20	(4)	(6)	(7)	(12)
QTA Storage (On-Site Vehicles)	1,260	100	(50)	(140)	(350)

NOTES:
PAL – Planning Activity Level
QTA – Quick Turnaround
SOURCE: Kimley-Horn and Associates, Inc., 2022.

1.1.4 Terminal Inventory

The Airport has two commercial passenger terminals: T1 and T2. Together, they provide approximately 3.33 million square feet of terminal facilities and 118 contact aircraft gates.

T1 is located between the Airport's parallel Runways 12R-30L and 12L-30R. T1 is comprised of seven concourses, designated A through G, that contain 102 contact gates and two ground-loaded gates. 10 contact gates are connected by sterile corridors to the T1 Federal Inspection Station (FIS) facility on Concourse G. Passenger movement is enhanced by moving sidewalks along Concourses G and C, and an automated people mover (APM) system along the front face of Concourse C, from Gate C1 to Gate C27.

T2 is located between Runway 17-35 and Runway 12R-30L in the southern portion of Airport property below Runway 4-22. T2 has one concourse, designated H, that contains 16 contact gates. Five of these gates are connected by sterile corridors to the T2 FIS.

Both terminals need expanded gate facilities to meet demands of PAL 2. Gate needs in PAL 3 slightly decrease in T1, while needs slightly increase at T2.

Table ES-5: Aircraft Gate Demand

Terminal	Existing Gate Count	PAL 2	Surplus / (Deficit)	PAL 3	Surplus / (Deficit)
T1	102	133	(31)	130	(28)
T2	16	17	(1)	20	(4)

NOTES:
PAL – Planning Activity Level
Gate requirements based on exiting airline allocations at T1 and T2
SOURCE: Ricondo & Associates, Inc., 2022.

The T1 check-in inventory includes four banks of baggage acceptance points: two primary check-in banks on Level 2 and two landside check-in banks on Level T. The T1 check-in inventory also includes a single bank of baggage acceptance points on Level 1.

The main Safety and Security Checkpoint (SSCP) banks located after check-in are split between two locations in T1: north and south. Each SSCP includes both Automated Screening Lanes (ASLs) and non-ASLs for passenger processing, as well as an employee screening lane. Each location in T1 contains 9 screening lanes for a total of 18 screening lanes in T1. Within the T1 complex, there are three other checkpoints: the recheck facility on Concourse G used for international inbound passenger processing, the skyway checkpoint with 2 lanes and the hotel T1 access point with 1 lane.

The T1 domestic baggage claim is located on Level 1 of the terminal. The baggage claim, located on the non-secure side, includes 11 individual devices ranging from 120 linear feet to 180 linear feet. Each claim unit is connected to an individual stripping belt in the cart staging area.

There are 104 holdrooms in the seven concourses at T1. The holdrooms of Concourses A through E support domestic Airplane Design Group (ADG) II and ADG III aircraft. Concourse F supports a range of ADG II to ADG V domestic aircraft. Concourse G holdrooms are configured for a range of aircraft, from ADG III to ADG V aircraft with Gates G1 through G10 capable of accommodating international arrivals. Holdrooms in T1 are generally undersized for gauge of aircraft served at the terminal.

Baggage screening is split between two locations in T1: T1 west and T1 south. Each baggage screening point has a bank of 5 and 2 inline screening units, respectively. Expansion space is reserved for 2 additional units at T1 south.

The FIS in T1 supports 10 international-capable gates, Gates G1 through G10. The FIS facility includes 2 bag claim devices with a total of 290 linear feet presentation length for each device. The existing facilities do not meet the requirements for PAL 2 and PAL 3.

Table ES-6: T1 Processor Functions

Function	Processor	Existing	PAL 2	PAL 3
Check-in Positions	Positions	77	57	62
Security Screening[1]	Lanes	18	16	18
Checked Baggage Screening	Devices	6	5	5
Outbound Makeup	Carts	189	167	203
Holdrooms[2]	Sq Ft	180,176	196,000	196,000
Domestic Baggage Claim	Devices	11	11	11
Federal Inspection Station	Sq Ft	5,750	6,772	7,430

NOTES:
Screening lanes at the CBP recheck, hotel, and skyway are limited use screening areas and not included in the total count
Holdroom requirements are based off existing holdroom sizing and do not include additional gates' holdroom requirements
SOURCE: Ricondo & Associates, Inc., June 2020.

The T2 domestic baggage claim is located on Level 1 of the T2 headhouse. The baggage claim, located on the non-secure side, includes 2 individual devices with 200 linear feet of presentation length each. Each claim unit is connected to an individual stripping belt in the cart staging area.

Security screening is split between two locations in T2: Checkpoint 1 and Checkpoint 2. Checkpoint 1 is the primary passenger screening location, and Checkpoint 2 is infrequently used/staffed. The T2 employee screening is completed in a TSA checkpoint on the south end of the passenger ticketing area and is behind a secure door. Checkpoint 1 contains 6 screening lanes and Checkpoint 2 contains 4 lanes, for a total of 10 screening lanes in T2.

There are 14 holdrooms in T2. Holdroom areas are spread along the concourse which are configured for ADG III aircraft. Gates H3 through H7 holdrooms are grouped in clusters for shared use and can accommodate up to ADG V aircraft for Gates H3 through H7. Gates H3 through H7 can also accommodate international arrivals.

Baggage screening is split between two locations in T2: T2 checked Baggage Inspection System (CBIS) and T2 out of gauge (OOG). Each baggage screening point has 2 inline screening units, respectively. Expansion space is reserved for 2 additional units in the T2 CBIS. Requirements for both PAL 2 and PAL 3 show the need for an additional screening device.

Both T1 and T2 contain FIS facilities. The T1 FIS facility supports 10 international-capable gates at T1 including Gates G1 through G10. The FIS facility includes 2 bag claim devices with a total of 290 linear feet of presentation length for each device. The T2 FIS facility supports 5 international-capable gates at T2, Gates H3 through H7. The FIS facility includes 2 bag claim devices with a total of 200 linear feet of presentation length for each device.

Table ES-7: T2 Processor Functions

Function	Processor	Existing	PAL 2	PAL 3
Check-in Positions	Positions	58	45	50
Security Screening	Lanes	10	7	7
Checked Baggage Screening	Devices	2	3	3
Outbound Makeup	Carts	64	68	66
Holdrooms[1]	Sq. Ft.	65,777	45,207	45,207
Domestic Baggage Claim	Devices	4	4	4
Federal Inspection Station	Sq. Ft.	54,920	1,883	2,910

NOTES:
Holdroom requirements are based off existing holdroom sizing and do not include additional gates' holdroom requirements
SOURCE: Ricondo & Associates, Inc., June 2020.

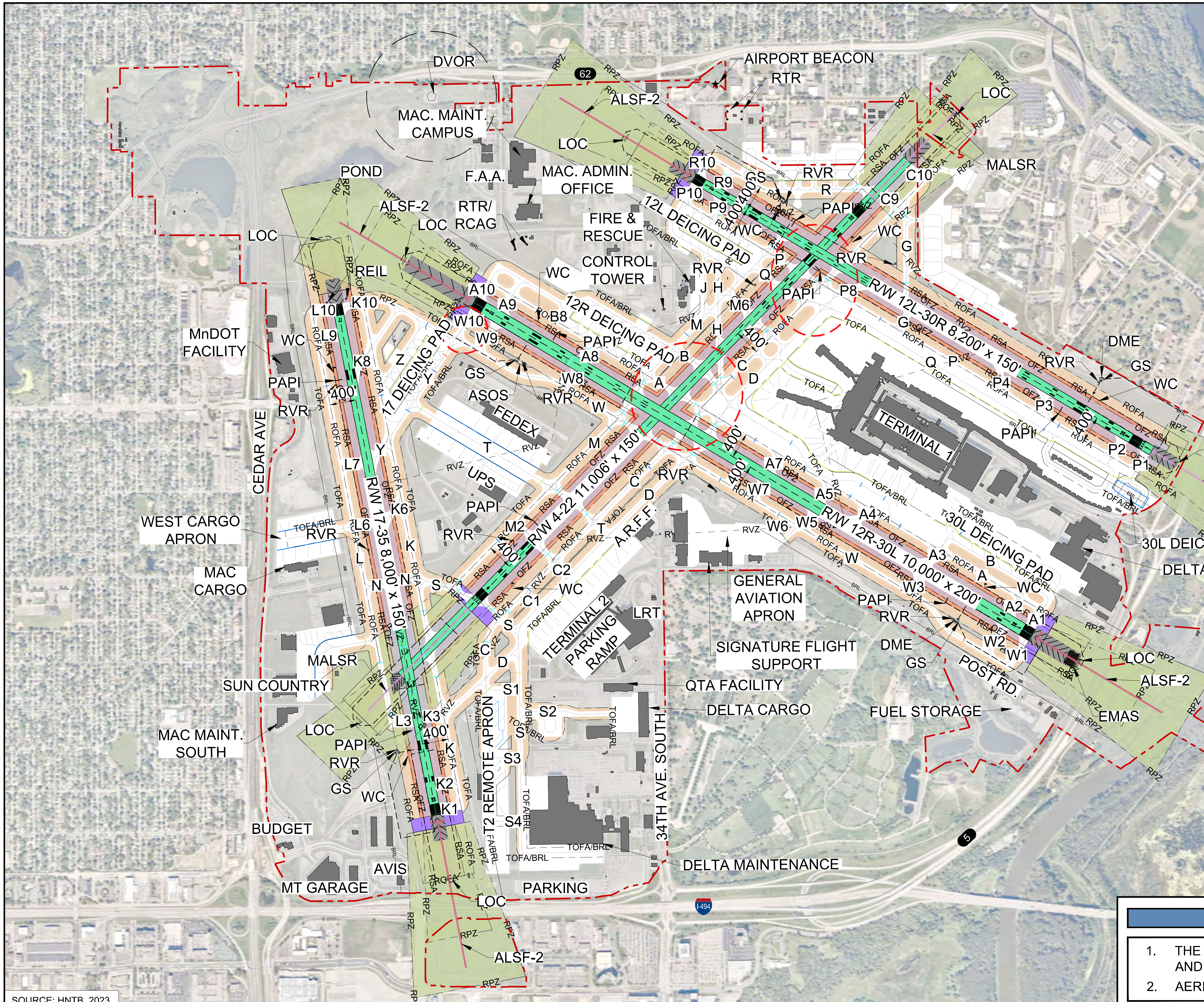
1.1.5 Airside Inventory

1.1.5.1 Runways

MSP has four runways, including one set of parallel runways. Runway 4-22 is the Airport's longest runway; it measures 11,006 feet long with a 1,550-foot displaced arrival threshold on the Runway 4 approach end and a 1,000-foot displaced arrival threshold on the Runway 22 approach end. Runway 12L-30R measures 8,200 feet long with a 200-foot displaced arrival threshold on the Runway 30R approach end. Runway 12R-30L measures 10,000 feet long by 200 feet wide. Runway 17-35 measures 8,000 feet long. The existing critical design aircraft at MSP is the Airbus A330-900neo, an ARC D-V aircraft. The future critical design aircraft has been identified as the Airbus A350-1000. The A350-1000, also a D-V aircraft, is the most demanding aircraft with forecast operations greater than 500 per year. Based on forecast operations and the critical design aircraft through 2040, additional runways or runway length at MSP is not required.

1.1.5.2 Taxiways

The taxiway and taxilane system provide aircraft connections between runways and aprons throughout the airfield. Like runway standards, taxiway standards are derived from the size and type of aircraft expected to use the taxiways. The existing critical design aircraft (A330-900neo) is Taxiway Design Group (TDG) 5. The future critical design aircraft (A350-1000) is TDG 6. The future shift to TDG 6 standards will have marginal impacts on taxiway pavement surfaces and will be in focused areas of the airfield based on future use and taxi-routes of the A350-1000.



DRAWING LEGEND

RUNWAY PAVEMENT	
EXISTING TAXIWAY / APRON PAVEMENT	
AIRPORT PROPERTY LINE	
EXISTING BUILDING - ON AIRPORT	
RUNWAY SAFETY AREA (RSA)	RSA
RUNWAY OBSTACLE FREE ZONE (OFZ)	OFZ
PRECISION OBSTACLE FREE ZONE (POFZ)	POFZ
RUNWAY OBJECT FREE AREA (ROFA)	ROFA
RUNWAY PROTECTION ZONE (RPZ)	RPZ
TAXIWAY OBJECT FREE AREA (TOFA)	TOFA
35' BUILDING RESTRICTION LINE (BRL) (1)	BRL
RUNWAY HOLDING POSITION (PATTERN A)	
ILS HOLDING POSITION (PATTERN B)	
INTERMEDIATE HOLDING POSITION (PATTERN C)	
NON-MOVEMENT AREA BOUNDARY	
APPROACH LIGHTING SYSTEM (MALSR)	
APPROACH LIGHTING SYSTEM (ALSF-2)	
NAVAID CRITICAL AREA	
HOT SPOT	
AIRPORT BEACON	★

NOTES

1. THE BUILDING RESTRICTION LINE FOLLOWS ANY NAVAID CRITICAL AREA, RPZ AND TOFA WHERE OVERLAPPING.
2. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)

N

0 1,600' 3,200'

MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

FEBRUARY 2023

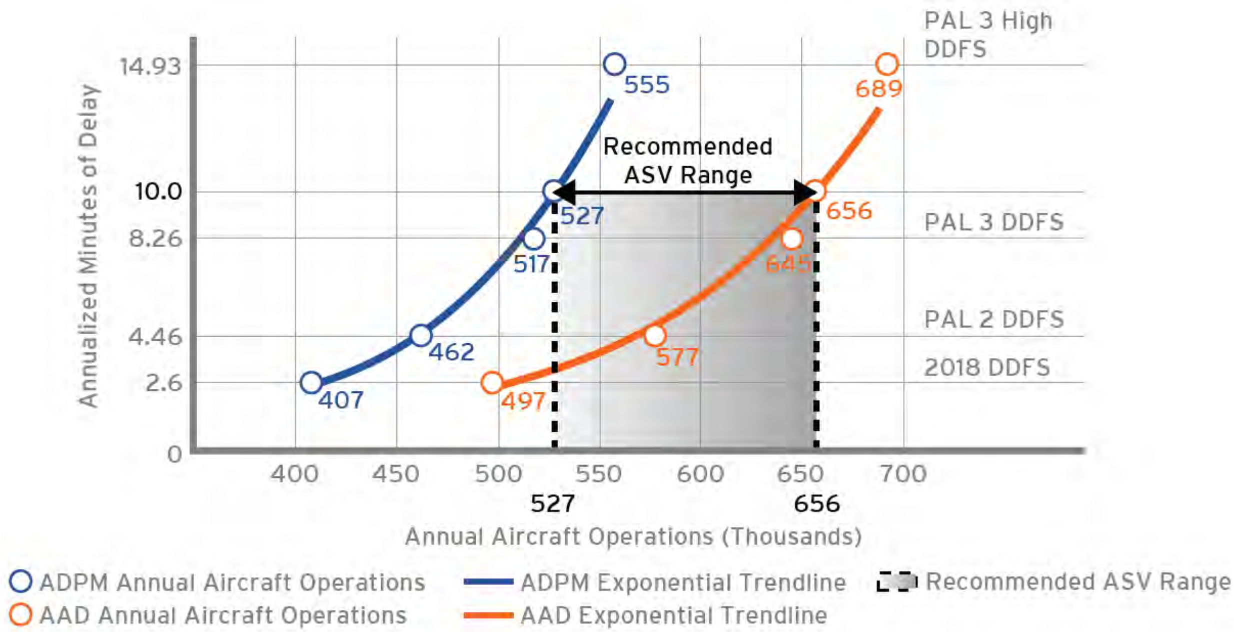
ES-6

EXISTING AIRFIELD CONFIGURATION

1.1.5.3 Airfield Capacity

A summer Design Day Flight Schedule (DDFS), developed with the forecast materials in **Section ES 3**, was used to complete a comprehensive airfield capacity assessment for the 2040 LTP. This capacity study evaluated estimated aircraft demand on an Average Annual Day (AAD), and an Average Day Peak Month (ADPM) basis. Both metrics present variations in the determination of Annual Service Volume (ASV) and annualized delay.

Exhibit ES-7: Annual Service Volume Ranges



NOTES:
PAL – Planning Activity Level
DDFS – Design Day Flight Schedule
ADPM – Average Day Peak Month
AAD – Average Annual Day
ASV – Annual Service Volume
SOURCES: HNTB Corporation, 2020 (analysis); MSP Long-Term Plan Airfield Capacity Study, December 2020.

1.1.5.4 Remain Overnight Parking and Deicing Pads

MSP has two designated remain overnight (RON) parking areas. RON A is located southeast of T1 Concourse G, accessible by Taxiway B, and is used by Delta Air Lines for narrowbody RON parking. RON A can accommodate a maximum of seven narrowbody aircraft or a combination of widebody aircraft and reduced narrowbody positions. RON B is located east of Runway 35 with access from Taxilane S. While this location is available for RON operations, the area's primary use is as a deicing pad. The LTP identified and addresses the need for additional RON capacity based on airline needs. The existing deicing capability meets the future demand of aircraft operations. An additional deicing pad is proposed in the preferred airfield layout (**Exhibit ES-8**) north of the T2 expansion. This is to acknowledge the increase in gates at T2 and to reduce the number of runway crossings during winter months.

1.1.5.5 Air Traffic Control Tower

Because MSP is a Part 139-certified airport with an operating air traffic control tower (ATCT), personnel require an unobstructed view from the cab of the tower to the movement area. This includes taxiways and runways, as well as the non-movement area boundary line. The ATCT and top cab should be located to provide a view to all points of the movement area and should preclude parked aircraft, buildings, and equipment from obstructing a controller's view.

The LTP does not propose any improvements to or relocation of the ATCT. Existing line-of-sight concerns related to seeing the far ends of Concourses A and G may be mitigated by local Ramp Control at the far ends of the concourses where aircraft can be directed to a designated location prior to contacting Ground Control.

1.1.5.6 Cargo

Air cargo facilities at MSP are located on the west and south sides of the Airport with on-airport cargo handling and processing generally occurring in four primary locations: 1) FedEx and UPS facilities, 2) the DHL facility (Amazon/DHL) and Sun Country facility, 3) Air Cargo Center, and 4) Main Delta Cargo facility. The existing cargo facilities at MSP represent approximately 523,000 square feet of total cargo building area designated for air cargo activities. The growing demand of e-commerce will require an enhanced future cargo footprint. The remaining cargo demand (freight, belly) are accommodated with existing facilities through the planning cycle.

ES 5. PREFERRED ALTERNATIVE

The alternative development process first focused on the terminal footprint, as aircraft gates and terminal space were the highest priorities identified in the 2040 LTP. Airside and landside concepts were later integrated into a consolidated list of potential terminal layouts that balance the needs of all three airport functions, while also acknowledging the geographical limitations of the airfield. The preliminary terminal layouts that were created focused on:

1. FIS function and location between T1 and T2; and
2. Gate expansion capabilities that would not overly burden airside functions. Expansion opportunities were considered on the basis of airline preferential gating (one gate assigned exclusively to one airline) or common-use gating (multiple airlines operating out of one gate).

The three basic terminal concepts were:

- Alternative 1A: Single FIS at T1; Preferential gating
- Alternative 2A: Single FIS at T2; Common-use gating
- Alternative 3A: FIS at both T1 and T2; Preferential gating

From there, airside and landside elements were incorporated into the terminal concepts.

An extensive stakeholder engagement process was conducted to share and solicit feedback on the three concepts. The project team conducted more than 15 meetings with airlines, tenants, agencies, MAC operational staff, MAC senior leadership, the Long-Term Plan Stakeholder

Advisory Panel (SAP), and members of the public. Stakeholder input was used to refine the concepts and inform decision-making for the preferred alternative.

Alternative 3.1A was selected as the preferred development alternative. This concept incorporates multiple elements from each of the three preliminary consolidated alternatives and addresses the balance between airside, landside, and terminal functions. Preferred Alternative 3.1A, shown on **Exhibit ES-8**, assumes FIS function remains at both T1 and T2 and balances the need for both preferential gating at T1 and a strategy to continue implementing common-use gating at T2.

This alternative addresses the concerns of airport congestion in the landside, terminal, and airside through a series of projects. Landside projects at both terminals – as well as the surrounding feeder roadways – were developed to reduce traffic congestion around the airport and at curbside areas. Parking will be expanded to accommodate the forecasted demand and acknowledge the need for reconstructing T1 parking facilities (Green/Gold) that are reaching the end of useful life.

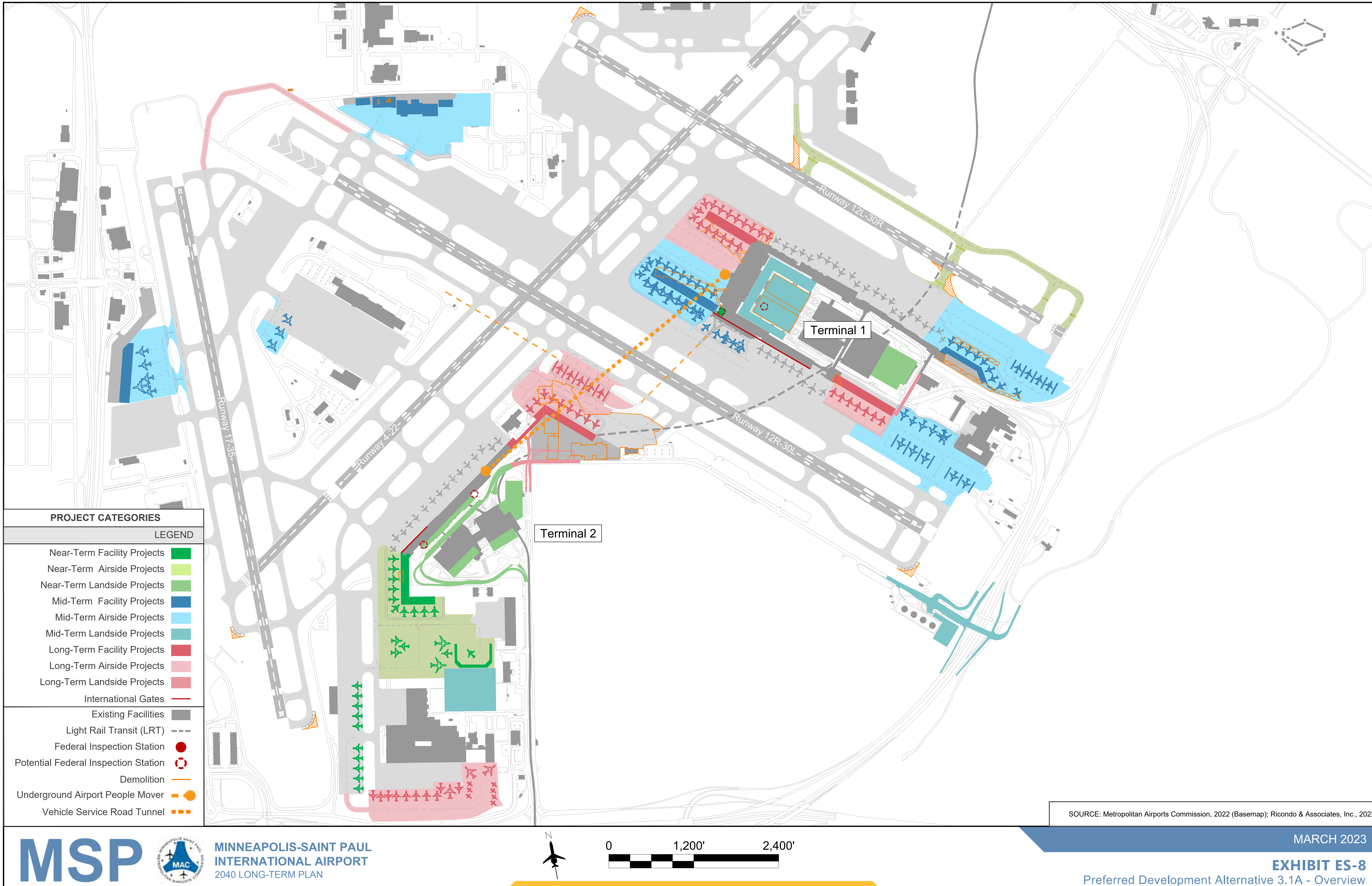
Terminal projects are also intended to address increased demand for narrowbody aircraft parking (ADG III) while maintaining an optimal level of service for passengers.

Airfield modifications were identified to improve efficiencies in aircraft ground maneuvering, specifically in areas where current design standards have been prohibitive, and to reduce runway crossings for aircraft accessing Runway 17-35. Projects include reconfiguring taxiways, expanding deicing and RON aircraft aprons, and relocating and expanding some support facilities.

A phased high-level implementation strategy was developed to categorize near-term, mid-term, and long-term projects. Phasing was determined by need and targeted demand.

- Near-term projects are primarily focused on increasing capability of existing facilities while creating areas for development staging.
- Mid-term projects are focused on increasing the capability of the Airport to accommodate projected demand.
- Long-term projects provide additional expansion for demand and increasing operational flexibility through inter-terminal connectivity.

The division between near-, mid-, and long-term development plans was established to characterize development that has a higher likelihood of justification and implementation within the 2040 planning cycle. However, it is important to recognize that the division in these windows of development is approximate and dynamic and will be subject to change as the MAC begins to implement the LTP. Needs and opportunities may evolve, and many supporting projects would also be needed to fully implement this program.



MSP

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EXHIBIT ES-8
Preferred Development Alternative 3.1A - Overview

1.1.6 Near-Term

Recommended near-term projects were selected because they provide continuity from previous LTP efforts, address imminent needs, or are prerequisites for mid- and/or long-term projects.

- Project 1-1: T1 Federal Inspection Services Facility Enhancements – Enhancements to the existing FIS inside T1 will help improve passenger throughput and make incremental improvements to existing capacity until the FIS function can be centrally located.
- Project 1-2: T2 South Terminal Expansion – An expansion of contact gates at T2 is proposed to the south and will consist of 11 gates. The phasing of the south concourse expansion occurs in the near-term to provide swing gates for staging future terminal projects. This project was brought forward in previous LTP efforts and was approved in the 2013 Environmental Assessment (EA).
- Project 1-3: Taxiway Edge Geometry – The taxiway edge geometry project will remove the existing 90-degree edge of pavement corners at the ends of Taxiway R and Taxiway R10, Taxiway W and Taxiway W1, Taxiway K and Taxiway K1, and Taxiway L and Taxiway L1. Revising the edge of pavement from a 90-degree corner to a rounded corner makes the taxiway easier to see and distinguishes it from the runway for pilots on approach, reducing the chances of a wrong-surface landing.
- Project 1-4: Runway 12L-30R Partial Parallel Taxiway and Taxiway P3 Reconfiguration – Existing Taxiways P and Q are wingspan restricted for simultaneous use by ADG III aircraft. Taxiway Q must remain sterile when aircraft larger than ADG III occupy Taxiway P. A partial parallel taxiway north of Runway 12L-30R will allow unrestricted ADG IV and V aircraft access to or from the Runway 30R approach end with full design conformity to improve airfield efficiency.
- Project 1-5: Ground Runup Enclosure (GRE) Relocation and Remain-Overnight Apron Construction – The south expansion of T2 requires the existing GRE to be relocated while developing additional RON space for aircraft staging. This project is carried forward from the previous LTP efforts and was approved in the 2013 EA.
- Project 1-6: U.S. Postal Service (USPS) Site Redevelopment – This project provides replacement public parking to accommodate parking displaced during Green/Gold Ramp demolition in the mid-term. The USPS site redevelopment project will construct a new rental car QTA facility and public parking structure on the footprint of the existing USPS site.
- Project 1-7: Orange Ramp North Expansion and Outrigger Expansions – A new parking structure will connect directly to the existing Orange Ramp via pedestrian and vehicular bridges on each level. The east and LRT outriggers will be vertically expanded to match the maximum elevation of the existing structure The parking expansion at T2, in addition to the USPS site redevelopment, will bolster the Airport's parking capacity to enable the demolition of the Green/Gold Ramps.
- Project 1-8: Orange and Purple Ramps Vertical Expansion – The vertical expansion includes two levels of parking structure for the entire Orange Ramp footprint, including the north

expansion, and seven levels of parking structure for the Purple Ramp outrigger expansion. Expansion can occur on the existing ramp footprint.

- Project 1-9: T2 Curb Frontage Improvements – This project includes needed physical improvements to vehicle operations in front of T2, specifically addressing curb front congestion. It will reconfigure the second level of the existing terminal to accommodate a new 2-level roadway along the front of the building. This reconfiguration will allow for optimal use of both the upper and lower curbsides for originating and destination passengers, alleviating the increased traffic on the existing single-level curbside. This project also consists of the construction of the new elevated departures roadway and at-grade arrivals roadway at T2. The new roadways will address curbside deficiencies and will be offset from the terminal building to provide additional security clearances.

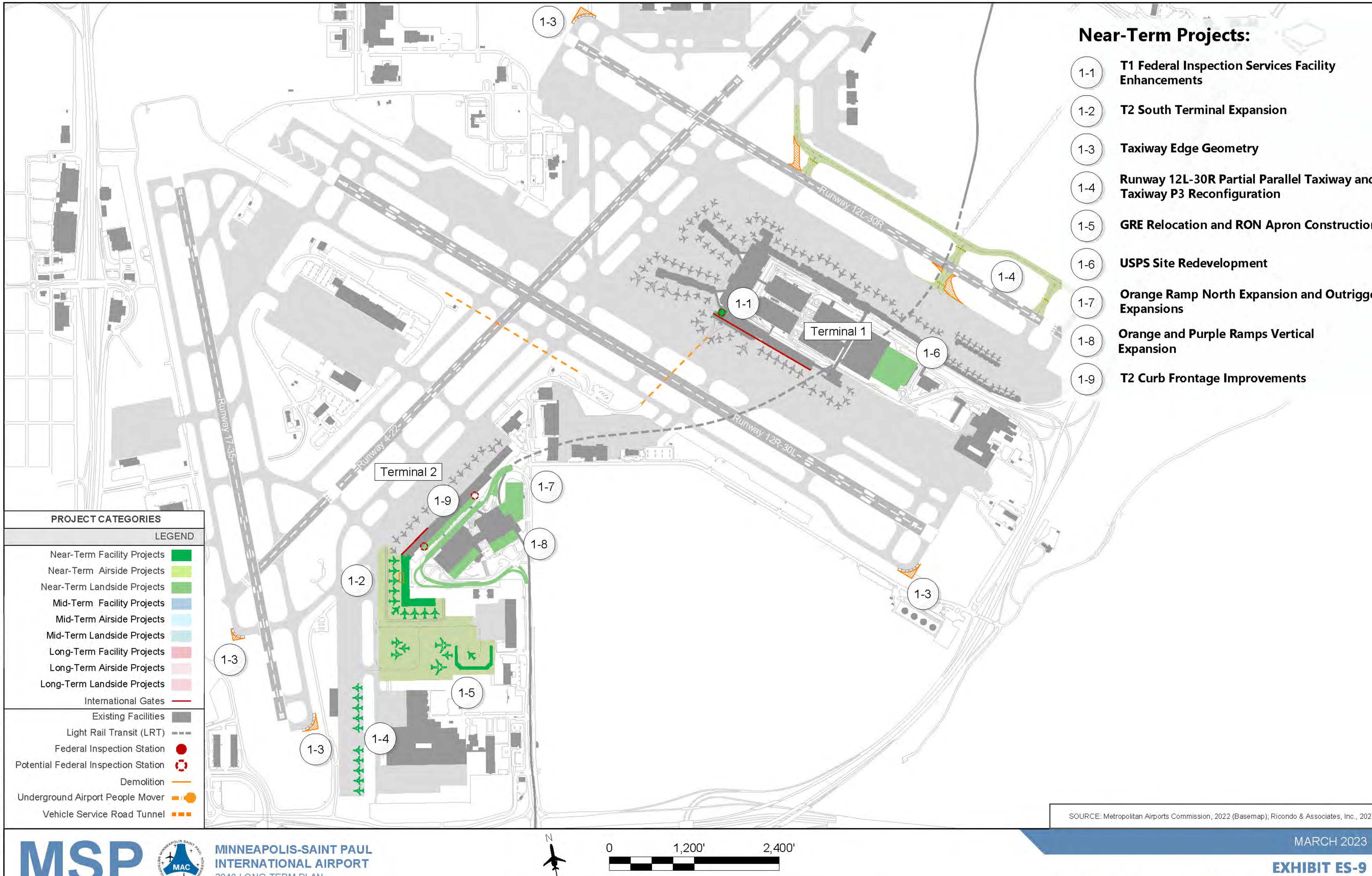

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EXHIBIT ES-9
Preferred Development Alternative 3.1A - Near-Term

1.1.7 Mid-Term

These projects are intended to meet mid-term demands and prepare for future long-term developments. Demands primarily include an increased need for contact gates for both domestic and international operations with expanded landside capacity to meet the additional demand.

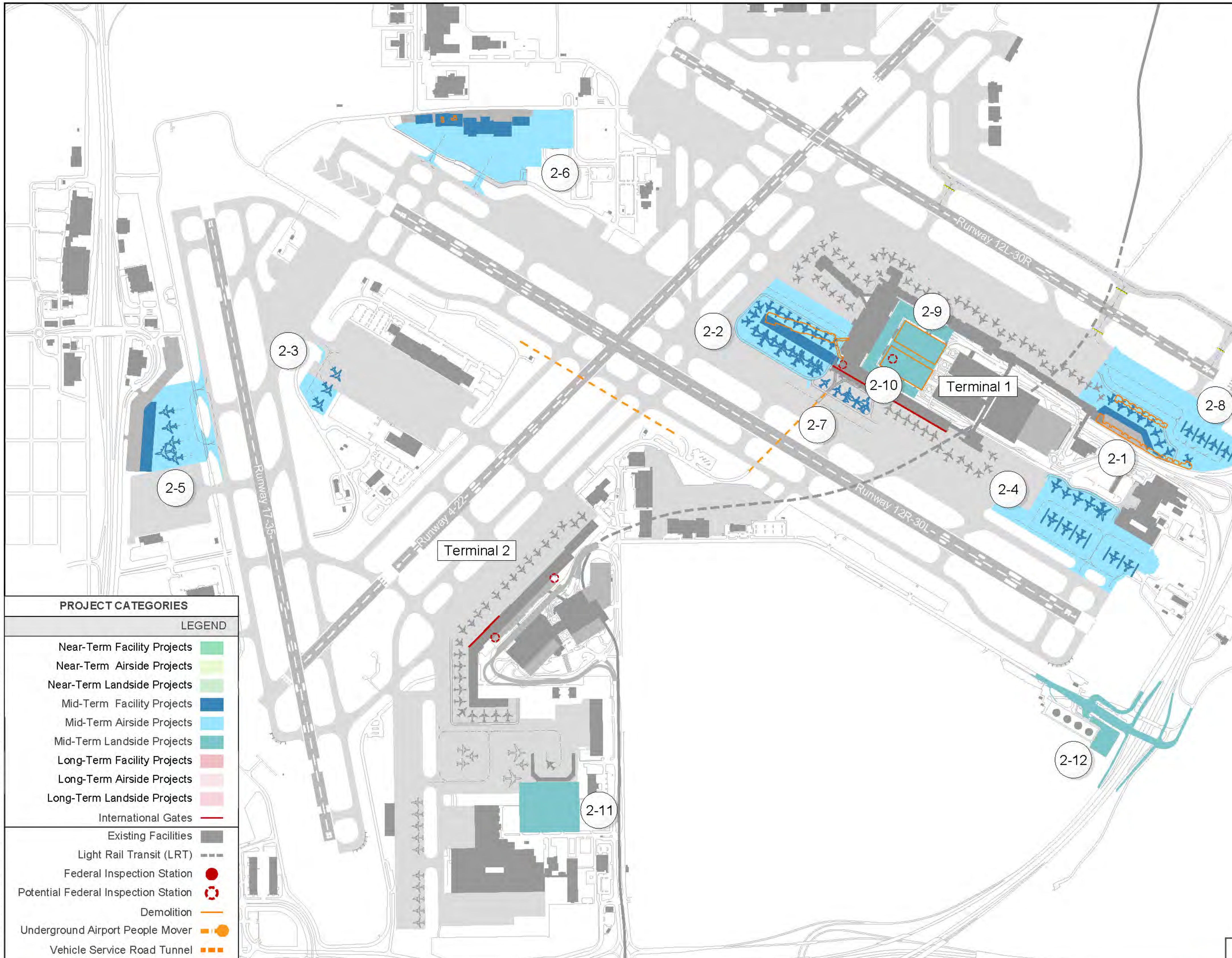
- Project 2-1: Reconstruct Concourse A; Demolish Concourse B – The new Concourse A is a single-loaded concourse consisting of 8 ADG III contact gates. The Concourse will replace the existing Concourse A/B complex, currently serving ADG II aircraft, which are under-sized.
- Project 2-2: Reconstruct Concourse F – The new Concourse F is a double-loaded concourse consisting of 19 ADG III contact gates. The reconstructed Concourse F provides 4 ADG V Multiple Aircraft Ramp System (MARS) gates capable of serving international flights. The redevelopment of Concourse F increases the existing gate count on the concourse by two gates. It also expands the number of gates capable of international arrivals to accommodate increased demand.
- Project 2-3: Central Cargo Apron Expansion – The Central Cargo Apron, specifically UPS apron, will be expanded to add two parking stalls.
- Project 2-4: Runway 30L Remain-Overnight Apron (RON) and Deice Pad Reconfiguration – The Runway 30L deice pad will be reconfigured to accommodate larger aircraft on the deice pad. The reconfiguration will make room for expanding the south end of Concourse G.
- Project 2-5: West Cargo Apron and Facility – This project will construct a new airfield apron, cargo warehouse and sort facility, and landside trailer docking and parking lot on the open lot north of the shared Amazon / DHL apron. The new apron and facilities will meet the anticipated cargo requirements for additional e-commerce cargo facilities.
- Project 2-6: Fixed Base Operator Relocation – To accommodate the north expansion of T2, the existing Fixed Base Operator (FBO) terminal and hangars will be relocated to the north side of the airfield, adjacent to Taxiway B. The new FBO is sized for in-kind replacement of existing facilities and is anticipated to meet long-term needs of the FBO (Signature Flight Support).
- Project 2-7: Runway 12R-30L Tunnel Reconstruction and Taxiway B Realignment – The Runway 12R-30L tunnel reconstruction and Taxiway B realignment project will increase airfield capacity and efficiency by extending the existing Vehicle Service Road (VSR) tunnel. The tunnel extension will allow for the alignment of Taxiway B as it crosses over the tunnel to be parallel to Taxiway A. The realignment of Taxiway B will allow aircraft to simultaneously taxi over the tunnel on Taxiway A and Taxiway B. This project is anticipated to occur concurrently with the reconstruction of Concourse F.
- Project 2-8: Runway 30R Deice Pad Reconfiguration – The Runway 30R deice pad reconfiguration will increase the capacity of the existing 30R deice pad by allowing up to four ADG III aircraft to be deiced at a time.
- Project 2-9: T1 Two-Level Roadway Reconstruction – The existing elevated departures and at-grade arrivals roadways will be reconstructed as the upper-level structure reaches the end

of life. The reconstructed inbound and outbound roadways will be compatible with the proposed Green/Gold Ramp redevelopment.

- Project 2-10: Green/Gold Ramp Redevelopment with New Federal Inspection Service (FIS) Facility – The ramps will be reconstructed as they near their end of useful life. The new structure will consist of a multi-use facility including parking, a centralized FIS facility, and MAC administrative space. The LTP recommends a preliminary design and alternative refinement project ahead of this project to validate a preferred layout as well as goals, objectives, and timeline of the reconstruction.

- Project 2-11: 34th Avenue Parking Development – This proposed concrete parking structure along 34th Avenue will serve as an employee parking facility for Delta employees. It will enable the proposed RON aircraft parking area adjacent to I-494 in the long-term project list.

- Project 2-12: TH 5 Interchange Reconstruction – A proposed new intersection for TH 5 and Post Road will improve capacity and intersection LOS. The geometry of the intersection included in the LTP is based on the work completed as part of the 2020 Improvements Environmental Assessment / Environmental Assessment Worksheet (EA/EAW).



Mid-Term Projects:

- **2-1** **Reconstruct Concourse A / Demolish Concourse B**
- **2-2** **Reconstruct Concourse F**
- **2-3** **Central Cargo Apron Expansion**
- **2-4** **Runway 30L RON Apron and Deice Pad Reconfiguration**
- **2-5** **West Cargo Apron and Facility**
- **2-6** **Fixed Base Operator Relocation**
- **2-7** **Runway 12R-30L Tunnel Reconstruction & Taxiway B Realignment**
- **2-8** **Runway 30R Deice Pad Reconfiguration**
- **2-9** **T1 Two-Level Roadway Reconstruction**
- **2-10** **Green/Gold Ramp Redevelopment with New Federal Inspection Services Facility**
- **2-11** **34th Avenue Parking Development**
- **2-12** **TH 5 Interchange Reconstruction**

SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Ricondo & Associates, Inc., 2022.

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EXHIBIT ES-10

Preferred Development Alternative 3.1A - Mid-Term

1.1.8 Long-Term

Long-term projects align with forecasted demand and prepare for future development beyond the 2040 LTP timeline. Forecasted demands primarily include an increased need for contact gates for both domestic and international operations, expanded landside capacity to meet additional demand, and increased connections between the two terminals to improve operational flexibility and enhance the passenger experience.

- Project 3-1: New T2 North Expansion – The expansion is a terminal extension consisting of nine ADG III contact gates north of the existing T2 footprint. This project will allow for current T2 carrier expansion and gates to accommodate reconstruction of T1 concourses. It is predicated on the relocation of the Signature FBO facilities to the north side of the MSP campus.

- Project 3-2: Concourse G South Expansion – The expansion includes seven ADG III contact gates. The phasing of the new concourse expansion occurs in the long-term to address the increasing demand of contact gates for aircraft operations.

- Project 3-3: Reconstruct Concourse E – The project includes 15 ADG III contact gates and is likely to result in Concourse E absorbing the existing Concourse D, which would trigger the need to rename the concourses in T1. This new concourse alignment creates additional airfield space between Concourse E and Concourse F, accommodating ADG III independent points of aircraft ingress and egress.

- Project 3-4: T1 to T2 Automated People Mover (APM) Tunnel Construction – A new APM tunnel from the headhouse of T1 will connect to the new north concourse on T2. The tunnel will allow for airside connectivity for passengers between the two terminals and increases the flexibility of the terminal for more efficient and connected operations.

- Project 3-5: Runway 4-22 Tunnel Reconfiguration and Deice Pad Construction – This project will increase deicing capabilities by adding an additional five ADG III deice positions north of the T2 north expansion. The positions may also be utilized as RON parking in non-deicing conditions.

- Project 3-6: South Remain-Overnight (RON) Apron Construction – The project will increase the Airport’s available RON parking. The RON apron will expand the apron capacity by approximately 1 million square feet.

- Project 3-7: Runway 12R End-Around Taxiway (EAT) Construction – The project will build a new taxiway around the approach end of Runway 12R, connecting Taxiway B to Taxiway K. The EAT will increase airfield capacity and safety by eliminating the crossing of Runway 12R-30L by aircraft landing or departing on Runway 17-35.

- Project 3-8: 34th Avenue and East 70th Street Reconstruction – This project consists of the reconstruction of the 34th Avenue and East 70th Street intersection to improve capacity. The intersection improvements would promote primary access to T2 facilities via Post Road. An elevated roadway across the intersection is recommended to reduce vehicle conflicts at the intersection.

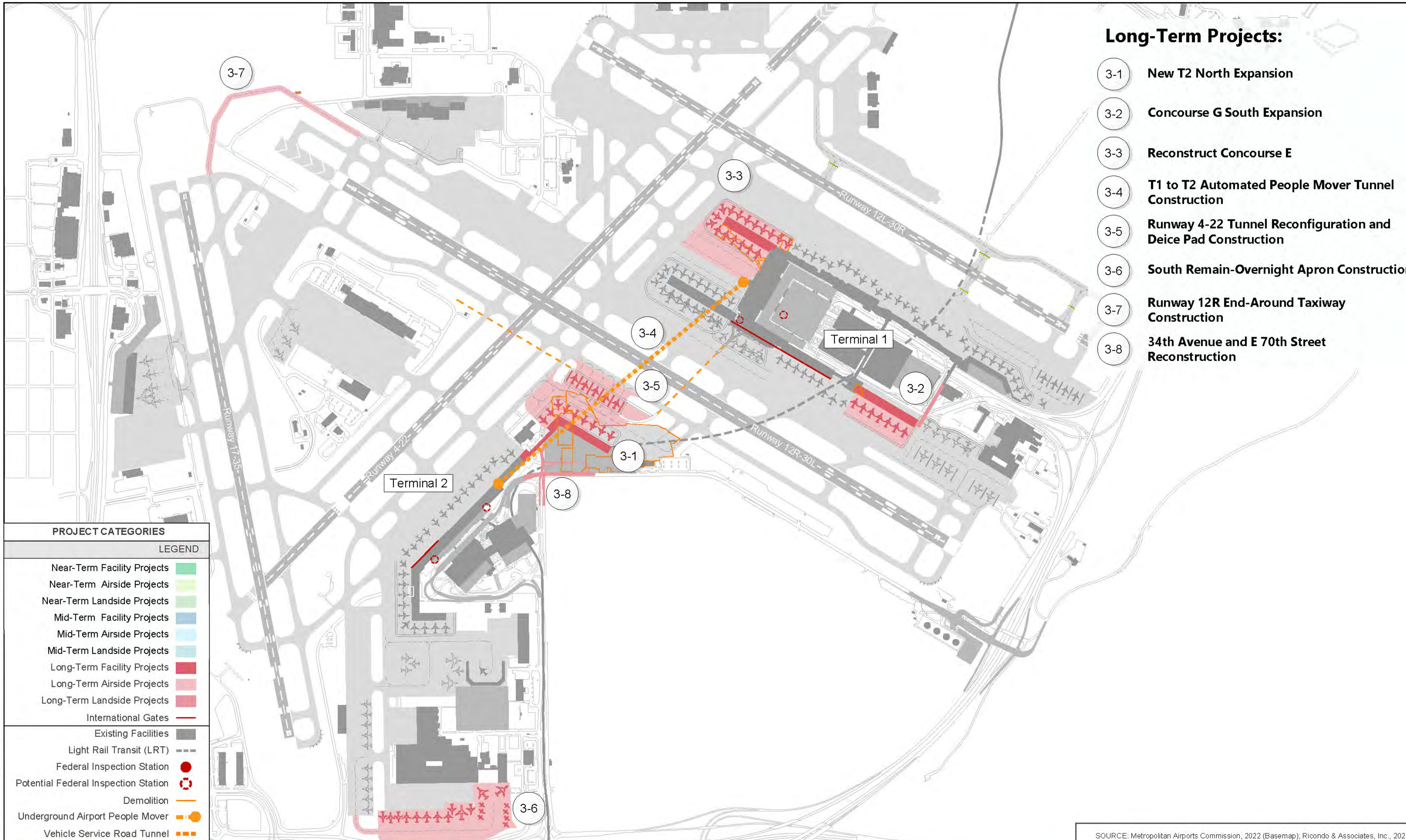

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EXHIBIT ES-11

Preferred Development Alternative 3.1A - Long-Term

ES 6. PROJECT COST ESTIMATES

The current work of the 2040 LTP included cost estimation based on the project phasing and priorities discussed in **Section ES 5**. As of Spring 2023, this work is in progress and will be included in the final LTP report as well as the final version of this executive summary.

ES 7. ENVIRONMENTAL OVERVIEW

The MAC has a longstanding commitment to creating a sustainable future. The MAC furthered this commitment in 2020 by setting the following 2030 goals:

- Reduce MSP's greenhouse gas emissions by 80%.
- Reduce MSP's water usage per passenger by 15%.
- Divert 75% of the Airport's waste away from landfills.
- Achieve a MAC employee engagement sustainability score of 85.

The MAC and airport stakeholders are working toward reaching these goals through a variety of means, such as reducing energy and CO2 emissions, achieving Level 2 in the Airport Carbon Accreditation program, diverting airport waste, reducing water consumption and climate resiliency planning.

Prior to any new construction identified in this plan, the MAC will complete an Environmental Assessment (EA) and/or an Environmental Assessment Worksheet (EAW) to meet Met Council guidelines and FAA requirements for utilizing Airport Improvement Program (AIP) grant funds. The environmental categories required for study prior to construction of the preferred development plan include noise, air quality, and water quality within the region surrounding the airport.

1.1.9 Aircraft Noise

The FAA's Aviation Environmental Design Tool (AEDT) was used to develop contours to evaluate potential aircraft noise impacts associated with the preferred development plan. To address the inherent uncertainty of developing a 20-year forecast of air traffic demand, three 2040 forecast scenarios were developed to evaluate the range of potential noise impact levels. These various scenarios create planning efficiencies and flexibility.

The 2040 Baseline Forecast is the expected outcome based on the preferred development plan and is the forecast contour used in the noise impact analysis. Forecast 2040 High and 2040 Low scenarios were also used to display a range of potential noise impact levels 20 years into the future.

The contours represent noise levels, expressed in the Day-Night Average Sound Level (DNL) metric. The FAA requires the DNL noise metric for determining and analyzing aircraft noise exposure to aid in the determination of aircraft noise and land use compatibility around U. S. airports.

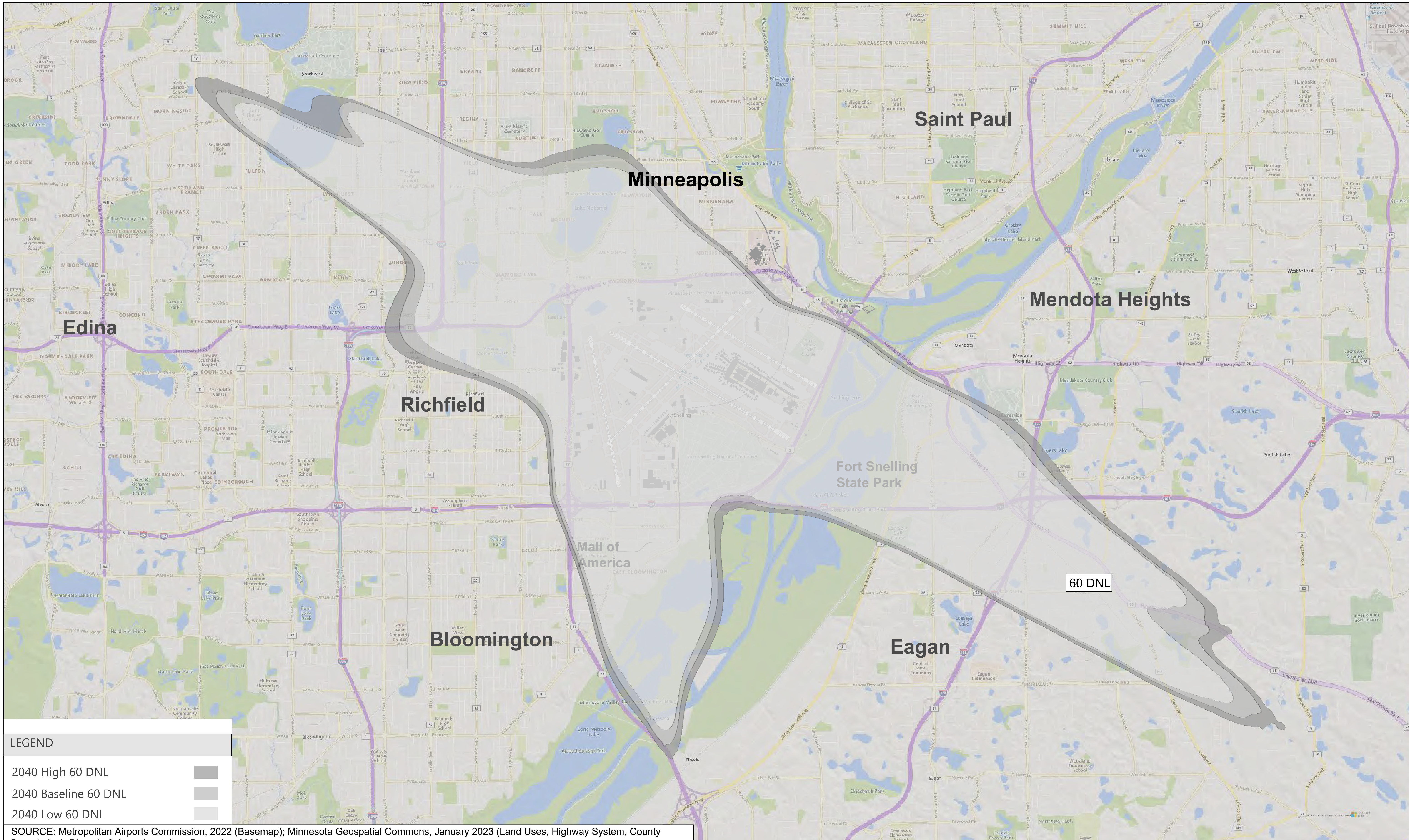
While the FAA considers residential structures incompatible within the 65 DNL noise contour, the MAC's noise mitigation program at MSP offers residential noise mitigation to the 60 DNL level. The 2040 forecast noise contours and analysis contained in this report do not qualify homes for the MAC's noise mitigation program. Eligibility for noise relief provided by the MAC is determined annually, based upon actual MSP noise contours developed for the preceding calendar year.

In summary, when the 2040 Baseline forecast, contours are compared to the 2018 Base Year contours:

- For the 60 DNL contour, the acreage contained with the contour increases by 39.9%. The 2040 Baseline Forecast 60 DNL contour contains 14,470 single-family homes and 4,234 multi-family units. More than 89% of these single-family homes and multi-family units have already been eligible for aircraft noise relief offered by the MAC's noise mitigation programs.

- For the 65 DNL contour, the acreage contained within the contour increases by 33.5%. The 2040 Baseline Forecast 65 DNL contour contains 2,421 single-family homes and 747 multi-family units. All single-family homes within the 65 DNL contour have already been eligible for the MAC's 5 dB noise reduction package. All multi-family units have already been eligible for aircraft noise relief offered by the MAC's noise mitigation programs.

A depiction of the noise contours from the three 2040 forecast scenarios is provided in **Exhibit ES-12**.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries); Ricondo & Associates, Inc., December 2022.

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EXHIBIT ES-12
2040 Forecast Scenario Contour Range

1.1.10 Air Quality

The current work of the 2040 LTP efforts has included a review of air quality, which is based on the previous 2013 EA efforts and related potential impacts from the 2040 preferred alternative. As of Spring 2023, this work is in progress and will be included in the final report of the LTP as well as the final version of this executive summary.

1.1.11 Sanitary Sewer and Water

The current work of the LTP effort has included a review of sanitary sewer and water, which is based on the previous 2013 EA efforts and related potential impacts from the 2040 preferred alternative impacts. As of Spring 2023, this work is in progress and will be included in the final report of the LTP as well as the final version of this executive summary.

Some of the key goals of the overall MAC sustainability efforts include:

- The goal for reducing the amount of water use on the campus. Upcoming projects to replace high-flow toilets and/or incorporate rainwater reuse for landscaping will help MAC attain its water reduction goal.
- Efforts to reduce the amount of solid waste sent to landfill is a key goal of the program. MAC is already incorporating waste reduction strategies into concession programs, including paper towel compactors in restrooms, compactors in trach cans within terminal spaces, expanding organics and recycling opportunities, and implementing compostable-only employee events.

1.1.12 Other Environmental Considerations

It is anticipated that most of the projects in the preferred development plan will require an environmental review process per federal National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA) requirements to identify the environmental footprint of the improvements more specifically before construction can begin. During that process, alternatives must be reviewed, and any potential impacts must be avoided if possible. If impacts cannot be avoided, they must be minimized to the extent possible and mitigated in full compliance with federal and state requirements.

The environmental review process cannot begin until there is a sufficiently detailed plan available to evaluate. The MAC will initiate the environmental review for the preferred development plan following the review by Metropolitan Council and formal adoption by the MAC Board. A full study of these environmental impact items at this time falls outside the scope of this long-term planning document.

ES 8. STAKEHOLDER AND PUBLIC ENGAGEMENT PROCESS

One of the goals established at the onset of the LTP was to include meaningful stakeholder engagement throughout the planning process. To fulfill this goal, a series of meetings, events and outreach activities have been conducted throughout the LTP development.

Engagement involved meeting with the public and stakeholder groups during the development of the draft LTP in order to present updates about the planning process and to discuss and consider public concerns and aspirations during the development of the LTP.

The meetings and events held during the development of the draft LTP are listed in Table **ES-8**.

Table ES-8: Meetings and Events Conducted During Draft LTP Development (1 of 2)

Audience	Materials Covered	Date	Location
MSP Noise Oversight Committee (NOC)	LTP Introduction, Goals, Process, Engagement Program and Schedule	3/20/2019	MAC
MSP NOC	LTP Engagement and Schedule	5/15/2019	MAC
MAC Planning, Development and Environment (PD&E) Committee	LTP Introduction, Goals, Process, Engagement Program and Schedule	6/3/2019	MSP
MSP Long-Term Plan Stakeholder Advisory Panel	LTP Introduction, Goals, Process, Engagement Program and Schedule	6/10/2019	Crowne Plaza, Bloomington
MSP NOC	LTP Engagement and Schedule	7/17/2019	MAC
MSP Long-Term Plan Stakeholder Advisory Panel	Aviation Activity Forecast Overview, Capacity Study, Review Stakeholder and Public Input	8/27/2019	InterContinental MSP Airport
MAC PD&E Committee	Aviation Activity Forecasts	9/3/2019	MSP
Minneapolis Intergovernmental Relations Committee	LTP Introduction, Goals, Process, Engagement Program, Existing Conditions, Aviation Activity Forecasts and Capacity Study	9/25/2019	Minneapolis City Hall
Public Experience MSP Event #1	LTP Introduction, Goals, Process, Engagement Program, Existing Conditions and Aviation Activity Forecasts	10/2/2019	Mall of America Executive Center
Minneapolis City Council and Staff Meeting	Aviation Activity Forecasts and Capacity Study	10/18/2019	Minneapolis City Hall
MSP Long-Term Plan Stakeholder Advisory Panel	Aviation Activity Forecasts, Capacity Study, Review Stakeholder and Public Input	1/30/2020	Crowne Plaza, Bloomington
Pause in the LTP process due to the COVID-19 pandemic			

Source: Metropolitan Airports Commission (MAC)

Table ES-8: Meetings and Events Conducted During Draft LTP Development (2 of 2)

Audience	Materials Covered	Date	Location
Pause in the LTP process due to the COVID-19 pandemic			
MSP NOC	Aviation Activity Forecast Update and LTP Schedule	11/10/2021	Virtual
MAC PD&E Committee	Aviation Activity Forecast Update and LTP Schedule	12/6/2021	MSP
MSP Long-Term Plan Stakeholder Advisory Panel	COVID-19 Airport Impacts, Aviation Activity Forecast Update and LTP Schedule	12/10/2021	Virtual
MSP NOC	LTP Process, Engagement Program and Schedule	3/16/2022	Virtual
Public Experience MSP Event #2	LTP Goals, Process, Existing Conditions, Aviation Activity Forecast Update and Capacity Study	4/12/2022	Virtual
MSP Long-Term Plan Stakeholder Advisory Panel	LTP Process, Engagement Program, Facility Requirements Overview and Preliminary Alternatives Review	8/4/2022	Bloomington CVB and Virtual
Public Experience MSP Event #3	Facility Requirements and Alternatives Review	8/23/2022	MAC
MAC PD&E Committee	LTP Process, Engagement Program, Facility Requirements, Alternatives Review and Preferred Alternative	2/6/2023	MSP
MSP NOC	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Aircraft Noise Analysis	3/15/2023	MAC
City of Minneapolis Airport Working Group	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Aircraft Noise Analysis	4/12/2023	Virtual
MSP Long-Term Plan Stakeholder Advisory Panel	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Aircraft Noise Analysis	4/13/2023	Crowne Plaza, Bloomington and Virtual
Metropolitan Council Technical Advisory Committee	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	5/3/2023	Metropolitan Council
Metropolitan Council TAC Planning Sub-Committee	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	5/11/2023	Virtual
Metropolitan Council Transportation Advisory Board	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	5/17/2023	Metropolitan Council
MAC PD&E Committee	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	6/6/2023	MSP
Public Experience MSP Event #4	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	7/11/23	Sabathani Community Center

Source: Metropolitan Airports Commission (MAC)

A 60-day public comment period began on June 21, 2023 and ended on August 21, 2023. In total, 139 public comments were received and ranged in a variety of topics, of which the pronounced areas of public comments included noise, terminal, landside, and MAC communications.

The noise comments were largely comprised of complaints regarding existing aircraft noise, as well as the concern for aircraft noise for future aircraft operations. As the primary focus of the MSP 2040 LTP remains with terminal function and footprint, the MAC will continue its long history of collaborating with stakeholders, including neighboring communities, to reduce noise. There are existing noise abatement procedures air traffic control will continue to utilize in reducing noise over residential areas when feasible, as well as continue to implement eligible homes with sound insulation mitigation. To-date, the sound insulation program has invested over $500 million in communities that surround the airport.

The terminal comments focused on passenger connectivity and the promotion of connecting passengers between T1 and T2 from the secure-side of the airport. Other topics included the notion of an undersized Federal Inspection Service (FIS) facility in T1, passenger connection times for connecting passengers in T1, and the request to add moving walkways in the terminals where they do not exist today.

Landside public comments focused on the need for curbfront improvements required in front of both T1 and T2 and acknowledged the need to reduce vehicle congestion. There were a couple of comments regarding the existing Metro Transit Light Rail (LRT) connection between both terminals and the need for increased safety, however the MAC has been partnering with LRT police and the City of Bloomington police department in an effort to improve LRT safety concerns. Electrical vehicles (Evs) were commented on, though the LTP acknowledges the emerging nature of this topic and MAC's desire to continue evolving landside services available. **Table ES-9** summarizes the number of comments by each category.

Table ES-9: Public Comments: Summary of Topics

Comment Category	Number of Comments	Percent of Total
Airline Relations	2	1%
Airside	6	4%
Environmental	9	6%
Indiscernible	6	4%
Landside	15	11%
MAC Communications	11	8%
Noise	69	50%
Terminal	21	15%
TOTAL	139	100%

Source: Metropolitan Airports Commission (MAC)

After reviewing the body of public comments, MAC staff has affirmed its position that the proposed preferred development alternative represents a reasonable, practical and cost-effective way to address the stated planning goals.

The Final Draft 2040 MSP LTP narrative report was submitted to the Metropolitan Council for review in January 2024. Under MS 473.165 and MS 473.611, the Metropolitan Council reviews long term comprehensive plans for each airport owned and operated by the MAC. The Council reviews and comments on all plans for consistency with the metropolitan development guide including Thrive MSP 2040 and the Transportation Policy Plan. The Full Metropolitan Council provided its determination of consistency on March 27, 2024.

The MAC Board voted to formally adopt the MSP 2040 LTP on May 20, 2024.

Chapter 1. Inventory

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Chapter 1 Inventory

1.1 INTRODUCTION

Minneapolis–Saint Paul International Airport (MSP or the Airport) is a commercial service airport that supports the Minneapolis–Saint Paul metropolitan area. MSP is located south of downtown Minneapolis, Minnesota, and southwest of downtown Saint Paul. The Airport property covers approximately 3,400 acres. The Airport is owned and operated by the Metropolitan Airports Commission (MAC). The MAC also operates six general aviation (GA) airports in the Twin Cities region: Airlake Airport (LVN), Anoka County–Blaine Airport (ANE), Crystal Airport (MIC), Flying Cloud Airport (FCM), Lake Elmo Airport (21D), and Saint Paul Downtown Airport (STP). **Exhibit 1-1** shows the location of MSP and the other airports comprising the MAC system.

As of 2019, the last full year before the pandemic, MSP ranked as the 16th busiest airport in the United States in terms of passengers, with 12.2 million enplaned passengers (passenger boardings). Additionally, it ranked as the 29th largest cargo airport in the United States, handling approximately 229,000 metric tons of air cargo. Also in 2019, approximately 406,000 aircraft operations (takeoffs or landings) occurred at the Airport.

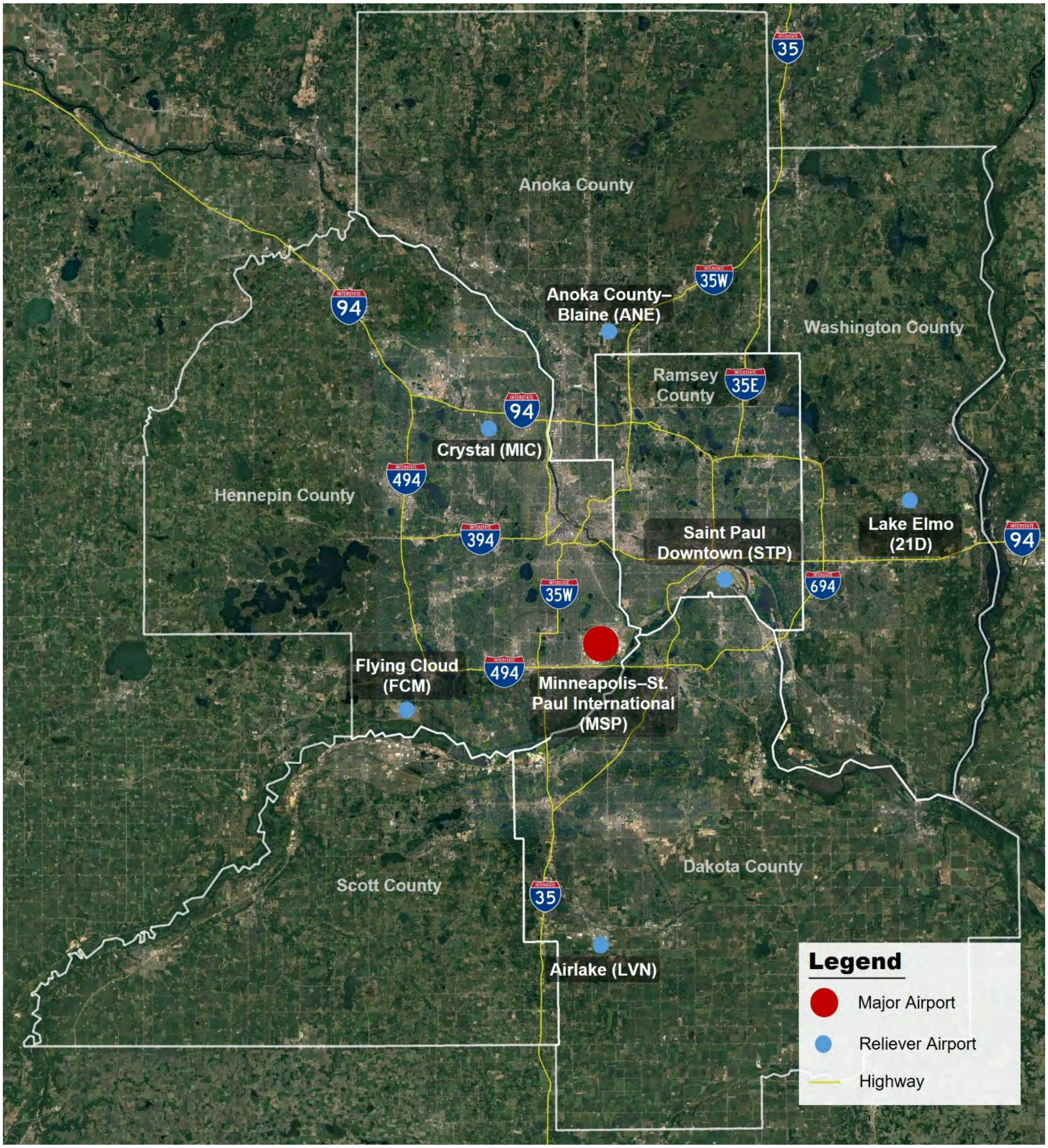
The MAC commenced a revision of the Long-Term Plan (LTP) in 2019. The LTP is an effort to update the findings of the previous 2030 Long-Term Plan (2030 LTP) and adapt them to the changes in the Airport's existing and future needs. The 2030 LTP, completed in 2010, recommended the reassignment of airlines between Terminal 1 (T1) and Terminal 2 (T2) to balance passenger demand and improve efficiency and customer service of both facilities through 2030. The 2030 LTP recommended utilizing T1 to accommodate Delta Air Lines (Delta) and its partner airlines while relocating all other airlines to T2. Specific terminal capital programs were recommended based on this terminal reassignment. Chapter 4 discusses the major elements that comprised the 2030 LTP.

The 2040 Long-Term Plan (2040 LTP or the report) provides a blueprint for the long-range infrastructure development necessary to accommodate the growth in commercial aviation demand at MSP through 2040, while prioritizing safety, efficiency, and environmental sustainability. The 2040 LTP addresses the Airport's commercial air passenger terminal, airfield, and landside facility requirements to maintain an acceptable level of service (LOS). The purpose of the 2040 LTP is to update the recommended capital improvements proposed in the MSP 2030 LTP using updated aviation forecasts, industry trends, and stakeholder expectations.

Due to changes brought on by the COVID-19 pandemic, the 2040 LTP was split into two phases. The first phase of development for the 2040 LTP involved conducting a survey of existing Airport infrastructure; assessing the capacity of the current gate and Airport facilities; developing the aircraft and passenger demand forecasts; conducting the passenger facility gap analysis; determining the gating requirements; and identifying the carrier alignment scenarios for each terminal.

The first phase was completed in July 2020, but the forecasts could not account for the potential effects of widespread disruptions in air service due to the COVID-19 pandemic. The MAC paused the 2040 LTP effort in 2020 for approximately 15-months because of the pandemic.

Exhibit 1-1: Metropolitan Airports Commission – Airport System



SOURCES: Google Earth, 2022 (aerial image); Metropolitan Airports Commission, 2022.

In October 2021, the MAC initiated the second phase of the 2040 LTP. The forecasts were updated to incorporate COVID-19 pandemic impacts on aviation demand. The second phase of the study included:

- Revising the demand forecast to account for changes resulting from the pandemic
- Estimating the long-term (2040) infrastructure needs, with planning activity level (PAL) evaluation points for the short-term and mid-term periods
- Evaluating potential development options
- Selecting a preferred plan
- Outlining a general timeline for implementing expansion projects at the near-, mid-, and long-term points throughout the planning horizon

1.2 NEED FOR LONG-TERM PLAN

The Metropolitan Council (Met Council) is the regional policymaking body, planning agency, and provider of essential services in the Twin Cities metro area. The Met Council adopted guidelines that require regular updates to the LTP to integrate pertinent information regarding the planning, development, and operation of the region's airports for compatibility with the surrounding areas. The primary objectives for the LTP are the following:

- **Objective 1:** Plan for future facilities that will meet forecast PALs in a manner that maintains and enhances customer service, while facilitating a seamless "one-journey" experience.
- **Objective 2:** Produce a development plan that positions the MAC to meet future demand levels, enhances financial strength, leverages environmental stewardship, and infuses sustainable thinking.
- **Objective 3:** Conduct the planning process in a manner that includes meaningful stakeholder engagement processes.

The purpose of the 2040 LTP is to address the three primary objectives. Objective 1 is addressed through the analysis of existing conditions and exploring options for optimizing and expanding Airport facilities, while creating a more convenient experience for passengers traveling through the Airport. As passenger demand grows at MSP, existing Airport facilities may not meet future demand or an acceptable LOS. **Exhibit 1-2** highlights curbside congestion at T2, which is a key concern, among others, that is discussed throughout this report. The 2040 LTP addresses customer LOS while ensuring that future facilities align with forecasted PALs.

Objective 2 is met by creating a plan that enables the MAC to achieve sustainable growth in a financially feasible manner. This plan integrates past and current studies into a framework, ensuring that growth from various infrastructure improvements does not conflict with the overall development and environmental stewardship of the Airport. The plan balances demand projections with financially viable development while retaining a robust environmental sustainability strategy.

Objective 3 is addressed by the framework developed by the Stakeholder Advisory Panel (panel). The framework is structured to receive information about the planning process and communicate public concerns and aspirations to the MAC through a series of public workshops. The panel has developed an engagement process that includes representation of a broad range of stakeholders. The stakeholders involved include airport tenants, passengers, public partners, local communities, regional businesses, and tourism associations.

Exhibit 1-2: T2 Curbside Congestion

SOURCE: HNTB, *Minneapolis–Saint Paul International Airport 2020 Improvements Environmental Assessment / Environmental Assessment Worksheet*, 2013

1.3 AIRPORT HISTORY

In 1915, the original 350 acres of Airport land were purchased for the Twin City Motor Speedway, a 2-mile motor derby racetrack loop. After 2 years of racing, the property was unused for several years, until the Twin City Aero Corporation acquired the property for development of a local airport. By 1920, the Airport was named Speedway Field and was fully developed with a landing field and hangar for airmail. In 1923, Speedway Field was renamed to Wold-Chamberlain Field after Minnesotans Ernest Wold and Cyrus Chamberlain, whose lives were taken in World War I. After the Minneapolis Park Board purchased the airfield in 1928 for $165,000, it was renamed the Minneapolis Municipal Airport, and the original concrete track was demolished for future expansion opportunities. The first passenger service flights began in 1929.

Throughout the 1930s, Airport facilities and services continued to grow and expand. To manage the growing Airport, the Minnesota Legislature established the MAC in 1943. In 1948, the Airport was renamed as the Minneapolis–Saint Paul International Airport / Wold-Chamberlain Field, and in 1958 construction began on the current T1 building. The 600,000-square-foot structure, housing 24 gates on 2 concourses, began operations in 1962. Originally, the terminal was forecast to serve approximately 4 million passengers per year by 1975. However, the estimated passenger growth drastically exceeded the original forecasts, with the Airport serving more than 4.1 million people by 1967. Passenger growth continued at an exponential rate throughout the 1970s and 1980s. To accommodate the exponential growth, the Minnesota Legislature passed the

Metropolitan Airport Planning Act in 1989, which ultimately established the Dual Track Airport Planning Process. Managed by the MAC and the Met Council, the almost seven-year planning process analyzed various options for either providing adequate air service capacity and facilities within the region or building a new airport to meet the demand.

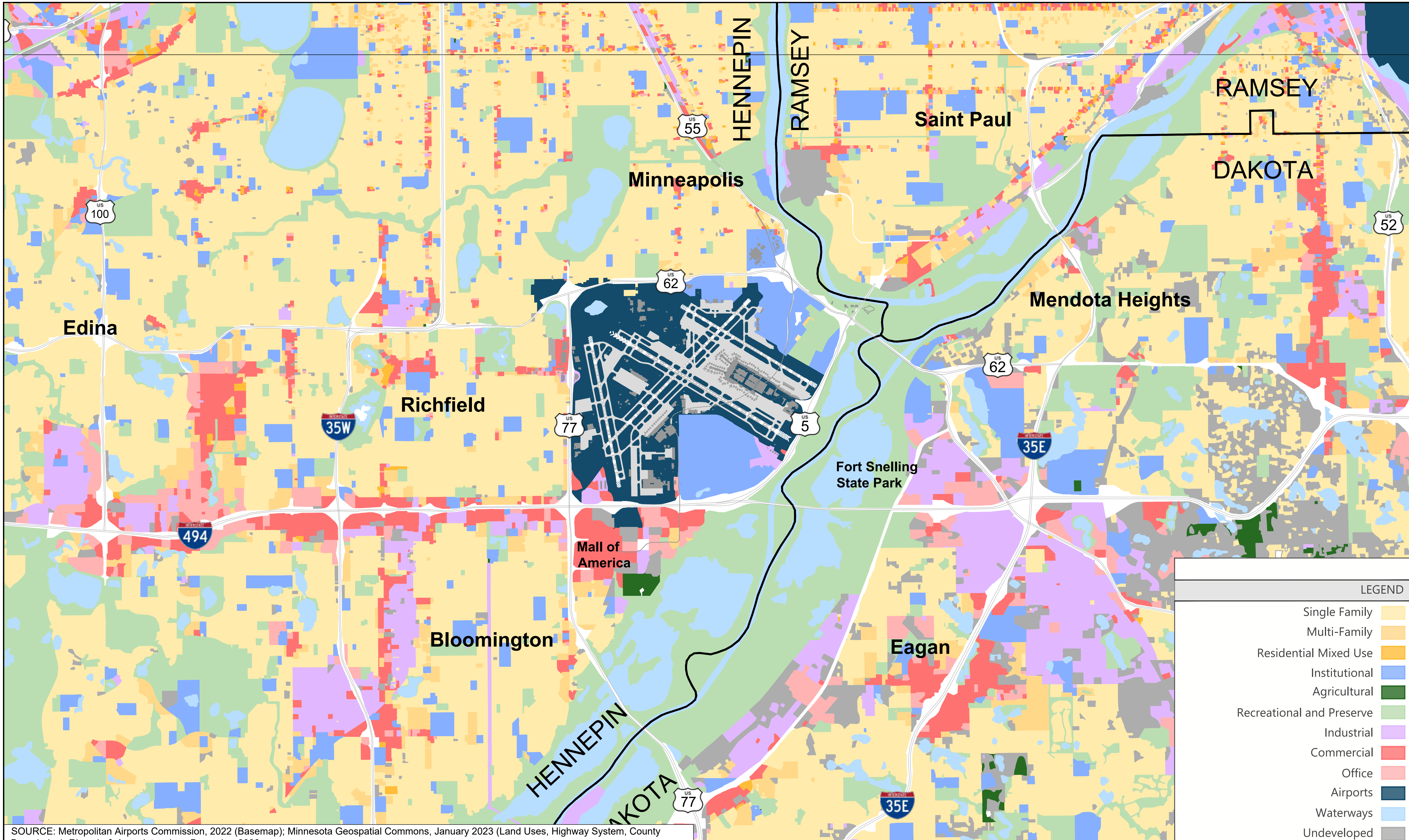
After completion of the analysis and a formal submission of recommendations to the Minnesota Legislature in 1996, legislation was passed by both the House and Senate on April 2, 1996, and signed by Governor Arne Carlson. The MAC thus ceased further study of a new airport development and implemented the MSP 2010 LTP. The LTP included more than an estimated $3.1 billion in Airport developments and improvements for gates, automobile parking, rental car facilities, and a new runway, Runway 17-35, opened in 2005 because of the 2010 LTP.

1.4 AIRPORT SETTING

MSP is in an urban area between Minneapolis and Saint Paul, Minnesota; it is surrounded by the suburban cities of Bloomington, Eagan, Mendota Heights, and Richfield. Minneapolis is located to the northwest, Saint Paul is located to the northeast, Bloomington is located to the southwest, Eagan is located to the southeast, Mendota Heights is located directly east, and Richfield is located directly west of MSP. **Exhibit 1-3** depicts these cities, as well as the associated counties, highway systems, and land use categories surrounding MSP. According to the U.S. Census Bureau, the total population of Minneapolis, St. Paul, Bloomington, Eagan, Mendota Heights, and Richfield was estimated to be approximately 950,000 in 2020. The entire region's population as of 2020 was approximately 3.2 million.

1.4.1 Surrounding Land Use

MSP is in Hennepin County, with Ramsey and Dakota counties directly east; the Airport is nestled among the six cities, although it is not technically part of any municipality. The Airport is in an urbanized area, and the majority of land surrounding MSP is developed by the adjacent municipalities. Highways 62, 77, 5, and Interstate 494 (I-494) follow the perimeter of the airport property. As reviewed on **Exhibit 1-3**, the land surrounding MSP includes residential, industrial, institutional, commercial, agricultural, recreational, and other uses. Land to the west and northwest of the Airport is primarily residential use, and land to the south and east consists primarily of a mix of commercial, industrial, and recreational land use, with pockets of residential use throughout. A band of recreational and reserve areas that include waters and wetlands follow along the southeast perimeter of the Airport boundary. The Mall of America is located adjacent to the southwest corner of MSP. Land uses within the southeast flight patterns for the primary Runways 12L-30R and 12R-30L are predominantly commercial, industrial, recreational, and preserve areas. Land uses within the northeast flight patterns for the primary runways consist largely of residential, recreational, and preserve areas. Land uses within the southern flight pattern for Runway 17-35 consists primarily of commercial, office, Mall of America, recreational, and preserve areas. Land uses within the northern flight pattern for Runway 17-35 consist of residential, recreational, and preserve areas.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries); Ricondo & Associates, Inc., December 2022.

MSP
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EXHIBIT 1-3
Land Use

1.4.2 Airspace

The National Airspace System (NAS) is the network of U.S. airspace, which includes navigation facilities, equipment, procedures, airports, and air traffic controllers. The NAS provides for the safe and efficient flow of aircraft in and out of airports across the country. The NAS is divided into classes of airspace (Classes A through G) that differ based on flight rules and interaction with air traffic control (ATC). The classification of airspace above the Airport is Class B, which extends from the surface up to 10,000 feet mean sea level (MSL).

The airspace in the Minneapolis–Saint Paul area falls under the jurisdiction of the following entities: the Minneapolis Air Route Traffic Control Center (ARTCC), Minneapolis Terminal Radar Approach Control (TRACON), and the MSP Air Traffic Control Tower (ATCT).

- **Minneapolis ARTCC** – The airspace over the continental United States is divided into 20 geographically defined ATC jurisdictions based on the ARTCCs, which provide radar service and other ATC services to enroute aircraft (i.e., those aircraft that are not landing or taking off). The Minneapolis ARTCC has jurisdiction of enroute traffic over portions of Minnesota, South Dakota, North Dakota, Wisconsin, Michigan, Nebraska, Kansas, Iowa, and Missouri.

- **Minneapolis TRACON** – The TRACON provides radar approach and departure control as well as other ATC services to aircraft flying in terminal area airspace. Jurisdiction over airspace in the Minneapolis–Saint Paul region is given to the Minneapolis TRACON.

- **MSP ATCT** – The ATCT provides ATC services to aircraft at and in the immediate vicinity of an airport, ensuring the safe and efficient flow of aircraft. Controllers are responsible for separating aircraft in the air or on the ground, in addition to providing weather information and route clearance to pilots. The ATCT at MSP is located between Runways 12R-30L and 12L-30R in the northeast quadrant of the Airport, adjacent to Taxiway J. The ATCT cab has a floor-level elevation of 965 feet MSL.

1.5 INVENTORY OF EXISTING FACILITIES

1.5.1 Overview

This section describes the inventory of existing facilities at MSP, which comprises the airfield, terminal, and landside facilities, including cargo, GA, and support facilities. Airfield facilities in this inventory include those that directly support aircraft operations, such as the runways, taxiways, aprons, remain-overnight (RON) parking, deicing pads, airspace, and navigational aids (NAVAIDs). Terminal facilities include all passenger-related facilities such as check-in, security, holdrooms, baggage handling and screening, international arrivals, and baggage claim. Landside facilities encompass facilities related to roadways, curbsides, parking, and other ground transportation functions.

1.5.2 Landside Inventory

Landside facilities directly serving MSP passengers and visitors include terminal area roadways, terminal curbsides, parking facilities, rental car facilities, and commercial ground transportation areas. These are shown for the Airport campus, T1, and T2 on **Exhibits 1-4**, **1-5**, and **1-6**, respectively.

1.5.2.1 Terminal Area Access and Egress

The Airport is surrounded by a highway network. State highways 5 and 77 (MN-5 and MN-77) lie directly to the east and west of the Airport, respectively. State Highway 62 (MN-62) and I-494 run along the north and south borders of the Airport, respectively. **Exhibit 1-1** illustrates the overall Airport campus layout relative to the regional roadway network.

The primary access and egress to T1 is provided via MN-5 and Glumack Drive. Glumack Drive is a one-way, continuous loop roadway that provides access and egress for the terminal area facilities, including the parking ramps, Ground Transportation Center (GTC), Rental Car Center, and the terminal curbsides. The T1 landside also houses a post office and hotel, which are accessible from Glumack Drive or Northwest Drive. All deliveries to the Airport use Northwest Drive.

T2 is accessed from I-494 and 34th Avenue South, and it egresses via 72nd Street. Humphrey Drive is a one-way, continuous loop roadway around the primary T2 facilities that provides access and egress for the terminal area facilities.

1.5.2.2 Terminal Curbside Facilities

Glumack Drive in front of the T1 passenger terminal is divided into an upper- and lower-level roadway. The upper-level roadway curbside provides drop-off space for originating passengers (departures) and some commercial vehicle operations. The west upper-level roadway supplies 830 linear feet of departures curbside. The west lower-level roadway provides 700 linear feet of pick-up space for terminating passengers (arrivals).

Humphrey Drive in front of T2 provides 1,200 linear feet of curbside, a shared area for drop-off space for originating passengers (departures), and pick-up space for terminating passengers (arrivals).

1.5.2.3 Parking

The Airport provides parking spaces in nine parking ramps distributed between T1 and T2. The parking ramps also include rental car facilities at both terminals. **Table 1-1** summarizes the existing parking supply for each parking facility and its estimated end of life.

T1 has five parking ramps: the Gold Ramp, Green Ramp, Red Ramp, Blue Ramp, and Silver Ramp (shown on **Exhibit 1-6**). The parking facilities are connected to T1 with an underground walkway area and/or the Hub Tram. Valet parking is available, for which vehicles are stored underneath the terminal building. An additional remote parking ramp for T1, the Quick Ride Ramp, is located on Northwest Drive and is served by a shuttle service that picks up and drops off at T1.

T2 has two parking ramps (shown on **Exhibit 1-7**): the Orange Ramp and Purple Ramp. The parking facilities are connected to T2 with an elevated skyway and an at-grade crosswalk.

A cell phone lot, containing approximately 40 stalls, is located on Post Road between the two terminals. Additionally, four off-Airport parking operators provide approximately 6,000 additional stalls with shuttle service to the Airport. Existing off-Airport parking providers include Park ‘N Go, Park ‘N Fly, EZ Air Park, and Shepard Road Airport Parking. Park ‘N Go and Park ‘N Fly are located nearest to the Airport, in the city of Bloomington. Delta currently provides employee parking in lots accessed from 34th Avenue; Delta employee parking requirements are not included in this report.

Table 1-1: Existing Parking Facilities

Facility	Estimated End of Life	Spaces
T1	--	**16,795**
Valet Garage	--	389
Gold/Brown Ramp (Levels 1–7)	2029	3,721
Green/Pink Ramp (Levels 1, M, 2–7)	2039	3,835
Blue Ramp (Levels 4–9)[1,2]	2075	2,650
Red Ramp (Levels 4-9)[1,2]	2075	2,806
Silver Ramp (Levels 6–11)[3,4]	2095	3,394
Quick Ride Ramp (Levels 1–2)	2075	**1,704**
T2	--	**8,716**
Orange Ramp (Levels 1, M, 2–8)	2085	4,668
Purple Ramp (Levels 2–8)[5]	2075	4,002
Employee Parking Surface Lot	--	46
Total	**--**	**27,215**

NOTES:
1 Does not include Blue and Red Ramps Level 1. This level is occupied by rental car quick turnaround operations.
2 Does not include approximately 1,700 proposed parking stalls on the Blue and Red Ramps Levels 2 and 3. These levels were vacated by rental car companies in 2020.
3 Does not include Silver Ramp Level 1. This level is occupied by the Transit Center and is used for commercial ground transportation operations.
4 Does not include Silver Ramp Levels 2 through 5. These levels are occupied by rental car companies for ready/return operations.
5 Does not include Purple Ramp Level 1. This level is used for commercial ground transportation operations.
SOURCE: Kimley-Horn and Associates, Inc., 2021.

Additional employee parking lots are distributed across the Airport to serve individual operations, including the MAC General Office, MAC Trades, GA, cargo, and the ATCT. Available parking stalls for these discrete operations are not included in this report.

1.5.2.4 Rental Car Facilities

Each terminal has its own set of rental car facilities in proximity. **Table 1-2** summarizes the existing rental car facilities. The customer service building (CSB) at T1 is located on Level 1 of the Silver Ramp. The Silver Ramp also houses the T1 ready/return area on Levels 2 through 5. The rental car facilities in the Silver Ramp are accessed via the Hub Tram and underground walkways. The T1 quick turnaround (QTA) facilities are located on Level 1 of the Red and Blue Ramps.

The T2 customer service operations and ready/return area occupy a portion of Level 1 and the Mezzanine Level of the Purple Ramp. The QTA facility is located on the south side of East 72nd Street near the Purple and Orange Ramps.

Table 1-2: Existing Rental Car Facilities

Facility	T1	T2	Total
Customer Service			
Customer Service Counter Positions	48	29	77
Ready / Return Stalls	2,050	665	2,715
Quick Turnaround			
Fueling Positions	76	24	100
Car Wash Bays	12	8	20
Vehicle Storage (Stacking Positions)	575	685	1,260

SOURCE: Kimley-Horn and Associates, Inc., 2021.

1.5.2.5 Commercial Ground Transportation

Commercial operators at MSP include taxis, limousines, transportation network companies (TNCs), Airport-operated shuttles, private shuttles, buses, and public transit. **Table 1-3** summarizes the existing supply for commercial ground transportation facilities.

Ground transportation functions at T1 occur at the GTC and the Transit Center. The GTC provides direct access to the east upper-level roadway and the east lower-level roadway. This area serves taxis, TNCs, limousines, Quick Ride Ramp shuttles, and various hotel and regional shuttles. The Transit Center, located on Level 1 of the Silver Ramp, serves charter buses, employee shuttles, Metro Transit buses, and off-site rental car and parking shuttles.

T2 has a similar mix of commercial ground transportation operators, which are consolidated on Level 1 of the Purple Ramp. Dedicated parking areas on Post Road provide additional space, approximately 503 stalls, for commercial vehicle staging. The locations for the various ground transportation holding lots are noted on **Exhibit 1-5**.

Table 1-3: Existing Commercial Ground Transportation Facilities

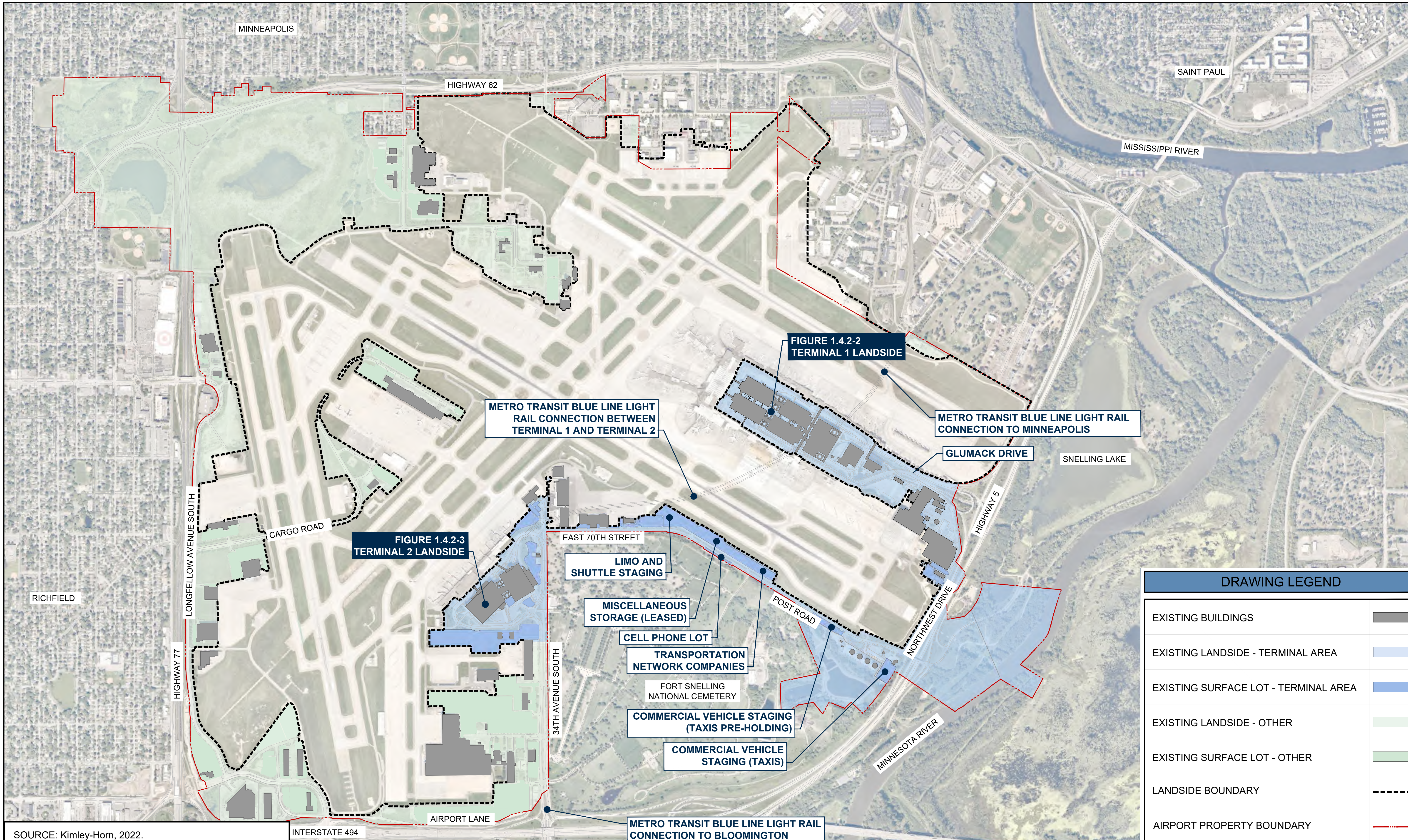
Facility	Number of Positions
T1	**133**
TNCs/Taxis/Limos	97
Shuttles	27
Buses	9
T2	**55**
TNCs/Taxis/Limos	29
Shuttles	21
Buses	5
Total	**188**

NOTE: TNC – Transportation Network Company
SOURCE: Kimley-Horn and Associates, Inc., 2021.

1.5.2.6 Transit and Multimodal

MSP has direct access to downtown Minneapolis and Bloomington via Metro Transit's light rail system and local bus service. T1 is served by a subterrain light rail station underneath the Silver Ramp, as well as local bus service at the Silver Ramp Transit Center. T2 has an at-grade light rail station along the east side of the Orange Ramp. No local bus routes service T2. **Exhibit 1-5** notes the light rail connections and **Exhibits 1-6** and **1-7** highlight the station locations at each terminal.

There are no designated bike lanes on the MSP campus. Northwest Drive is a low-speed roadway, with lower traffic volumes than Glumack Drive; bicyclists can use Northwest Drive to access the T1 Silver Ramp from Post Road. Bicyclists can access T2 using 34th Avenue South or Post Road. There is also a sidewalk on the west side of 34th Avenue South between T2 and I-494.



SOURCE: Kimley-Horn, 2022.

MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT

2040 LONG-TERM PLAN

N

0 1,600' 3,200'

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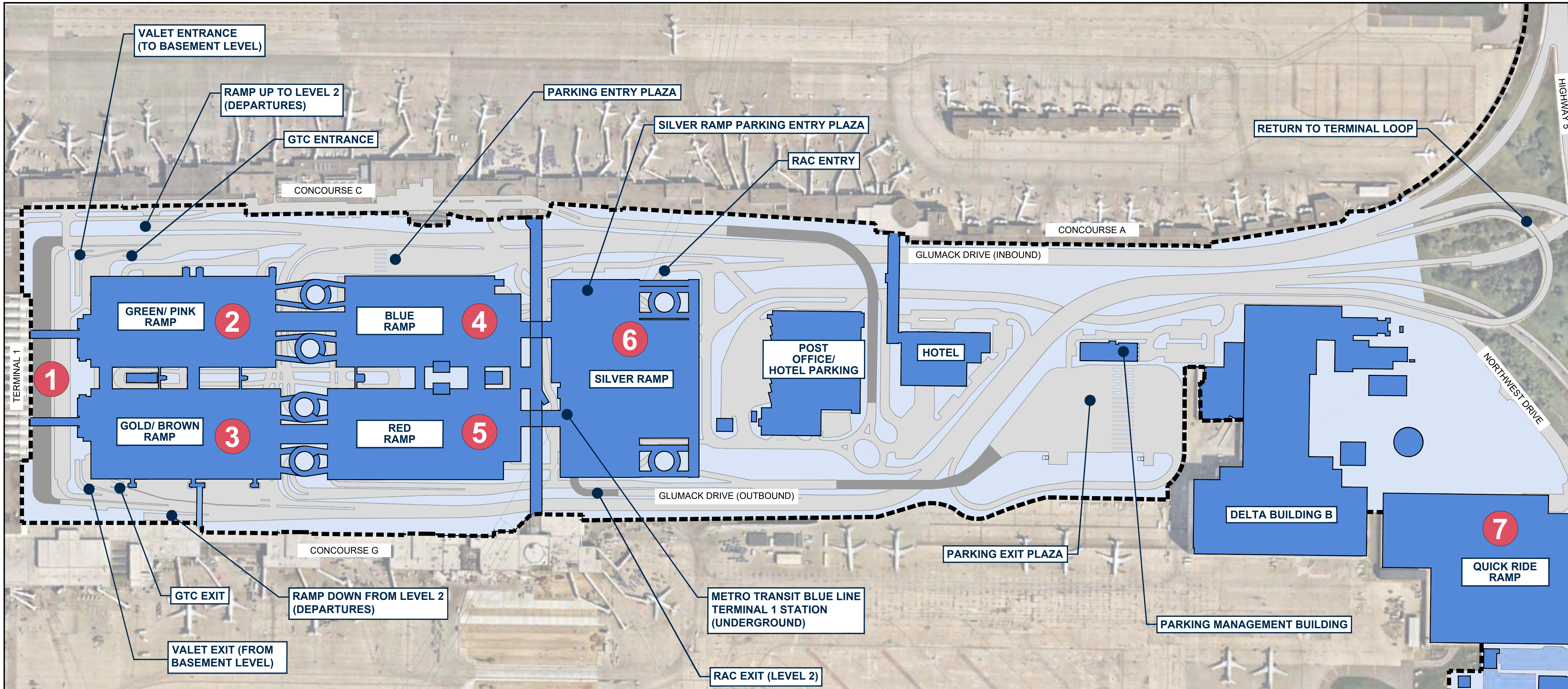
EXHIBIT 1-4

EXISTING LANDSIDE CONDITIONS - CAMPUS



1 Curbside
- L1 West: Arrivals (Passenger Pick-Up)
- L1 East: GTC
- L2 West: Departures (Passenger Drop-Off)
- L2 East: Departures (Commercial Vehicles and Delta Curbside Check-In)

2 Pink Ramp
- L1: GTC, ePark Elite, Employee Parking
- LM: General Parking, Valet Overflow Storage

Green Ramp
- L2-L7: General Parking

3 Brown Ramp
- L1: GTC, General Parking, Employee Parking

Gold Ramp
- L2, L4-L7: General Parking
- L3: Hourly Parking

4 Blue Ramp
- L1: RAC QTA
- L2-L3: Not Used
- L4-L9: General Parking

5 Red Ramp
- L1: RAC QTA
- L2-L3: Not Used
- L4-L9: General Parking

6 Silver Ramp
- L1: RAC CSB, Transit Center
- L2-L5: RAC RR
- L6-L11: General Parking

7 Quick Ride Ramp
- L1: Delta & Public Parking
- L2: Public Parking

Abbreviations:

- CSB: Customer Service Building
- GTC: Ground Transportation Center
- L#: Level Number
- M: Mezzanine Level
- RAC: Rent-A-Car
- RR: Ready-Return
- QTA: Quick Turn Around

DRAWING LEGEND
EXISTING BUILDINGS LANDSIDE
EXISTING LANDSIDE
EXISTING SURFACE LOT LANDSIDE
LANDSIDE BOUNDARY

MSP

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EXHIBIT 1-5

EXISTING LANDSIDE CONDITIONS - TERMINAL 1

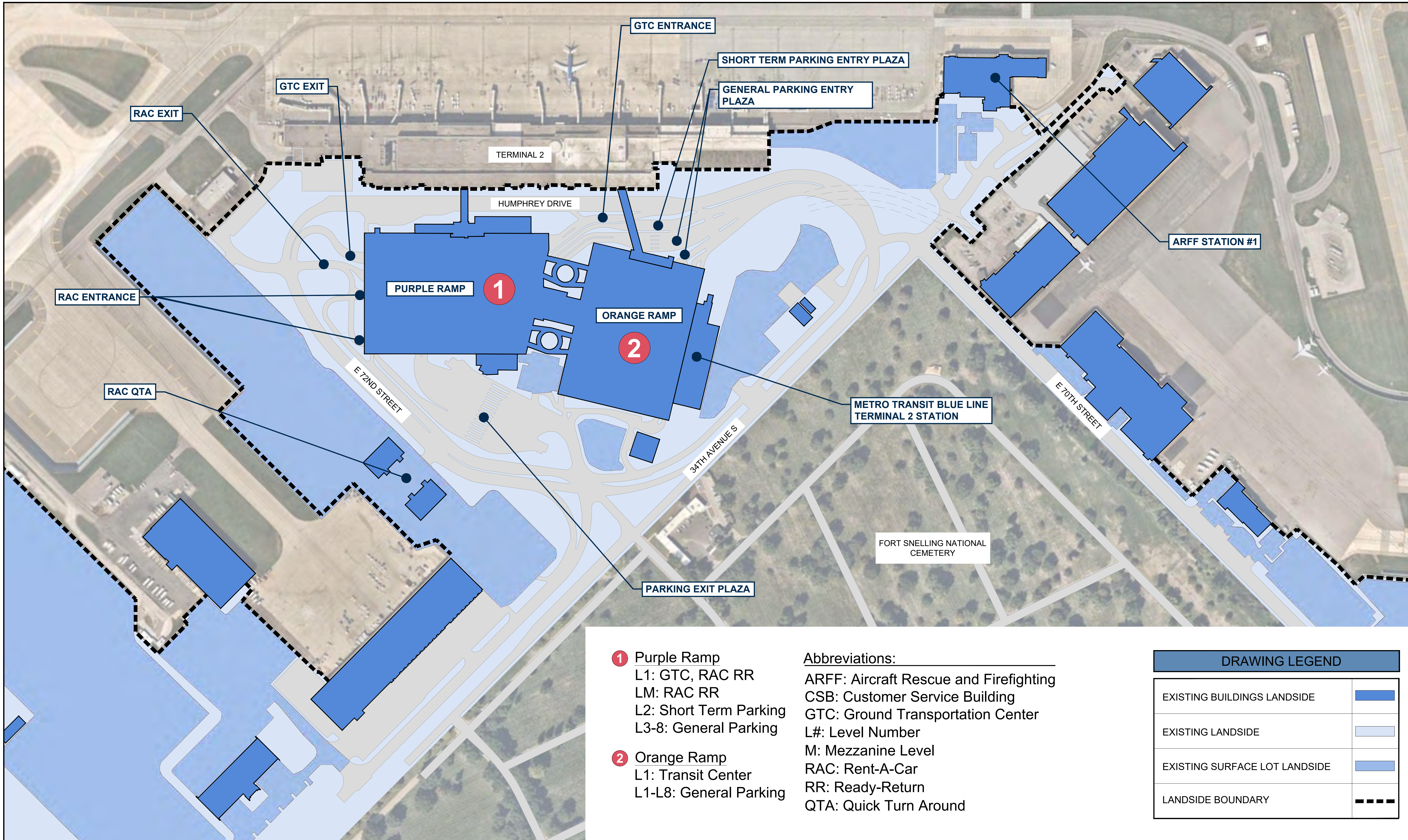

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EXHIBIT 1-6

EXISTING LANDSIDE CONDITIONS - TERMINAL 2

1.5.3 Terminal Inventory

The Airport has two commercial passenger terminal complexes: T1 and T2. Together, they provide approximately 3.33 million square feet of terminal facilities and 118 contact aircraft gates.

T1 is located between the Airport's parallel runways in the southern land envelope below Runway 4-22. T1 comprises seven concourses, designated A through G, that contain 102 contact gates[1] and 2 ground-loaded gates;[2] 10 gates are connected by sterile corridors to the T1 International Arrivals Facility, known as the Federal Inspection Station (FIS) facility, on Concourse G. **Table 1-4** summarizes the concourses and gate counts. Passenger movement is enhanced by moving sidewalks throughout the T1 complex and an automated people mover (APM) system along the front face of Concourse C, from Gate C1 to Gate C27.

T2 is located between Runway 17-35 and Runway 12R-30L in the southern land envelope below Runway 4-22. T2 has one concourse, designated H, which contains 16 contact gates[3]. Five of these gates are connected by sterile corridors to the T2 FIS. **Table 1-4** summarizes the gate counts.

The remainder of this section reviews the primary functional spaces existing within T1 and T2. Reference **Appendix A**, Section 1.3, to access exhibits of the existing facilities.

Table 1-4: Gate Inventory

Terminal	Concourse	Gate	Type	Airlines	Maximum ADG
1	A	11	Contact	Delta	ADG II
1	B	8	Contact	Delta	ADG II
1	B	3	Ground Load	Denver Air	ADG II
1	C	26	Contact	Delta	ADG III
1	D	6	Contact	Delta	ADG IV (B757-3W)
1	E	16	Contact	Alaska Airlines, Spirit Airlines, Air Canada, United Airlines, American Airlines	ADG IV (B757-3W)
1	F	16	Contact	Delta	ADG IV (B767)
1	G	20	Contact	Air France, Delta, KLM	ADG V
2	H	14	Contact	Allegiant Air, Condor, Frontier Airlines, Icelandair, JetBlue Airways, Southwest Airlines, Sun Country Airlines	ADG IV
Total		120			

NOTE: ADG – Airplane Design Group
SOURCES: Metropolitan Airports Commission, 2020; Ricondo & Associates, Inc., February 2020.

[1] Contact gates provide access to aircraft from the building via passenger boarding bridges.

[2] Ground-loaded gates provide a path for passengers to exit the building onto the apron and access the aircraft via stairs.

[3] Contact gates provide access to aircraft from the building via passenger boarding bridges.

1.5.3.1 Check-in Facilities Inventory

The T1 check-in inventory includes four banks of baggage acceptance points: two primary check-in banks on Level 2 and two landside check-in banks on Level T. The T2 check-in inventory includes a single bank of baggage acceptance points on Level 1. All baggage acceptance points include an agent position, desk, baggage belt, passenger staging process area, and passenger queue space. **Tables 1-5** and **1-6** present the inventory for the T1 and T2 check-in facilities.

Table 1-5: T1 Check-in Facilities Inventory

Airline	Kiosks	Agent Positions	Bag Drop Kiosks	Automated Bag Drops	Total Bag Induction Points
T1 Ticket Lobby					
Delta / SkyTeam	48	35	--	--	35
Aer Lingus[1]	--	2 (premium only)	--	--	2
Air Canada	4	4	--	--	4
Alaska Airlines[1]	--	2 (premium only)	--	--	2
American Airlines	20	4	6	--	10
Spirit Airlines	--	4	--	--	4
United Airlines	16	6	4	--	10
Common Use[2] (AS, EI, NK, EAS)	24	--	--	8	8
Tram Level (Delta)	5	10[3]	--	--	10
East Departures Facility (Delta)	--	12[4]	--	--	12

NOTES:
AS – Alaska Airlines
EI – Aer Lingus
NK – Spirit Airlines
EAS – Essential Air Service
1 Aer Lingus and Alaska Airlines have counters for premium passengers. Economy passengers will use common-use resources.
2 Common-use facilities service Alaska Airlines (AS), Air Lingus Limited (EI), Spirit (NK), Air Choice One (3B), and Boutique Air (4B).
3 The Tram Level counter totals are based on the existing configuration.
4 The East Departures Facility offerings are based on a plan to expand from 6 to 12 agent positions.
SOURCES: Metropolitan Airports Commission, 2020; Alliiance, 2020; Ricondo & Associates, Inc., February 2022.

Table 1-6: T2 Check-in Facilities Inventory

Airline	Kiosks	Agent Positions[1]	Bag Drop Kiosks	Automated Bag Drops	Total Bag Induction Points[1]
T2 Ticket Lobby					
Sun Country	--	20–28	--	--	20–28
Condor	--	4–6	--	--	4–6
Icelandair	--	4–6	--	--	4–6
Frontier Airlines	3	4–6	--	--	4–6
JetBlue Airways	3	4–6	--	--	4–6
Southwest Airlines	10	14	--	--	14

NOTE:
1 Agent counters at T2 are common-use and can fluctuate usage throughout the day.
SOURCES: Metropolitan Airports Commission, 2020; Ricondo & Associates, Inc., February 2020.

1.5.3.2 Holdrooms Inventory

As presented in **Table 1-7**, 104 holdrooms are in T1. Concourse A and Concourse B holdrooms are configured for domestic Airplane Design Group (ADG) II aircraft. Holdrooms are configured to be directly adjacent to allow for sharing of holdroom space between gates. Concourse C holdrooms are configured for domestic ADG II and ADG III gates. Holdroom areas are spread along the concourse in grouped clusters for shared use, where possible. Concourse D holdrooms are configured for domestic ADG II and ADG III aircraft. The holdrooms are grouped together in a single open area to maximize passenger utilization with neighboring gates. Concourse E holdrooms are configured for domestic ADG III aircraft. Concourse F holdrooms are configured for a range of domestic ADG III to ADG V aircraft. Holdrooms are usually physically separate from each other on Concourse F, except for the end-of-pier clusters on each concourse, with gate clusters F7/F9 and F8/F10 as the exception. Concourse G holdrooms are configured for a range of aircraft, from ADG III to ADG V aircraft. Gates G1 through G10 can also accommodate international arrivals.

The T2 holdrooms are configured for ADG III aircraft. Holdroom areas are spread along the concourse in grouped clusters for shared use and can accommodate up to ADG V aircraft for Gates H3 through H7. Gate H4 is capable of accommodating ADG IV aircraft when sharing the holdroom with Gate H3. Gate H5 is capable of accommodating ADG V aircraft when sharing the holdroom with Gate H4. H6 is capable of accommodating ADG V aircraft when sharing the holdroom with Gate H7. Gates H3 through H7 can also accommodate international arrivals.

Table 1-7: Holdroom Inventory

Concourse	Number of Gates	Total Square Footage of Holdrooms
A	11	8,121
B	9	8,929
C	26	46,806
D	6	12,067
E	16	28,883
F	16	35,011
G	20	40,359
T1 Subtotal	**104**	**180,176**
T2 Subtotal	**14**	**65,777**
Total	**118**	**245,953**

SOURCES: Metropolitan Airports Commission, 2020; Ricondo & Associates, Inc., February 2020.

1.5.3.3 Baggage Claim Inventory

The inbound baggage process comprises two components: the baggage claim devices and circulation area within the non-secure footprint of the facility, and the tug and cart staging area in the security identification display area (SIDA or airside) directly adjacent to the interior baggage claim.

The T1 domestic baggage claim is located on Level 1 of the T1 headhouse. The baggage claim, located on the non-secure side, includes 11 individual devices ranging from 120 linear feet to 180 linear feet of presentation length. Each claim unit is connected to an individual stripping belt in the cart staging area. **Table 1-8** presents the inventory for the T1 domestic baggage claim.

Table 1-8: Domestic Baggage Claim Inventory

Attribute	Unit	T1	T2
Bag Claim Carousels	Devices	11	2
Bag Claim Presentation Frontage	Linear Feet (Per Device)	120 – 1 Device 160 – 1 Device 180 – 9 Devices	200 – 2 Devices

SOURCES: Metropolitan Airports Commission, 2020; Ricondo & Associates, Inc., February 2020.

The T2 domestic baggage claim is located on Level 1 of the T2 headhouse. The baggage claim, located on the non-secure side, includes 2 individual devices with 200 linear feet of presentation length each. Each claim unit is connected to an individual stripping belt in the cart staging area. **Table 1-8** presents the inventory for the T2 domestic baggage claim.

1.5.3.4 Security Checkpoint Inventory

The main Security Screening Checkpoint (SSCP) banks located after check-in are split between two locations in T1: north and south. Each SSCP includes both Automated Screening Lanes (ASLs) and non-ASLs for passenger processing, as well as an employee screening lane. Each location in T1 contains 9 screening lanes for a total of 18 screening lanes in T1.

There are three other checkpoints within the T1 complex. The recheck facility on Concourse G is primarily used for international inbound passenger processing, specifically after the FIS process. The Skyway and hotel passenger SSCPs are located adjacent to the hotel and skyway within the T1 complex. The skyway checkpoint has two lanes, while the hotel has one lane. The sand hotel checkpoints are limited in their operational times and do not have check-in facilities located adjacent to them.

Security screening is split between two locations in T2: Checkpoint 1 and Checkpoint 2. Each SSCP has a bank of non-ASLs for passenger processing. T2 does not have an employee screening lane. Checkpoint 1 contains 6 screening lanes and Checkpoint 2 contains 4 lanes, for a total of 10 screening lanes in T2.

Table 1-9 presents the SSCP inventory for both terminals.

Table 1-9: Security Screening Checkpoint Inventory

Equipment	T1					T2	
	South[1]	North[1]	Recheck[2]	Skyway[3]	Hotel[4]	# 1	# 2
Non-ASL Lanes	2	2	3	2	1	6	4
ASL Lanes	7	7	0	0	0	0	0
Employee Lanes	1	1	0	0	0	0	0
Total Lanes	9	9	3	2	1	6	4
WTMD/AIT	5/5	5/5	2/2	1/1	1/1	3/3	2/2
TDC Podiums	10	10	2	2	1	3	2

NOTES:
ASL – Automated Screening Lane
WTMD – Walk Through Metal Detector
AIT – Advanced Imaging Technology
TDC – Travel Document Checker
1 The T1 inventory is based on operational improvement plans provided by Alliiance.
2 Available for international connecting passengers only.
3 Open 5:30 a.m. to 1:15 p.m. No bag checking facilities are available prior to this checkpoint.
4 Open 4:45 a.m. to 10:00 a.m. No bag checking facilities are available prior to this checkpoint.
SOURCES: Metropolitan Airports Commission, 2020; Alliiance, 2020; Ricondo & Associates, Inc., February 2020.

1.5.3.5 Baggage Screening Facilities Inventory

Baggage screening is split between two locations in T1: T1 west and T1 south. Each baggage screening point has a bank of 5 and 2 CTX 9800 inline screening units, respectively. The units are arranged in an N+1 configuration, which assumes a single-unit redundancy. Bag throughput reflects this configuration. Expansion space is reserved for 2 additional units at T1 south.

Baggage screening is split between two locations in T2: T2 checked baggage inspection system (CBIS) and T2 out of gauge (OOG). Each baggage screening point has two CTX 9800 inline screening units, respectively. The T2 CBIS supports the primary baggage screening, while the T2 OOG supports the international connection baggage screening. The units are arranged in an N+1 configuration, which assumes a single-unit redundancy. Bag throughput reflects this configuration. Expansion space is reserved for two additional units in the T2 CBIS. **Table 1-10** presents the baggage screening inventory for both terminals.

Table 1-10: Baggage Screening Facilities Inventory

Location	EDS Capacity			Expansion Reserved (Units)	Mainline BHS Capacity			CBRA Workstations	Notes
	EDS Models	Unit Throughput/Hour	Total EDS Throughput (Less N+1)		Number of Mainline Feeds	Bags/Hour /Feed	Total Mainline Feed Capacity		
T1 West CBIS	CTX 9800	674	2,022	-	2	1,800	3,600	14	Design Year: 2012
T1 South CBIS	CTX 9800	674	674	2	1	1,800	1,800	6	Design Year: 2017
T2 CBIS	CTX 9800	674	674	2	1	1,800	1,800	6	Design Year: 2016
T1 OOG and FIS	CT80XL (inline)	185	185	-	1	30	30		

NOTES:
EDS – Explosive Detection System
CBRA – Checked Baggage Resolution Area
BHS – Baggage Handling System
CBIS – Checked Baggage Inspection System
FIS – Federal Inspection Services
OOG – Out-of-Gauge
T1 – Terminal 1
T2 – Terminal 2
SOURCES: Metropolitan Airports Commission, 2020; Ricondo & Associates, Inc., February 2020.

1.5.3.6 Federal Inspection Station Inventory

Both T1 and T2 contain FIS facilities. Each facility includes a primary inspection area with automated passport control (APC) kiosks, international bag claim units, secondary and customs inspection areas, exit control area, space for Customs and Border Protection (CBP) offices and support space, and sterile circulation space for passenger movement from the international gates through the FIS process.

The T1 FIS facility supports 10 international-capable gates at T1, Gates G1 through G10. The FIS facility includes 2 bag claim devices with a total of 290 linear feet of presentation length for each device. **Table 1-11** presents the T1 FIS inventory.

The T2 FIS facility supports 5 international-capable gates at T2, Gates H3 through H7. The FIS facility includes 2 bag claim devices with a total of 200 linear feet of presentation length for each device. The international bag claim area has a set of movable walls that allows for the international claim units to be used for domestic arrival operations during times of international arrivals inactivity. **Table 1-11** presents the T2 FIS inventory.

Table 1-11: Federal Inspection Services Inventory

Attribute	Units	T1	T2
Primary Officer Booths	Positions	14	12
Primary Officer Podiums	Positions	2	--
APC Kiosks	Units	24	10
GE APC Kiosks	Units	8	4
Exit Control Positions	Positions	2	2
Bag Claim Carousels	Devices	2	2
Bag Claim Presentation Frontage	Linear Feet (Per Device)	290	200

NOTES:
APC – Automated Passport Control
GE – Global Entry
SOURCES: Metropolitan Airports Commission, 2020; Ricondo & Associates, Inc., February 2020.

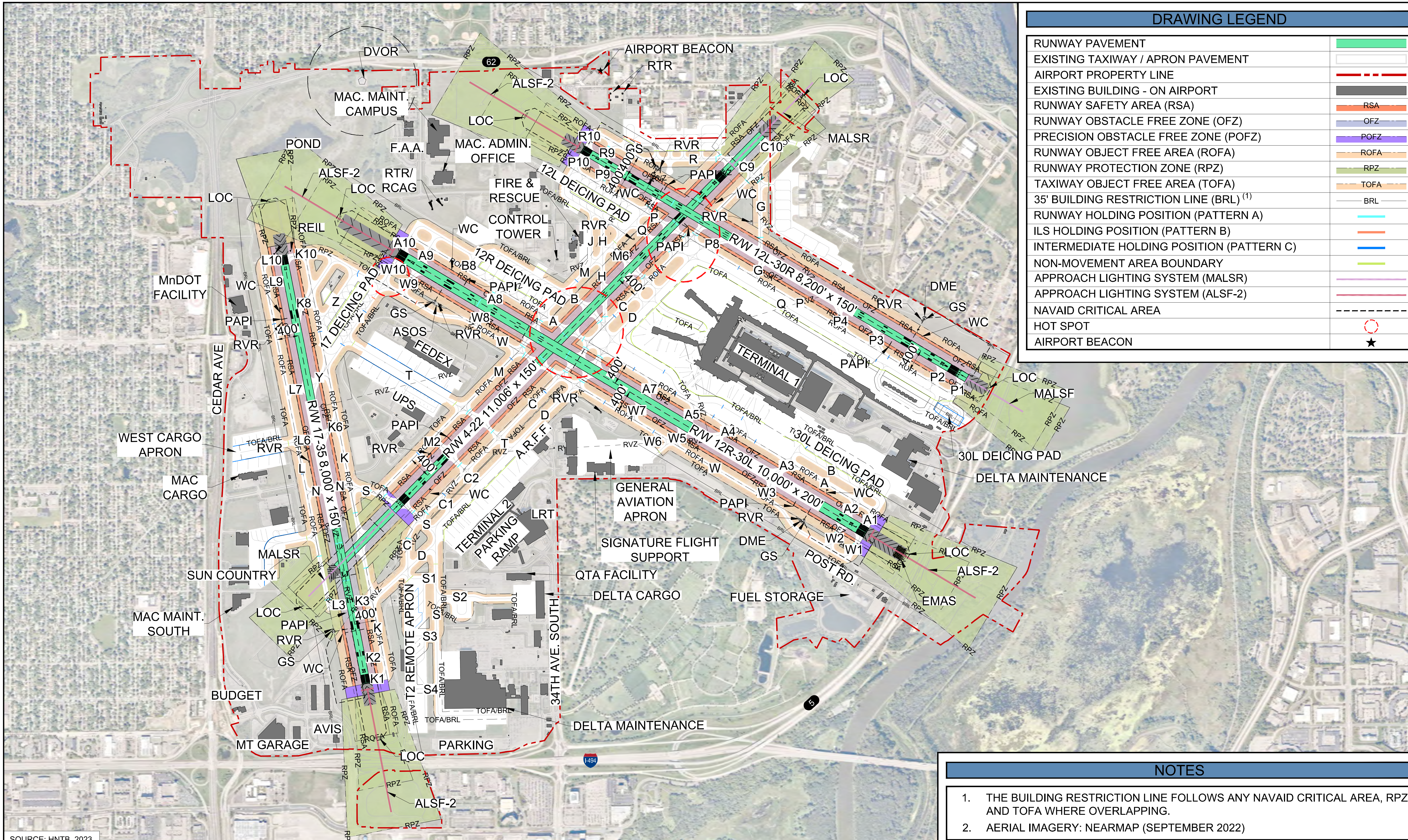
1.5.4 Airfield Inventory

1.5.4.1 Runways

MSP has four runways, including one set of parallel runways. Runway 4-22 is the Airport's longest runway; it measures 11,006 feet long by 150 feet wide and has a 1,550-foot displaced arrival threshold on the Runway 4 approach end and a 1,000-foot displaced arrival threshold on the Runway 22 approach end. Runway 12L-30R measures 8,200 feet long by 150 feet wide and has a 200-foot displaced arrival threshold on the Runway 30R approach end. Runway 12R-30L measures 10,000 feet long by 200 feet wide. Runway 17-35 measures 8,000- feet long by 150 feet wide. **Exhibit 1-7** depicts the existing airfield configuration.

Federal Aviation Administration (FAA) airport design standards in Advisory Circular (AC) 150/5300-13B, *Airport Design (AC 13B), March 2022*, provide design guidelines for a safe and efficient airport system. General conformity to the FAA standards ensures an aircraft in a particular category can safely operate at an airport.

The Runway Design Code (RDC) identifies the existing and future design standards for a runway and is made up of three components: Airplane Design Group (ADG), Aircraft Approach Category (AAC), and approach visibility minimums. The AAC identifies the range of aircraft approach speeds that can be accommodated by the runway. The ADG is a function of the wingspan and tail height dimensions of the critical design aircraft. The approach visibility minimum is defined as the approved minimum horizontal visibility that the specific runway accommodates, expressed as a Runway Visual Range (RVR) value. The RDC provides the information needed to determine which design standards apply for existing and future configurations and are specific to each runway end. **Table 1-12** summarizes the components of an RDC, and **Table 1-13** presents the resulting runway characteristics for each runway.



DRAWING LEGEND

RUNWAY PAVEMENT	
EXISTING TAXIWAY / APRON PAVEMENT	
AIRPORT PROPERTY LINE	
EXISTING BUILDING - ON AIRPORT	
RUNWAY SAFETY AREA (RSA)	RSA
RUNWAY OBSTACLE FREE ZONE (OFZ)	OFZ
PRECISION OBSTACLE FREE ZONE (POFZ)	POFZ
RUNWAY OBJECT FREE AREA (ROFA)	ROFA
RUNWAY PROTECTION ZONE (RPZ)	RPZ
TAXIWAY OBJECT FREE AREA (TOFA)	TOFA
35' BUILDING RESTRICTION LINE (BRL) (1)	BRL
RUNWAY HOLDING POSITION (PATTERN A)	
ILS HOLDING POSITION (PATTERN B)	
INTERMEDIATE HOLDING POSITION (PATTERN C)	
NON-MOVEMENT AREA BOUNDARY	
APPROACH LIGHTING SYSTEM (MALSR)	
APPROACH LIGHTING SYSTEM (ALSF-2)	
NAVAID CRITICAL AREA	
HOT SPOT	
AIRPORT BEACON	★

NOTES

1. THE BUILDING RESTRICTION LINE FOLLOWS ANY NAVAID CRITICAL AREA, RPZ AND TOFA WHERE OVERLAPPING.
2. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)

SOURCE: HNTB, 2023.

N

0 1,600' 3,200'

MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

FEBRUARY 2023

EXHIBIT 1-7
EXISTING AIRFIELD CONFIGURATION

Table 1-12: Runway Design Code (RDC) Components

Aircraft Approach Category (AAC)		
A	Less than 91 knots	
B	91 knots or more but less than 121 knots	
C	121 knots or more but less than 141 knots	
D	141 knots or more but less than 166 knots	
E	166 knots or more	
Airplane Design Group (ADG)		
	Wingspan	**Tail Height**
I	Less than 49 feet	Less than 20 feet
II	49 feet but less than 79 feet	20 feet but less than 30 feet
III	79 feet but less than 118 feet	30 feet but less than 45 feet
IV	118 feet but less than 171 feet	45 feet but less than 60 feet
V	171 feet but less than 214 feet	60 feet but less than 66 feet
VI	214 feet but less than 262 feet	66 feet but less than 80 feet
Approach Visibility Minimums (Runway Visual Range – RVR)		
VIS	Visual approach	
5,000	Not lower than 1 mile	
4,000	Lower than 1 mile, but not lower than ¾ mile	
2,400	Lower than ¾ mile, but not lower than ½ mile	
1,600	Lower than ½ mile, but not lower than ¼ mile	
1,200	Lower than ¼ mile	

NOTE: VIS - Visibility in feet
SOURCE: US Department of Transportation, Federal Aviation Administration, Advisory Circular 150/5300-13B, *Airport Design*, March 2022.

As featured in **Table 1-13**, the Approach Reference Code (APRC) and Departure Reference Code (DPRC) identify the operational capabilities of each runway and adjacent taxiways where no special operating procedures or restrictions are necessary. The APRC and DPRC do not consider runway length; they are only a measurement of ideal operational characteristics, as they relate to runway-taxiway separation (APRC and DPRC) and visibility minimums (APRC only). The APRC and DPRC can be used to determine what aircraft operations can occur without operational restrictions. Likewise, aircraft occasionally operating on a runway exceeding the APRC/DPRC, it identifies when operational restrictions should be in place, such as the occasional passage of ADG VI aircraft on a runway designed to ADG V standards. APRC and DPRC are assigned to each runway end and can be different between runway ends on the same runway.

Declared distances effectively reduce the amount of runway available for takeoff, aborted takeoffs, and landings so that adequate space exists for Runway Safety Areas (RSAs) and Runway Object Free Areas (ROFAs) to mitigate the presence of unsuitable land use in the runway protection zone (RPZ) or mitigate the presence of an obstacle in the approach or departure path of an aircraft. RSA, ROFA, and RPZ dimensional standards are reviewed in Chapter 3. **Table 1-13** presents the declared distances for each runway end at MSP, which are defined below by the FAA.

- Takeoff Run Available (TORA) – The runway length declared available and suitable for the ground run of an aircraft taking off.

- Takeoff Distance Available (TODA) – The TORA plus the length of and remaining runway or clearway beyond the far end of the TORA; the full length of TODA may need to be reduced because of obstacles in the departure area.
- Accelerate-Stop Distance Available (ASDA) – The runway plus stopway length declared available and suitable for the acceleration and deceleration of an aircraft aborting takeoff.
- Landing Distance Available (LDA) – The runway length declared available and suitable for landing an aircraft.

Table 1-13: Existing Runway Characteristics

Runway	4-22		12L-30R		12R-30L		17-35	
Length	11,006'		8,200'		10,000'		8,000'	
Width	150'		150'		200'		150'	
Surface	Concrete – Grooved		Concrete – Grooved		Concrete – Grooved		Concrete – Grooved	
Pavement Strength[1]	PCN: 105/R/B/W/T		PCN: 105/R/B/W/T		PCN: 106/R/B/W/T		PCN: 118/R/B/W/T	
	S-100		S-100		S-100		S-100	
	D-200		D-200		D-200		D-200	
	DT-400		DT-400		DT-400		DT-400	
	DDT-850		DDT-850		DDT-850		DDT-850	
Critical Design Aircraft	Airbus A330-900 NEO (Tail Height = 55'-1", Wingspan = 210'-0")							
Runway End	4	22	12L	30R	12R	30L	17	35
Lowest Approach Minimums Available	2,400 RVR / 200 HAT	4,000 RVR / 400 HAT	700 RVR / 100 HAT	4,000 RVR / 100 HAT	600 RVR / 100 HAT	1,000 RVR / 100 HAT	5,500 RVR / 600 HAT	600 RVR / 110 HAT
Runway Design Code (RDC)	D-V-2400	D-V-4000	D-V-700	D-V-4000	D-V-600	D-V-1000	D-V-5500	D-V-600
Approach Reference Code (APRC)	D/IV/2400 D/V/2400	D/IV/4000 D/V/4000	D/IV/1200	D/IV/4000 D/V/4000	D/IV/1200	D/IV/1200	D/IV/4000	D/IV/1200
Departure Reference Code (DPRC)	D/IV, D/V	D/IV, D/V	D/IV, D/V	D/IV, D/V	D/IV, D/V	D/IV, D/V	D/IV, D/V	D/IV, D/V
Runway-to-Parallel Taxiway Separation	Taxiway C (400' – 600') Taxiway M (400' – 550')		Taxiway P (400') Taxiway R (400')		Taxiway A (400') Taxiway W (400' – 600')		Taxiway K (400') Taxiway L (400')	
Displaced Threshold	1,550'	1,000'	None	200'	None	None	None	None
Landing Distance Available (LDA)	9,456'	10,006'	7,620	8,000'	10,000'	10,000'	8,000'	8,000'
Takeoff Run Available (TORA)	11,006'	11,006'	8,200'	8,200'	10,000'	10,000'	8,000'	8,000'
Takeoff Distance Available (TODA)	11,006'	11,006'	8,200'	8,200'	10,000'	10,000'	8,000'	8,000'
Accelerate-Stop Distance Available (ASDA)	11,006'	11,006'	7,620'	8,200'	10,000'	10,000'	8,000'	8,000'

NOTES: 1 The PCN is a number that expresses the load-carrying capacity of a pavement for unrestricted operations.
PCN – Pavement Classification Number
S – Single Wheel (expressed in thousands of pounds); D – Double Wheel (expressed in thousands of pounds); DT – Double Tandem (expressed in thousands of pounds); DDT – Dual Double Tandem (expressed in thousands of pounds); TORA – Takeoff Run Available (runway length declared available and suitable for the ground run of an aircraft taking off); TODA – Takeoff Distance Available (TORA plus the length of the remaining runway or clearway beyond the far end of the TORA; full length of TODA may need to be reduced because of obstacles in the departure area); ASDA – Accelerate-Stop Distance Available (runway plus stopway length declared available and suitable for the acceleration and deceleration of an aircraft aborting takeoff); LDA – Landing Distance Available (runway length declared available and suitable for landing an aircraft)
SOURCE: HNTB Corporation, November 2022.

1.5.4.1 Taxiways and Taxilanes

The taxiway and taxilane system shown on **Exhibit 1-8** provides aircraft connections between runways and aprons throughout the airfield. Like runway standards, taxiway standards are derived from the size and type of aircraft expected to use the taxiways. The Main Gear Width (MGW) and the Cockpit to Main Gear (CMG) dimensions determine the Taxiway Design Group (TDG) classification. The TDG establishes the standards for taxiway width, taxiway shoulder width, taxiway edge safety margin (TESM), and taxiway fillet design at intersections. The designated ADG of a taxiway determines other dimensional standards, such as the Taxiway Safety Area (TSA), Taxiway Object Free Area (TOFA), and separation standards in relation to other airfield pavements (runways, taxiways, taxilanes, aprons, and Vehicle Service Roads (VSRs)). The dimensional standards are discussed in Chapter 3. **Table 1-14** summarizes the existing taxiways and taxilanes at MSP and their basic characteristics.

Table 1-14: (1 of 5) Taxiway System Summary

Taxiway	Segment	Type	Width	Shoulder Width	ADG	TDG
A	TWY A1 – TWY A4 TWY A4 – TWY A7 TWY A7 – TWY A10	Full Parallel TWY	75’	35’ 30’ 35’	V	5
A1	RWY 12R-30L – TWY A TWY A – TWY B	RWY Entrance Crossover TWY	100’	35’	V	5
A2	RWY 12R-30L – TWY A TWY A – TWY B	RWY Entrance Crossover TWY	100’ 120’	35’ 30’	V	5
A3	RWY 12R-30L – TWY A TWY A – TWY B	High-Speed Exit Crossover TWY	100’ 150’	35’ 30’	V	5
A4	TWY A – TWY B	High-Speed Exit TWY	100’	35’	V	5
A5	RWY 12R-30L – TWY A	Exit TWY	100’	35’	V	5
A7	RWY 12R-30L – TWY A	Exit TWY	100’	35’	V	5
A8	RWY 12R-30L – TWY A	Exit TWY	100’	35’	V	5
A9	RWY 12R-30L – TWY A TWY A – TWY B	RWY Entrance Crossover TWY	100’	35’	V	5
A10	RWY 12R-30L – TWY A TWY A – TWY B	RWY Entrance Crossover TWY	100’	35’	V	5
B	TWY A1 – TWY A3 TWY A3 – DWY D TWY D – TWY M TWY M – TWY A10	Full Parallel TWY	75’ 75’ 100’ 75’	20’ None 35’ 35’	IV (<135’) IV V V	4 5 5 5
B8	TWY A – TWY B	Crossover TWY	75’	35’	V	5
RWY 30L Deicing Pad Taxilane	TWY A3/B – TWY A2/B	Deicing Pad TL	50’	None	IV (<135’)	4

NOTES: TWY – Taxiway; RWY – Runway; ADG – Airplane Design Group; TDG – Taxiway Design Group
SOURCE: HNTB Corporation, November 2022.

Table 1-14: (2 of 5) Taxiway System Summary

Taxiway	Segment	Type	Width	Shoulder Width	ADG	TDG
C	NMAB Parking–TWY D TWY D – RWY 12R-30L TWY 12R-30L – TWY A TWY A – TWY P TWY P – RWY 12L-30R RWY 12L-30R – TWY C10	Apron TWY Partial Parallel TWY Partial Parallel TWY Partial Parallel TWY Partial Parallel TWY Partial Parallel TWY	75’ 100’ 75’ 100’ 75’ 100’	35’	V	5
C1	TWY C – TWY D	Crossover TWY	100’	30’	V	5
C2	RWY 4-22 – TWY C TWY C – TWY D	RWY Exit Crossover TWY	100’	35’	V	5
C5	TWY C – TWY D	Crossover TWY	100’	35’	V	5
C6	RWY 4-22 – TWY C TWY C – TWY D	RWY Exit Crossover TWY	75’ 100’	35’	V	5
C9	RWY 4-22 – TWY C	RWY Entrance TWY	100’	35’	V	5
C10	RWY 4-22 – TWY C	RWY Entrance TWY	100’	35’	V	5
D	TWY K – TWY C1 TWY C1 – TWY W TWY W – TWY A TWY A – TWY P	Partial Parallel TWY	75’ 75’ 100’ 75’	35’ 30’ 35’ 35’	V	5
G	TWY P – RWY 12L-30R RWY 12L-30R – TWY C	RWY Exit TWY Midfield Connector	100’ 75’	35’ 10’	V	5
G1	TWY G - Apron	Apron Access TWY	75’	50’	V	5
G2	TWY G - Apron	Apron Access TWY	75’	35’	V	5
H	TWY B – TWY Q	Midfield Connector	75’	35’	V	5
J	TWY M – TWY Q	Midfield Connector	50’	25’	III (<85.3’)	3
K	TWY K1 – TWY K10	Full Parallel TWY	75’	35’	V	5
K1	RWY 17-35 – TWY K	RWY Entrance TWY	100’	35’	V	5
K2	RWY 17-35 – TWY K	RWY Entrance TWY	100’	35’	V	5
K3	RWY 17-35 – TWY K	RWY Exit TWY	100’	34’	V	5
K6	RWY 17-35 – TWY K	High-Speed Exit TWY	100’	35’	V	5
K8	RWY 17-35 – TWY K TWY K – TWY W	High-Speed Exit TWY Crossover TWY	100’ 75’	35’	V	5
K10	RWY 17-35 – TWY K	RWY Entrance TWY	100’	35’	V	5
L	TWY L3 – TWY L10	Partial Parallel TWY	75’	35’	V	5
L3	RWY 17-35 – TWY L	RWY Exit TWY	100’	35’	V	5
L5	TWY L – NMAB Marking	Apron TWY	100’	35’	V	5
L5 Taxilane	NMAB Marking – Apron	Apron TL	75’	25’	V	5

NOTES: TWY – Taxiway; RWY – Runway; ADG – Airplane Design Group; TDG – Taxiway Design Group
SOURCE: HNTB Corporation, November 2022.

Table 1-14: (3 of 5) Taxiway System Summary

Taxiway	Segment	Type	Width	Shoulder Width	ADG	TDG
L6	RWY 17-35 – TWY L TWY L – NMAB Marking	RWY Exit TWY Apron TWY	100’	35’	V	5
L6 Taxilane	NMAB Marking - Apron	Apron TL	75’	None	V	5
L7	RWY 17-35 – TWY L	RWY Exit TWY	100’	35’	V	5
L9	RWY 17-35 – TWY L	RWY Entrance TWY	100’	35’	V	5
L10	RWY 17-35 – TWY L	RWY Entrance TWY	100’	35’	V	5
M	TWY S – TWY W TWY W – TWY A TWY A – TWY P TWY P – RWY 12R-30L	Partial Parallel TWY Partial Parallel TWY Partial Parallel TWY Exit TWY	75’ 100’ 75’ 100’	35’	V	5
M2	RWY 4-22 – TWY M	RWY Exit TWY	100’	35’	V	5
M6	RWY 4-22 – TWY M	RWY Exit TWY	100’	35’	V	5
N	TWY K – TWY L	RWY Exit TWY	100’	35’	V	5
P	TWY P1 – TWY M TWY M – TWY P10	Full Parallel TWY	75’	35’ 30’	V	5
P1	RWY 12R-30L – TWY P TWY P – NMAB Marking	RWY Entrance TWY Deicing Pad TWY	100’	35’	V III (<97’)	5 3
P2	RWY 12R-30L – TWY P TWY P – TWY Q	RWY Entrance TWY Crossover TWY	100’	34’	V III (<97’)	5 3
P3	RWY 12R-30L – TWY P	High-Speed Exit TWY	75’	35’	V	5
P4	RWY 12R-30L – TWY P	High-Speed Exit TWY	75’	35’	V	5
P8	RWY 12R-30L – TWY P	High-Speed Exit TWY	75’	35’	V	5
P9	RWY 12R-30L – TWY P	RWY Entrance TWY	100’	35’	V	5
P10	RWY 12R-30L – TWY P TWY P – TWY Q	RWY Entrance TWY Crossover TWY	100’	34’	V IV	5
Q Taxilane	NBAB Marking – Concourse A-B TL & RWY 30R Deicing Pad	Apron TL	50’	None	III (<97’)	3
Q	NMAB Marking – TWY P2 TWY P2 – TWY P3 TWY P3 – TWY D TWY D – TWY M TWY M – TWY P10	Apron Access TWY Partial Parallel TWY Partial Parallel TWY Partial Parallel TWY Partial Parallel TWY	50’ 50’ 50’ 100’ 75’	None None None 35’ 35’	III (<97’) III (<97’) IV (<135’) V IV	3 3 4 5 5

NOTES: TWY – Taxiway; RWY – Runway; ADG – Airplane Design Group; TDG – Taxiway Design Group
SOURCE: HNTB Corporation, November 2022.

Table 1-14: (4 of 5) Taxiway System Summary

Taxiway	Segment	Type	Width	Shoulder Width	ADG	TDG
Concourse A-B Taxilane	TL Q – NMAB Marking NMAB Marking–TWY Q	Apron TL	35’	None	III (<81.5’)	2
Concourse E-F Taxilane	TWY D–NMAB Marking NMAB Marking-Gates E7/F7 Gates E7/F7 – Gates E1/F1	Apron TWY Apron TL Apron TL	50’	None	IV (<135’) IV (<135’) III	4 4 3
R	RWY 4-22 – TWY R8 TWY R8 – TWY R10	Midfield Connector Partial Parallel	75	10’ 35’	V	5
R3	TWY R – Apron	Apron Access TWY	60’	35’	V	5
R4	TWY R – Apron	Apron Access TWY	60’	30’	V	5
R5	TWY R – Apron	Apron Access TWY	60’	30’	V	5
R6	TWY R – Apron	Apron Access TWY	80’	30’	V	5
R7	TWY R – Apron	Apron Access TWY	80’	30’	V	5
R8	TWY R – Apron	Apron Access TWY	100’	10’	V	5
R9	RWY 12R-30L – TWY R	RWY Entrance TWY	100’	35’	V	5
R10	RWY 12R-30L – TWY R	RWY Entrance TWY	100’	35’	V	5
S	TWY K – NMAB Marking	Midfield Connector	75’	35’	V	5
S Taxilane	NMAB Marking – TL S4 TL S4 – Apron	Midfield Connector TL Apron Access TL	75’	30’	V III	5 3
S1 Taxilane	TWY D – TL S	Apron TL	100’	35’	IV	5
S2 Taxilane	TL S – Run-Up Pad & Apron	Apron Access TL	75’	35’	V	5
S3 Taxilane	TL S - Apron	Apron TL	75’	30’	III	3
S4 Taxilane	TL S - Apron	Apron TL	75’	30’	IV (<135’)	4
T	TWY D – TWY C TWY C – RWY 4-22 RWY 4-22 – TWY M TWY M–NMAB Marking Infield Cargo Apron NMAB Marking–TWY Y	Crossover TWY RWY Exit TWY RWY Exit TWY Apron TWY Apron TL Apron TWY	100’ 75’ 100’ 100’ 75’ 100’	30’ 35’ 35’ 35’ None 35’	V	5

NOTES: TWY – Taxiway; RWY – Runway; ADG – Airplane Design Group; TDG – Taxiway Design Group
SOURCE: HNTB Corporation, November 2022.

Table 1-14: (5 of 5) Taxiway System Summary

Taxiway	Segment	Type	Width	Shoulder Width	ADG	TDG
W	TWY W1 – TWY D TWY D – TWY M TWY M – TWY K	Full Parallel TWY	75' 100' 75'	35'	V	5
W1	RWY 12R-30L–TWY W	RWY Entrance TWY	100'	35'	V	5
W2	RWY 12R-30L–TWY W	RWY Entrance TWY	100'	34'	V	5
W3	RWY 12R-30L–TWY W	RWY Exit TWY	100'	35'	V	5
W5	RWY 12R-30L–TWY W TWY W–NMAB Marking	RWY Exit TWY Apron Access TWY	75'	35'	V IV (<135')	4
W5 Taxilane	NMAB Marking - Apron	Apron Access TL	75'	10'	IV (<135')	4
W6	TWY W–NMAB Marking	Apron Access TWY	50'	20'	III	3
W6 Taxilane	NMAB Marking - Apron	Apron Access TL	50'	20'	III	3
W7	RWY 12R-30L–TWY W	RWY Exit TWY	100'	35'	V	5
W8	RWY 12R-30L–TWY W	RWY Exit TWY	100'	35'	V	5
W9	RWY 12R-30L–TWY W	RWY Entrance TWY	100'	35'	V	5
W10	RWY 12R-30L–TWY W	RWY Entrance TWY	100'	35'	V	5
Y	RWY 17-35 – TWY K TWY K – TWY W	High-Speed Exit Midfield Connector	100' 75'	35'	V	5
Z	TWY K – TWY W	Midfield Connector	75'	35'	V	5
RWY 4-22	TWY K – TWY P	RWY Operating as TWY	150'	35'	V	5

NOTES: TWY – Taxiway; RWY – Runway; ADG – Airplane Design Group; TDG – Taxiway Design Group
SOURCE: HNTB Corporation, November 2022.

1.5.4.2 Apron Areas

As presented on **Exhibit 1-8**, there are several aircraft apron and parking areas throughout the MSP airfield. The naming in **Exhibit 1-9** and in the following sections is for reference purposes only and not a reflection of the actual designation for these areas.

- **Apron A –** The T1 apron is approximately 5.5 million square feet and is located between Runways 12L-30R and 12R-30L. This apron supports all gates at T1 and is accessible from perimeter Taxiways B, D, and Q. This apron accommodates 102 gate positions and 4 hardstand positions.
- **Apron B –** The T2 apron is approximately 1.1 million square feet and is located between the T2 building and Taxiway D. This apron accommodates 14 gate positions and 2 additional hardstand positions.
- **Apron C1 –**The infield cargo area apron has two aprons separated by Taxiway T. The north ramp is operated by FedEx and is approximately 680,000 square feet. The south ramp is

operated by UPS and is approximately 650,000 square feet. Both cargo ramps have associated warehouses with landside access tunneled under Runway 17-35 via Cargo Road.

- **Apron C2 –** The west cargo apron is located west of Taxiway L and is approximately 650,000 square feet. DHL and Amazon share use of the apron and the associated warehouse. Landside access is provided on Cargo Road to Longfellow Avenue.
- **Apron D1 –** The Minnesota Air National Guard (MNANG) apron is located north of Runway 12L-30R and accessible via Taxiway G. Apron D1 is approximately 850,000 square feet and north of Apron D1 is a closed taxilane and apron used by the MNANG museum. Both the D1 Apron and closed taxiway are outside of the MAC property line. Per the MNANG website, the MNANG operates the C-130 Hercules out of the MSP Base and provides airlift of troops, cargo, and medical patients along with expeditionary combat support in communications, security forces, and civil engineering worldwide.
- **Apron D2-** The United States Air Force Reserve, 934th Airlift Wing apron is located north of Runway 12L-30R and accessible via Taxiway R. Apron D2 is approximately 750,000 square feet, of which approximately 310,000 square feet is outside of the MAC property line. The 934th Airlift Wing operates the C-130 Hercules out of the MSP Station and provides worldwide deployment of people, cargo, and services which support the United States Air Force.
- **Apron E –** In the center of the airfield, south of the intersection of Runways 12R-30L and 4-22, is the fixed base operator (FBO) apron. This apron is approximately 820,000 square feet, and it allows for the parking of charter and private aircraft. Generally, the aircraft is ADG III or smaller, but access to the apron is suitable for up to ADG V aircraft, if needed. The apron is surrounded by 7 hangars and a Signature Flight Support (Signature) terminal building. The existing hangars total approximately 263,000 square feet.
- **Apron F1 –** Apron F1 is located off Taxiway S and is approximately 673,000 square feet total. Delta uses the apron area for maintenance and staging of aircraft. There are several Delta hangars and maintenance buildings with access to the apron.
- **Apron F2** - Apron F2 is also located off Taxiway S, to the west of the GRE. The apron is approximately 226,000 square feet. The apron is primarily used as a staging area by Delta for their cargo operations. The apron is accessible via a 107,000 square-foot cargo warehouse facility.
- **Apron F3 -** Apron F3 is located off Taxiway B at the approach end of Runway 30L. The apron is approximately 324,000 square feet and is used by Delta as an aircraft maintenance and staging area. A 115,000 square foot hangar provides access to apron area.
- **Apron G –** Apron G is located on the west side of the airfield off Taxiway L near the Runway 4 approach end. The apron is approximately 700,000 square feet and is used as an aircraft staging and maintenance area by Sun Country. There are three Sun Country hangars totaling approximately 235,000 square feet at the apron.

1.5.4.3 Remain-Overnight Parking (RON)

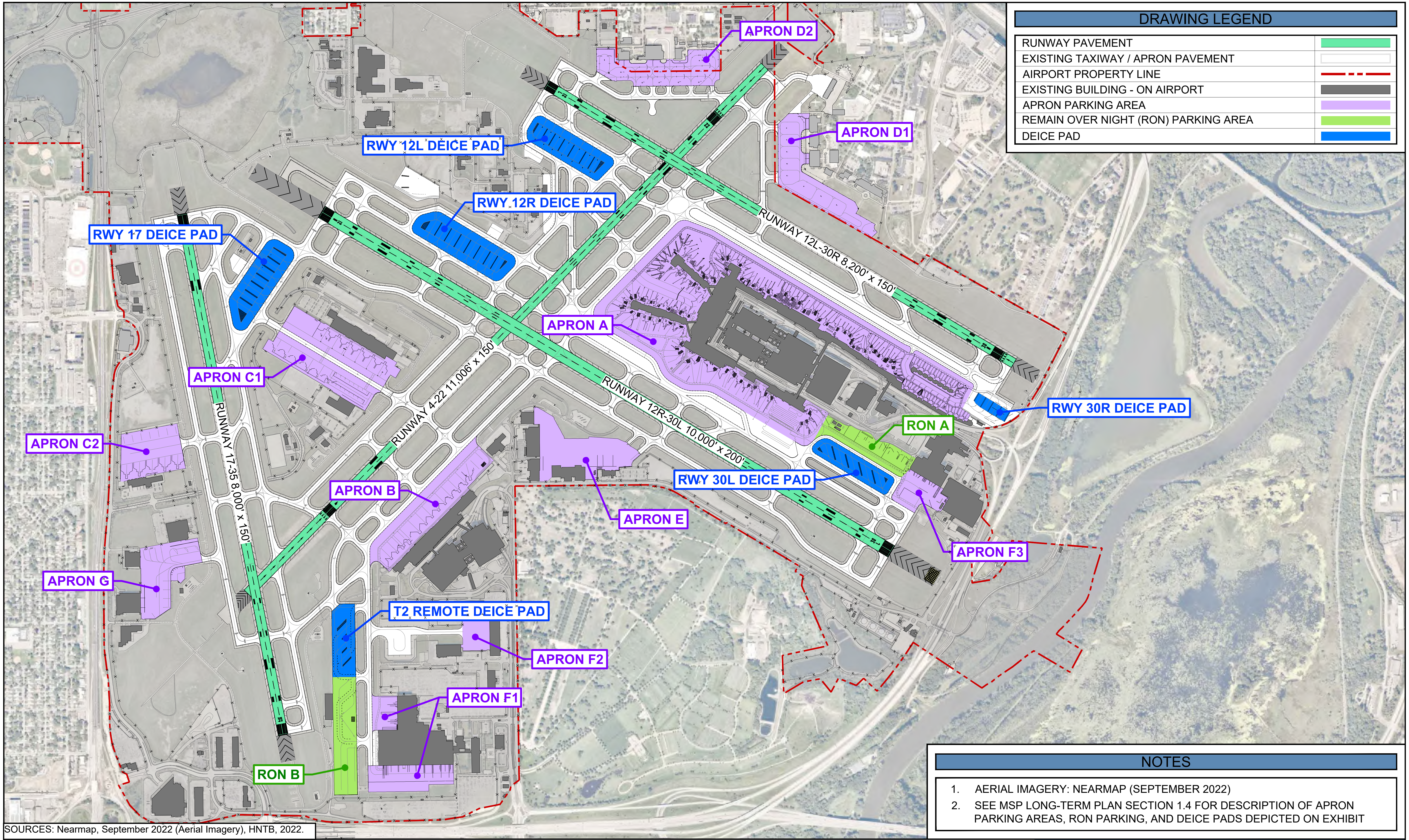
MSP has two designated Remain-Overnight (RON) parking areas depicted on **Exhibit 1-9**. RON A is located southeast of T1 Concourse G, accessible by Taxiway B, and is used by Delta for narrowbody RON parking. RON A can accommodate a maximum of seven narrowbody aircraft or a combination of widebody aircraft and reduced narrowbody positions. RON A has a jet blast wall protecting Foshay Drive from parked aircraft.

RON B is referred to as the T2 Remote Apron and is located east of Runway 35 with access from Taxilane S. While this location is available for RON operations, the area's primary use is as a deicing pad. When used for RON, the area is suitable for parking narrowbody aircraft in a variety of configurations. Airlines using this area for RON are most likely carriers operating from T2 which do not have a dedicated on-airport maintenance apron or a large number of contact gates, such as Allegiant, Frontier, or Jet Blue. The area also has a service vehicle storage facility attached to the west.

1.5.4.4 Deicing Pads

MSP has six deicing pads located near each runway end as shown on **Exhibit 1-8**. The Runway 17 Deice Pad is located adjacent to Runway 17 between Taxiways Y and Z and can accommodate seven narrowbody aircraft. The maximum size aircraft accommodated varies by spot on the deice pad. The largest aircraft that can be accommodated on the Runway 17 Deice Pad is the B757-300W. The T2 Remote Deice Pad is located to the south as a portion of the T2 Remote Apron and can accommodate six narrowbody aircraft. The largest aircraft accommodated on the northern three positions is the B737-900W and the largest aircraft accommodated on the southern three positions is the B757-300W. The Runway 12R Deice Pad is located northeast of Runway 12R along Taxiway A and can accommodate eight narrowbody aircraft. The largest aircraft accommodated on the northern six positions is the B757-300W and the largest aircraft accommodated on the southern two positions is the EMB-175. The Runway 30L Deice Pad is located adjacent to Runway 30L along Taxiway B and can accommodate five narrowbody aircraft. The largest aircraft accommodated on the deice pad is the B757-300W. The Runway 12L Deice Pad is adjacent to Runway 12L in between Taxiway P and Taxiway Q and can accommodate seven narrowbody aircraft. The maximum size aircraft accommodated varies by spot on the deice pad. The largest aircraft that can be accommodated on the Runway 12L Deice Pad is the B757-300W. The Runway 30R Deice Pad is at the end of T1 Concourse A, adjacent to Runway 30R, and can accommodate two narrowbody EMB-195 aircraft and two regional jet CRJ-900 aircraft.

The deicing pads are sized for narrow body aircraft usage and are used by the various airlines serving MSP. On occasion, widebody aircraft may be deiced at deicing pads, however they block the taxiway behind the aircraft when that occurs. Therefore, most widebody aircraft are deiced at or near their assigned gate position. The following users/carriers deice at gates or on the ramp: Air France, Bemidji Aviation, Delta widebody aircraft, FedEx, KLM, Signature, United, UPS, and west cargo carrier widebody aircraft.



SOURCES: Nearmap, September 2022 (Aerial Imagery), HNTB, 2022.

DRAWING LEGEND

RUNWAY PAVEMENT	
EXISTING TAXIWAY / APRON PAVEMENT	
AIRPORT PROPERTY LINE	
EXISTING BUILDING - ON AIRPORT	
APRON PARKING AREA	
REMAIN OVER NIGHT (RON) PARKING AREA	
DEICE PAD	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. SEE MSP LONG-TERM PLAN SECTION 1.4 FOR DESCRIPTION OF APRON PARKING AREAS, RON PARKING, AND DEICE PADS DEPICTED ON EXHIBIT

MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

JANUARY 2023

EXHIBIT 1-8

AIRCRAFT PARKING, RON, AND DEICE FACILITIES

1.5.4.5 Airfield Lighting

MSP has a variety of lighting systems to assist with operations during periods of low visibility or at night. A summary of lighting features for each runway is presented in **Table 1-15**. Existing lighting installations include the following:

- **Runway Lighting** – All runways are equipped with High Intensity Runway Edge Lights (HIRLs). In-pavement runway centerline lights (RCLs) are installed on all runways, except Runway 4-22.
- **Approach Lighting System (ALS)** – Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) are installed on the Runway 4 and 22 approach ends and are installed in-pavement along the respective 1,550-foot and 1,000-foot displaced thresholds. A Medium Intensity Approach Lighting System with Sequenced Flashing Lights (MALSF) is installed on the Runway 30R approach end. Runways supporting CAT II/III precision approaches have a High Intensity Approach Lighting System with Sequenced Flashers (ALSF-2) and are installed on the Runways 12R, 12L, 30L, and 35 approach ends.
- **Precision Approach Path Indicator (PAPI)** – PAPI is a lighting system that provides visual approach slope information. The system provides a combination of white and red-light projection patterns along the desired path to the touchdown point. All runways are equipped with a four-light PAPI system. All PAPIs, except for Runway 17, are located on the left side of the runway (when viewed from an aircraft on approach land).
- **Runway Status Lights (RWSLs)** – The RWSLs prevent runway incursions by providing a critical visual queue if the runway is in use and therefore unsafe for entry or crossing. There are two types of RWSLs: Takeoff Hold Lights (THLs) which are near the ends of the runway, and Runway Entrance Lights (RELs) which indicate when it is safe to enter or cross a runway. There are no THLs present at MSP. RELs are present at Runway 17-35 at taxiways K1, K2, K3, N (both sides of Runway 17-35), K6, Y, L3, L6, and L7; at Runway 12R-30L at Taxiways A1, A2, A3, A5, A7, D (both sides of Runway 12R-30L), C (both sides of Runway 12R-30L), M (both sides of Runway 12R-30L), A8, A9, A10, W1, W2, W3, W5, W7, W8, W9, and W10; and at Runway 12L-30R at Taxiways P1, P2, G (both sides of Runway 12L-30R), C (both sides of Runway 12L-30R), P9, P10, R9, and R10.
- **Runway End Identifier Lights (REIL)** – REILs consist of two synchronized flashing strobe lights (one on each side of the runway at the threshold), providing a visual reference point to assist pilots in identifying the runway end during approach. Only the approach end of Runway 17 has REILs installed.
- **Airport Beacon** – The airport beacon is located northeast of Runway 12R-30L near the VOR sight. The airport beacon indicates the location of the airport to pilots at night.
- **Taxiway Lighting** – All taxiways have Medium Intensity Taxiway Lights (MITL) to support nighttime and low visibility operations. Select taxiways also feature in-pavement Taxiway Centerline Lighting (TCL). Installation of TCLs are generally tied to being on a Surface Movement Guidance and Control System (SMGCS) routing for low visibility operations (CAT II/III).

- **Runway Guard Lights (RGL)** – RGLs are intended to reduce the likelihood of a runway incursion by indicating to pilots the presence of a runway. RGLs include both aboveground (wigwags) and in-pavement lighting. The yellow lights flash and alternate to enhance situational awareness. At MSP, all runway-taxiway intersections include aboveground RGLs.

Table 1-15: Existing Runway Lighting

	Runway End							
Lighting	4	22	12L	30R	12R	30L	17	35
HIRL	X	X	X	X	X	X	X	X
RCL			X	X	X	X	X	X
MALSR	X	X						
MALSF				X				
ALSF-2			X		X	X		X
PAPI	X	X	X	X	X	X	X	X
REIL							X	
RGL	X	X	X	X	X	X	X	X

NOTES:
HIRL – High-Intensity Runway Light
RCL – Runway Centerline Light
MALSR – Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights
MALSF – Medium-Intensity Approach Lighting System with Sequenced Flashing Lights
ALSF-2 – High-Intensity Approach Lighting System with Sequenced Flashing Lights
PAPI – Precision Approach Path Indicator
REIL – Runway End Identifier Light
RGL – Runway Guard Light
SOURCE: HNTB Corporation, November 2022.

1.5.4.6 Navigational Aids

MSP has a variety of navigational aids (NAVAIDs) to aid aircraft operations at the Airport. NAVAIDs are generally classified as precision, non-precision, or visual, and the category of NAVAIDs present determines the approach type for each runway end.

NAVAIDs, for use by a precision instrument approach procedure, typically include a glideslope antenna (GS), localizer antenna (LOC), and select Global Positioning Systems (GPS). These NAVAID components, when combined, create a horizontally and vertically guided Instrument Landing System (ILS).

Non-precision NAVAIDs include GPS, Airport Surveillance Radar 9 (ASR-9), Very High Frequency (VHF) Omni-Directional Range (VOR) with or without Distance Measuring Equipment (DME), Non-Directional Beacon (NDB), Runway Visual Range (RVR), and Tactical Air Navigation (TACAN). **Table 1.4-5** summarizes the various NAVAIDs available for each runway end.

Table 1-16: Existing Navigational Aids

	Runway End							
NAVAID	4	22	12L	30R	12R	30L	17	35
Glideslope Antenna			X	X	X	X		X
Localizer Antenna	X	X	X	X	X	X	X	X
Runway Visual Range	X	X	X	X	X	X	X	X
Inner Marker Beacons			X		X	X		X
Distance Measuring Equipment			X	X	X	X	X	X

NOTE: NAVAID – Navigational Aid
SOURCE: HNTB Corporation, November 2022.

1.5.4.7 Runway Operating Characteristics

MSP has historically operated with five runway-use configurations. The flows, driven by wind and weather conditions, are North, Straight North, Mixed A, South, and Straight South. **Table 1-17** describes the configurations that are depicted on **Exhibit 1-9**. In total, the modeled flows represent 91.92% of the average annual runway-use configuration. During strong winter storms, where winds tend to originate from the north, Runway 35 is used as the primary arrival runway and Runway 4 is used as the primary departure runway. Departing aircraft generally enter Runway 4 at Taxiway S for this runway-use configuration.

Table 1-17: Runway Operating Configurations

	North	Straight North	Mixed A	South	Straight South
Arrival Runway(s)	30L, 30R, 35[1]	30L, 30R	30L, 30R	12L, 12R	12L, 12R
Departure Runway(s)	30L, 30R	30L, 30R	30L, 30R, 17	12L, 12R, 17	12L, 12R

NOTE:
1 Requires the use of a complex Converging Runway Operation (CRO) with simultaneous arrivals on Runways 30L, 30R, and 35.
SOURCE: Metropolitan Airports Commission, 2022.

1.5.4.8 Runway Wind Coverage

The existing runway configuration's ability to accommodate wind coverage requirements as outlined by the FAA in Advisory Circular 150/5300-13B is presented below. To accommodate the existing AAC D aircraft operations, MSP needs to cover at least 95% of all-weather combined wind coverage for the 20-knot crosswind component. This requirement is met for each runway, as well as the combined airfield wind coverage requirement. **Table 1-18** to **Table 1-22** summarize the wind coverage data for the runways at MSP.

STRAIGHT NORTH FLOW
VMC / MVMC / IMC

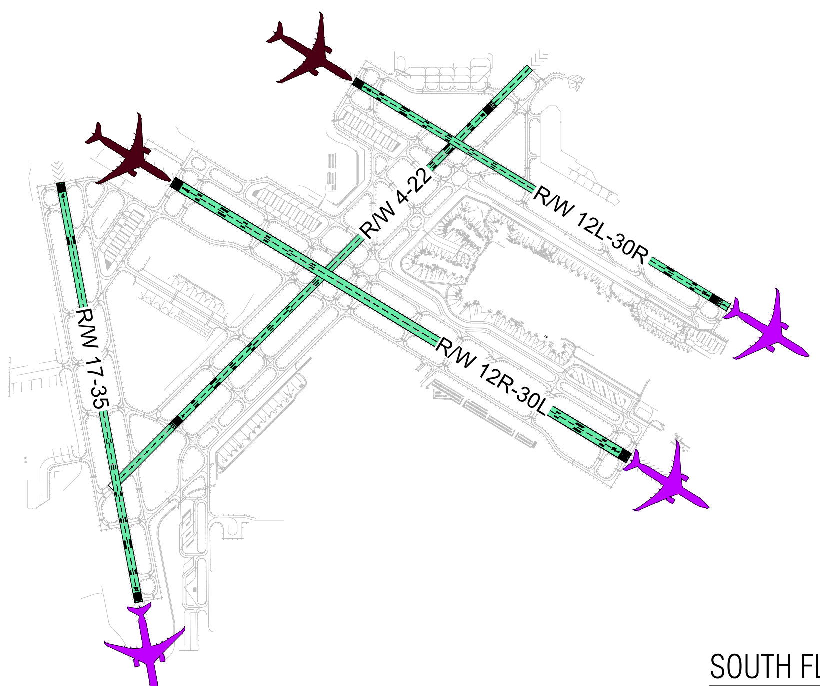
MIXED FLOW A
VMC / MVMC / IMC

VISUAL METEOROLOGICAL CONDITIONS (VMC)
CEILING HEIGHT ≥ 2,500' AND VISIBILITY ≥ 5 MILES

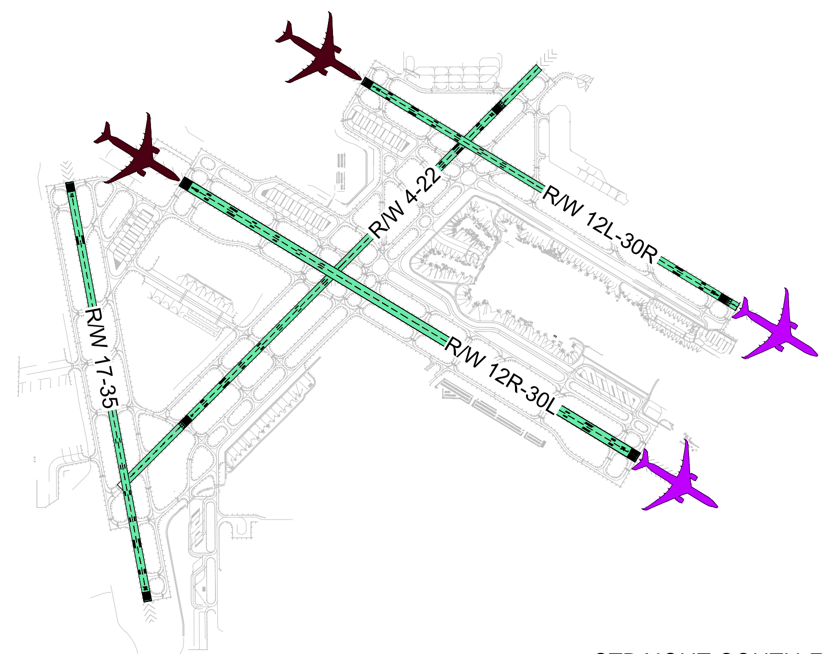
MARGINAL VISUAL METEOROLOGICAL CONDITIONS (MVMC)
CEILING HEIGHT < 2,500' AND ≥ 800' OR
VISIBILITY < 5 MILES AND ≥ 2 MILES

INSTRUMENT METEOROLOGICAL CONDITIONS (IMC)
CEILING HEIGHT < 800' OR VISIBILITY < 2 MILES

SOURCE: FAA, AVIATION SYSTEM PERFORMANCE METRICS, AIRPORT EFFICIENCY MODULE



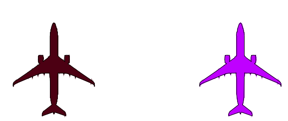
SOUTH FLOW
VMC / MVMC / IMC



STRAIGHT SOUTH FLOW
VMC / MVMC / IMC

NORTH FLOW
VMC / MVMC

DRAWING LEGEND	
EXISTING RUNWAY PAVEMENT	
EXISTING TAXIWAY / APRON PAVEMENT	



SOURCES: Nearmap, September 2022 (Aerial Imagery).

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MINNEAPOLIS-SAINT PAUL
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NOT TO SCALE

JANUARY 2023
EXHIBIT 1- 9
RUNWAY OPERATING CONFIGURATIONS

Table 1-18: Runway 4-22 Wind Coverage

Crosswind Component (Knots)	VFR Coverage	IFR Coverage	All Weather Coverage
10.5	81.71%	83.40%	81.97%
13.0	89.28%	90.33%	89.44%
16.0	96.58%	96.73%	96.63%
20.0	99.24%	99.14%	99.24%

NOTES: VFR – Visual Flight Rules; IFR – Instrument Flight Rules
SOURCE: U.S. Department of Transportation, Federal Aviation Administration, Airport Data and Information Portal (ADIP), 2022.

Table 1-19: Runway 12L/R to Runway 30L/R Wind Coverage

Crosswind Component (Knots)	VFR Coverage	IFR Coverage	All Weather Coverage
10.5	91.94%	88.87%	91.60%
13.0	96.15%	94.11%	95.92%
16.0	99.13%	98.15%	99.02%
20.0	99.86%	99.63%	99.83%

NOTES: VFR – Visual Flight Rules; IFR – Instrument Flight Rules
SOURCE: U.S. Department of Transportation, Federal Aviation Administration, Airport Data and Information Portal (ADIP), 2022.

Table 1-20: Runway 17-35 Wind Coverage

Crosswind Component (Knots)	VFR Coverage	IFR Coverage	All Weather Coverage
10.5	89.37%	88.02%	89.25%
13.0	94.40%	93.42%	94.31%
16.0	98.24%	97.85%	98.21%
20.0	99.60%	99.48%	99.59%

NOTES: VFR – Visual Flight Rules; IFR – Instrument Flight Rules
SOURCE: U.S. Department of Transportation, Federal Aviation Administration, Airport Data and Information Portal (ADIP), 2022.

Table 1-21: All Runways Wind Coverage

Crosswind Component (Knots)	VFR Coverage	IFR Coverage	All Weather Coverage
10.5	99.71%	99.65%	99.70%
13.0	99.95%	99.95%	99.95%
16.0	99.99%	99.99%	99.99%
20.0	100%	100%	100%

NOTES: VFR – Visual Flight Rules; IFR – Instrument Flight Rules
SOURCE: U.S. Department of Transportation, Federal Aviation Administration, Airport Data and Information Portal (ADIP), 2022.

Table 1-22: Runway Operating Configurations – Instrument Flight Rules Coverage (20 Knots)

Runway Operating Configuration	Wind Coverage
Straight North	71.02%
Mixed A	98.72%
South	84.42%
Straight South	79.93%

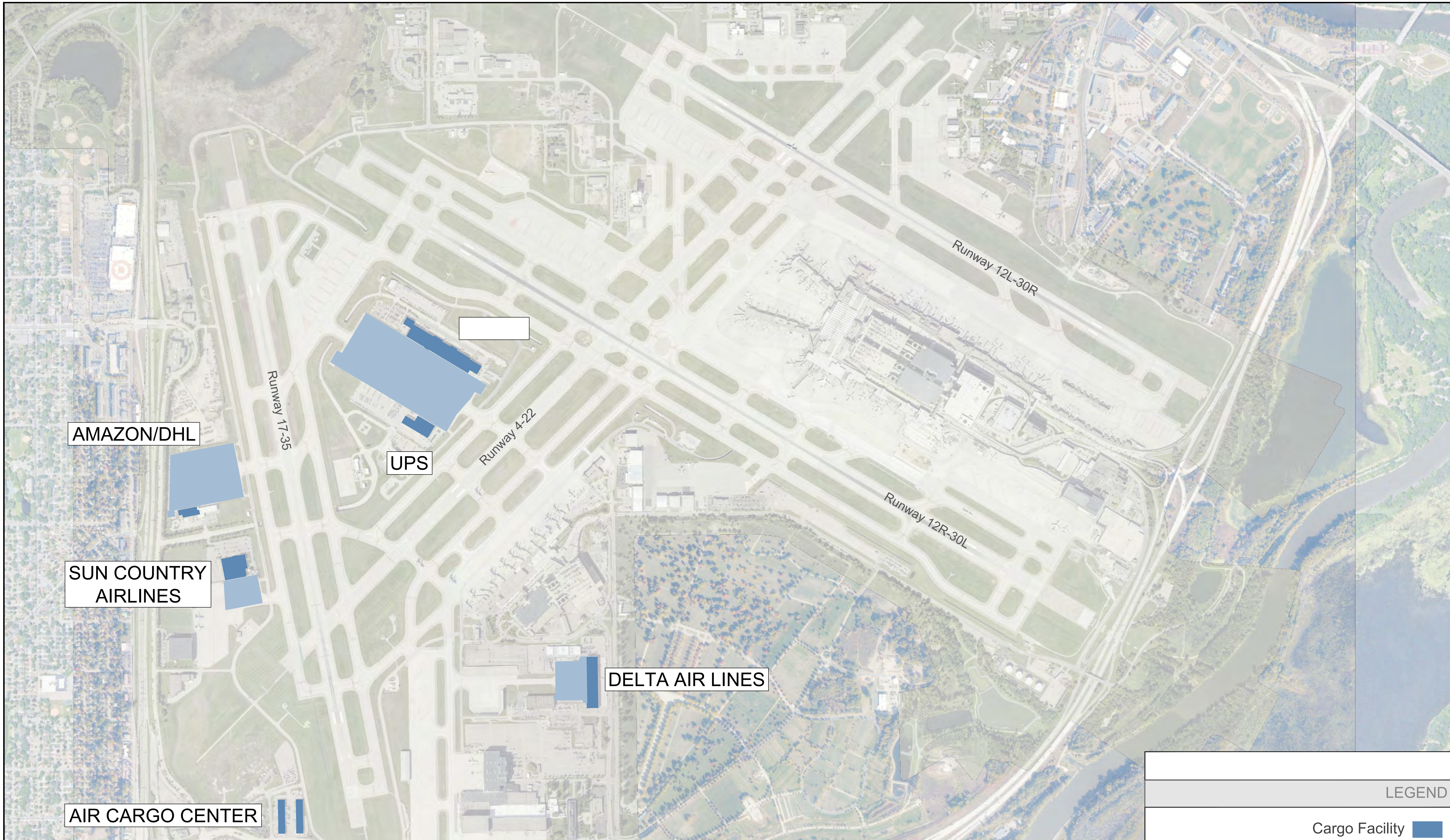
SOURCE: U.S. Department of Transportation, Federal Aviation Administration, Airport Data and Information Portal (ADIP), 2022.

1.5.5 Cargo

Air cargo facilities at MSP are located on the west and south sides of the Airport with on-airport cargo handling and processing generally occurring in four primary locations: 1) FedEx and UPS facilities, 2) the DHL facility (Amazon/DHL) and Sun Country facility, 3) Air Cargo Center, and 4) Main Delta Cargo facility. **Exhibit 1-10**, MSP Air Cargo Facilities Map shows a map of the Airport and location of the cargo facilities.

The existing cargo facilities at MSP shown in **Table 1-23** represent approximately 523,000 square feet of total cargo building area designated for air cargo activities. All the space leased to FedEx and UPS is dedicated to air cargo whereas Delta facilities, the DHL facility housing Amazon and DHL, and the Air Cargo Center also have other aeronautical or non-cargo related activities which are not accounted for in the summary table below. Freighter cargo (primarily FedEx and UPS) represented about 88% of total air cargo in 2020 but has historically only represented about 74% of total air cargo, the remainder being transported in the belly hold of commercial passenger aircraft. The recent shifts in air cargo segments are mainly due to the impact of the COVID-19 pandemic and the reduction in scheduled passenger services at MSP.

Due to the pandemic, the Delta Dash facility has been closed. All volume is being processed through their main cargo facility. As passenger flights return and more belly space becomes available, the Dash facility may reopen.



SOURCES: Metropolitan Airports Commission, 2022 (Basemap); Nearmap, September 2022 (Aerial Imagery), Ricondo & Associates, Inc., 2022.

MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT

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EXHIBIT 1-10

Existing Cargo Facilities

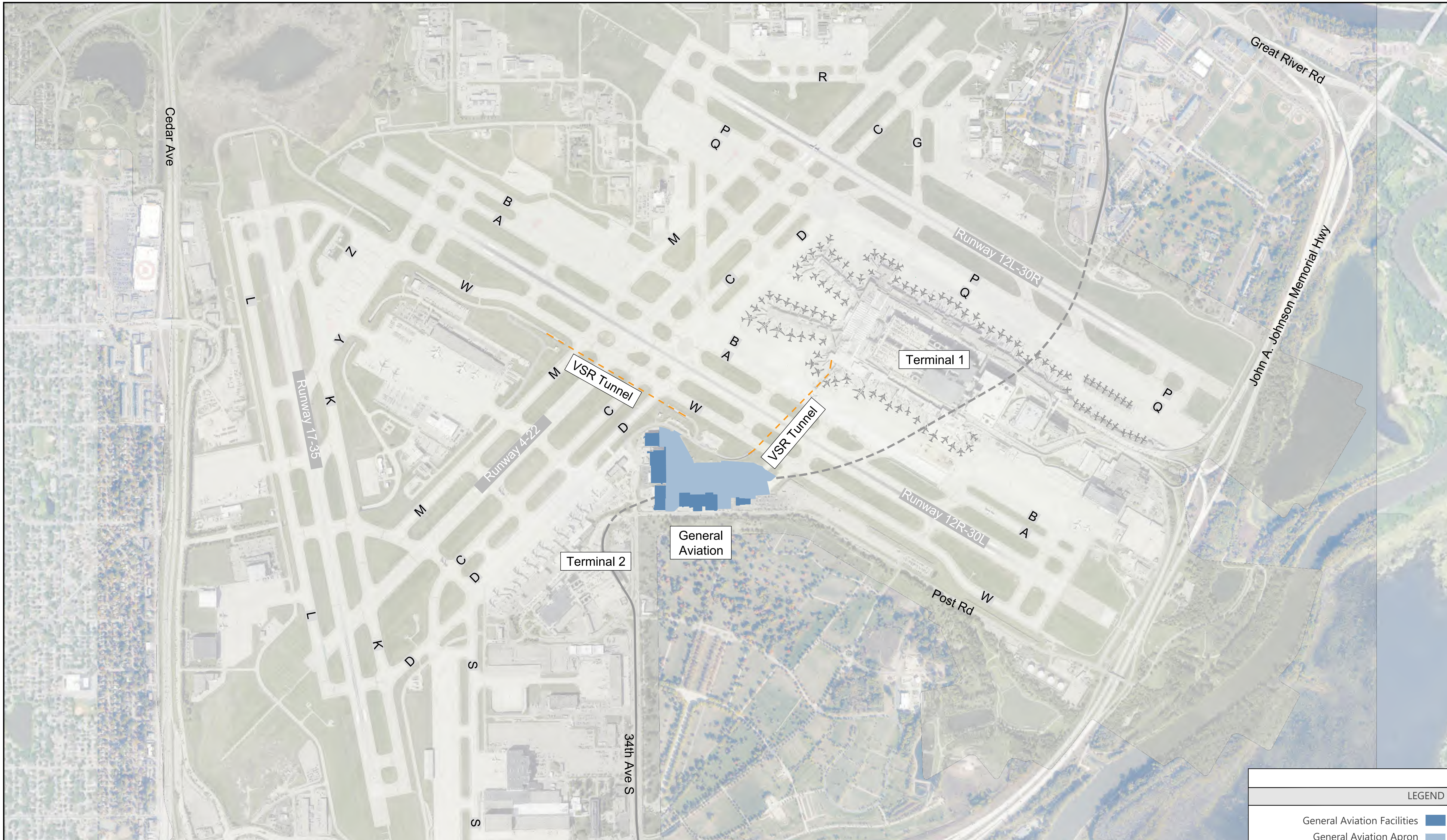
Table 1-23: Existing Air Cargo Facilities

Building	Carrier	Building SQ FT	Apron SQ FT	Landside/Other SQ FT	2020 Metric Tons
FedEx	FedEx	203,000	341,000	522,540	89,793
UPS	UPS	67,000	406,128	558,374	70,566
Delta	Main Delta Cargo	104,036	0	585,698	18,365
	Delta Dash	2,064	0	33,000	
DHL	Amazon (Atlas/Sun Country)	3,009	240,000	54,828	12,216
	DHL	33,284			7,531
	WFS	10,134			Handler Only
Sun Country Headquarters	Sun Country (Belly/Amazon)	6,165		Shared	1,837
Air Cargo Center	Other/WFS	23,953	0	Shared	3,389
	Southwest Airlines	7,458	0	Shared	
	Air General	7,575	0	Shared	
	Vacant (old DHL)	55,000	0	Shared	0
Total Estimate		**522,678**	**987,128**		**203,697**

NOTES:
UPS – United Parcel Service
DHL – Dalsey, Hillblom and Lynn
WFS – Worldwide Flight Services
The Delta Dash facility closed in 2020, but it may reopen.
SOURCE: Landrum & Brown, Inc., Cargo Facts, April 2019 (data provided by carriers).

1.5.6 General Aviation

General aviation (GA) facilities are located on a 37-acre site off East 70th Street. Fixed Base Operator (FBO) services are provided by Signature Flight Support (Signature). In 2002, Signature built a new GA facility, which now provides 18,500 square feet of facilities featuring a lobby, office space, conference rooms, private phone suites, pilot lounge, showers, lockers, a game room, and a quiet room. A 3,700 square-foot garage provides indoor storage for ground equipment. There are also about 185 public automobile parking spaces. The site includes about 267,000 square feet of hangar/storage/shop space and 88,000 square yards of apron. The FBO also provides aircraft maintenance. The General Aviation (GA) apron is shown on **Exhibit 1-11**.



SOURCES: Metropolitan Airports Commission, 2022 (Basemap); Nearmap, September 2022 (Aerial Imagery), Ricondo & Associates, Inc., 2022.

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EXHIBIT 1-11
General Aviation Facilities

1.5.7 Support Facilities

Support facilities (which include airline maintenance, airport maintenance, Aircraft Rescue & Fire Fighting (ARFF) facilities), Federal Aviation Administration facilities, and miscellaneous facilities are in various locations of the airport.

Delta (which acquired Northwest) occupies two maintenance complexes and a cargo facility on the south side of the airport. Most of the old Northwest Building B maintenance facility (adjacent to the T1 inbound/outbound roadway) has been demolished. Two hangars, an engine test cell, and associated facilities that remain (approximately 751,000 square feet), are used by Delta for aircraft maintenance, shops, and repairs. Delta's maintenance and cargo facilities are shown on **Exhibit 1-12.**

There are three additional airline maintenance hangars on the western edge of the airfield that provide a total of approximately 247,000 square feet of floor space for hangars, shops, and offices. These hangars are shown on **Exhibit 1-12.**

The main Aircraft Rescue & Fire Fighting (ARFF) facility is located near the center of the airfield on the south side of the runways; a satellite ARFF facility is located on the north side of the airfield between the parallel runways. The ARFF facilities are shown on **Exhibit 1-12**.

SOURCES: Metropolitan Airports Commission, 2022 (Basemap); Nearmap, September 2022 (Aerial Imagery), Ricondo & Associates, Inc., 2022.

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EXHIBIT 1-12
Support Facilities

1.6 ENVIRONMENTAL CONSIDERATIONS

This section reviews the environment around the Airport, such as the parks, wetlands and waterways, and historic sites. In addition, proposed projects and improvements are reviewed, as well as the MSP 2020 Improvements Environmental Assessment / Environmental Assessment Worksheet.

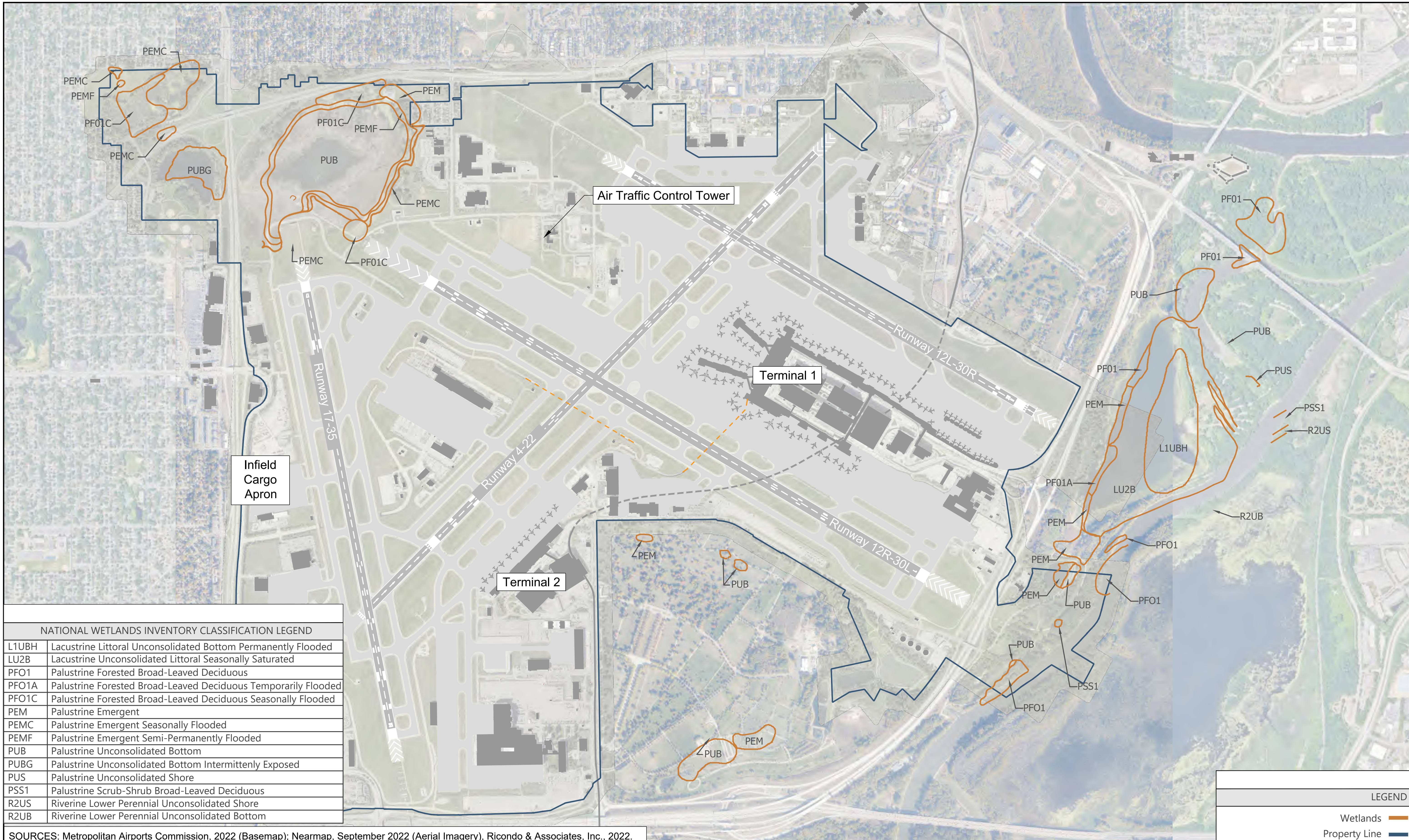
1.6.1 Environment Around the Airport

As previously shown on **Exhibit 1-3**, many state and regional parks are within the vicinity of MSP, including Fort Snelling State Park, located just beyond Runway 30R-30L, as well as Pike Island Park, Washington Park, Wilson Park, Veterans Memorial Park, Taft Park, and Morris Park. The Minnesota Valley National Wildlife Refuge is adjacent to MSP, located just south of I-494 in Bloomington.

Additionally, many historic sites are at or near MSP. Historic sites include Fort Snelling beyond the northeast corner of the Airport, and the Original Wold-Chamberlain Terminal Historic District on Airport property.

The Minnesota River runs along the east side of MSP from the northeast corner and continues south. The majority of stormwater from the Airport drains via storm sewers to retention ponds prior to discharge to the Minnesota River. Many lakes are also within the vicinity of MSP, including Mother Lake at the northwest corner of the Airport and Snelling Lake to the southeast. Only a few remnant wetlands at the north end of Runway 17, adjacent to the Mother Lake area, are still in existence on the airfield.

The wetlands were mitigated through permits granted by the U.S. Army Corps of Engineers (USACE) and the Minnesota Department of Natural Resources (DNR), as well as in accordance with federal and state laws. The MAC serves as its own local government unit for any Wetland Conservation Act (WCA) jurisdictional wetlands. The Minnesota DNR would have jurisdiction over any remnants that qualify under its authority. **Exhibit 1-13** depicts the National Wetlands Inventory within the Airport property.



NATIONAL WETLANDS INVENTORY CLASSIFICATION LEGEND

L1UBH	Lacustrine Littoral Unconsolidated Bottom Permanently Flooded
LU2B	Lacustrine Unconsolidated Littoral Seasonally Saturated
PFO1	Palustrine Forested Broad-Leaved Deciduous
PFO1A	Palustrine Forested Broad-Leaved Deciduous Temporarily Flooded
PFO1C	Palustrine Forested Broad-Leaved Deciduous Seasonally Flooded
PEM	Palustrine Emergent
PEMC	Palustrine Emergent Seasonally Flooded
PEMF	Palustrine Emergent Semi-Permanently Flooded
PUB	Palustrine Unconsolidated Bottom
PUBG	Palustrine Unconsolidated Bottom Intermittenly Exposed
PUS	Palustrine Unconsolidated Shore
PSS1	Palustrine Scrub-Shrub Broad-Leaved Deciduous
R2US	Riverine Lower Perennial Unconsolidated Shore
R2UB	Riverine Lower Perennial Unconsolidated Bottom

SOURCES: Metropolitan Airports Commission, 2022 (Basemap); Nearmap, September 2022 (Aerial Imagery), Ricondo & Associates, Inc., 2022.

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EXHIBIT 1-13
National Wetlands Inventory

1.6.2 2020 Improvements Environmental Assessment / Environmental Assessment Worksheet Overview

Most of the environmental considerations for the 2040 LTP have not changed from the 2030 LTP document. Both plans' requirements for growth are focused primarily on the terminal and landside development efforts. Due to the similarities between the two plans, it was determined that the MSP 2020 Improvements Environmental Assessment / Environmental Assessment Worksheet (EA/EAW), which covers anticipated Airport development needs, would be an appropriate document for the inventory of environmental considerations for the 2040 LTP.

The MSP 2020 EA/EAW was completed in 2013 to ensure an acceptable LOS at the Airport through 2020. Proposed projects and improvements covered by the EA/EAW were based on the preferred development option from the 2030 LTP. Reference **Appendix B** for the entire document.

The MAC coordinated with the FAA, stakeholders, and the public throughout the preparation of the EA/EAW. Coordination began in late 2010, which was followed by public presentations and briefings throughout 2011 and 2012. Public comments for the EA/EAW closed in October 2012.

The MAC determined that the MSP 2020 Improvements Project was adequate under the Minnesota Environmental Policy Act (MEPA), and the proposed MSP 2020 Improvements EA/EAW did not have the potential for significant environmental effects. In turn, an environmental impact statement (EIS) for the proposed MSP 2020 Improvements Project was not necessary. The EA/EAW findings were as follows:

- The air quality assessment for the preferred development meets National Ambient Air Quality Standards (NAAQS) for Hennepin County, designated as the attainment area for the EA/EAW.
- The proposed project would result in an increase in greenhouse gas (GHG) emissions of less than 1% over the Airport's 2010 existing GHG emissions.
- The project improves highway operations without adding significant new capacity; therefore, emissions from vehicles within the project attainment area will not differ materially from 2010 conditions.
- Emissions from construction projects associated with the proposed project will be *de minimis* and temporary. Mitigation measures, such as dust control measures and management of soil and water contamination, will be necessary for any impacts during these projects.
- As of 2020, the Airport's existing airfield can accommodate forecasted daily and annual demand at a reduced LOS. Aircraft noise impacts are virtually identical under the no-action alternative and the preferred development project.
- The proposed project will not result in changed conditions in land use compatibility related to socioeconomic impacts, vehicular traffic, endangered or threatened species, or historical, architectural, archeological, and cultural resources.

The proposed development required federal actions and approvals by the FAA and the Federal Highway Administration (FHWA), including local approvals by the MAC. The EA/EAW addressed all the impact categories discussed in the EAW form under MEPA, as well as all FAA and FHWA impact categories. In 2013, the FAA issued a finding of no significant impact/record of decision (FONSI /ROD), determining the EA/EAW for the proposed MSP 2020 Improvements project was adequate under the National Environmental Policy Act (NEPA), and there were no significant impacts associated with the proposed project.

1.6.3 Approved Environmental Review Projects

The proposed MSP 2020 Improvements project did not necessitate changes to runway usage or increase aircraft operations. The Airport's existing infrastructure could accommodate the forecast daily and annual demand for 2020, with a reduced LOS. Future impacts were found to be compliant with existing environmental conditions, with mitigation in several aspects of Airport development.

The environmental projects list for the 2040 LTP is derived from the preferred development option in the MSP 2020 Improvements EA/EAW (January 2013). **Table 1-24** lists the historical improvements that are included and approved. **Table 1-25** lists the proposed improvements that are included and approved. These improvements are presented on **Exhibit 1-14**. Diagrams of the approved environmental review projects for T1 and T2 are presented on **Exhibits 1-15** and **1-16**, respectively.

These development projects in the list have been completed since the approval of the EA/EAW:

- Runway 17 Deicing Pad Construction
- Runway 17-35 Land Acquisition

Table 1-24: (1 of 3) Historical Airport Projects Previously Identified for Consideration of Cumulative Environmental Impacts at the Airport

Project	Description	Construction Year
Runway 17 Deicing Pad Construction	Constructed a deicing/holding pad for Runway 17. Included paving of adjacent Taxiways W, Y, K8, and Y3 and a snow-melt pad associated with the glycol collection system. Also included construction of a support facility for deicing vehicles. The support facility has six 2,000-gallon glycol tanks and pumps and supply piping for Type I glycol.	2005
Runway 17-35 Land Acquisition	Acquired off-Airport land required to provide for the Runway 17-35 runway protection zone (RPZ). In addition, 29 single-family residences and 2 apartment complexes with a total of 132 units located in Bloomington, south and east of Mall of America, were acquired for noise mitigation purposes.	2005–2006
Taxiway Q Construction	Constructed Taxiway Q between Runway 4-22 and Taxiway C.	2005
Residential Sound Insulation – 2007 Day-Night Average Sound Level (DNL) 65 Contour	Completed the program to insulate single-family residential houses within the certified 2007 DNL 65 noise contour.	2007
Taxiway C/D Complex	Reconstructed and reconfigured Taxiways C and D between Runway 12L-30R and Runway 12R-30L. This project relocated both taxiways further to the west, which allowed unrestricted access of Group V aircraft around the west side of Concourses E and F.	2005–2010
34th Avenue Reconstruction – North of 70th Street	Reconstructed 34th Avenue north of 70th Street.	2005
Taxiway M Extension	Extended Taxiway M to the south, approximately 2,100 feet, to connect with Taxiway S to provide an alternative taxi route for Runway 17 departures for T1 during low visibility conditions.	2006
Multi-Family Sound Insulation (Inside 2007 65 DNL)	Sound insulated 575 multi-family units within the 2007 65 DNL contour.	2007

SOURCE: HNTB Corporation, 2013.

Table 1-24: (2 of 3) Historical Airport Projects Previously Identified for Consideration of Cumulative Environmental Impacts at the Airport

Project	Description	Construction Year
Metropolitan Airports Commission (MAC)		
T2 Parking Structure Expansion	Expanded the T2 parking structure to provide an additional 4,550 parking spaces, as well as vertical circulation to link the Light Rail Transit (LRT) to the new skyway to the T2 Terminal.	2007
Pavement Rehabilitation – Runway 12R-30L	Reconstructed the middle section of Runway 12R-30L located between Runway 4-22 and Taxiway A4.	2009
Residential Sound Insulation	Conducted sound insulation program based on the 2007 Noise Exposure Map contained in the Part 150 Update, consistent with the terms and conditions of the court-ordered Consent Decree.	2008
Taxiway P Reconstruction	Realigned and reconstructed the section of Taxiway P from Taxiway C to Taxiway P4. This project provided for the mill and overlay of the bituminous section on Runway 12L-30R from Runway 4-22 to Taxiway P6.	2008–2009
Concourse G Extension – Site Preparation	Demolished the Building B complex, except for premises retained by Northwest.	2009
Airport Lane / 34th Avenue Access Reconfiguration	Realigned the access from 34th Avenue and the Airport to conform to standards for similar types of intersections.	2009
Noise Mitigation Settlement	Continued the implementation of the noise mitigation program based on the Noise Exposure Map contained in Part 150 Update, consistent with the terms and conditions of the court-ordered Consent Decree.	2011–2012
Data Center Facilities	Constructed a new consolidated data center.	2012
Taxiway C Extension to T2 Remote	Extended Taxiway C between Taxiway S and the T2 Remote Apron to improve access to and from the T2 Remote Apron and the Delta Building C maintenance complex.	2011
North-Side Storm Sewer Improvements	Conducted improvements to the storm sewer system and Ponds 3 and 4 between Pond 3 and the Minnesota River.	2012–2013
Minnesota Department of Transportation (MnDOT)		
I-494 between 34th Avenue and France Avenue	Included milling, overlay, and construction of a west-bound auxiliary lane from Portland Avenue to Nicollet Avenue, a median barrier, and drainage. It also included construction of a west-bound auxiliary lane 35W to TH 100 and replacement of the Xerxes Avenue bridges.	2013

SOURCE: HNTB Corporation, 2013.

Table 1-24: (3 of 3) Historical Airport Projects Previously Identified for Consideration of Cumulative Environmental Impacts at the Airport

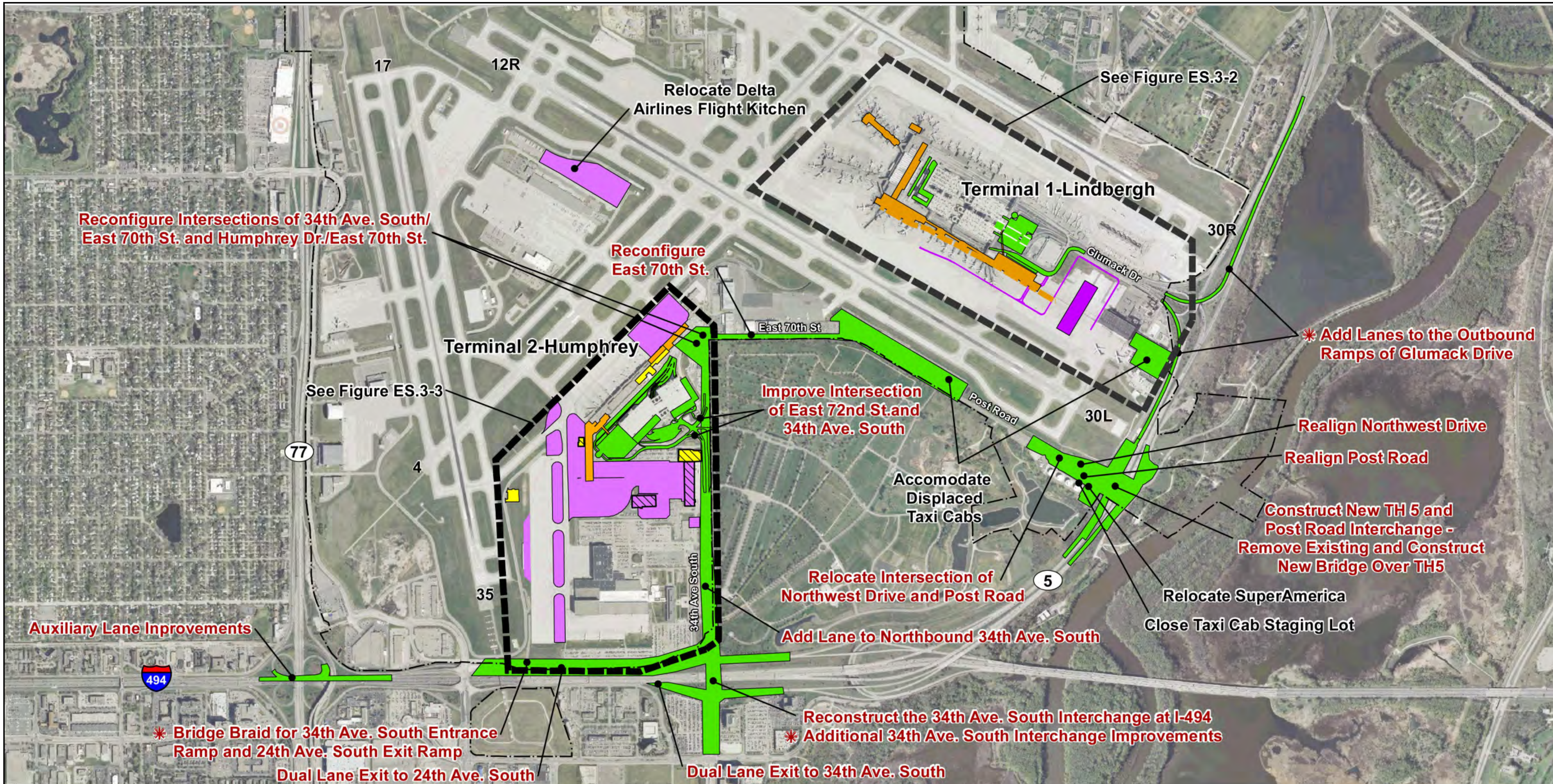
Project	Description	Construction Year
Federal Aviation Administration (FAA)		
Performance-Based Navigation (PBN) Procedure Design and Implementation	Beginning in November 2010, the FAA worked to develop PBN procedures and a plan for implementation. In addition to safety and operational considerations, the FAA included noise criteria that were developed by the Airport Noise Oversight Committee (NOC). The NOC noise criteria focused on a noise analysis, including DNL noise contour and single-event noise evaluations of the proposed procedures; a public information program; and various procedure design considerations intended to reduce noise impacts around the Airport, where possible.	2013
	At the Sept. 19, 2012, NOC meeting, the FAA Air Traffic Organization (ATO) presented the PBN procedures, highlighting the considerations given to the NOC design criteria. The Metropolitan Airports Commission (MAC) provided its noise analysis of the procedures in compliance with the related NOC criteria. The NOC facilitated the noise contour analysis. The FAA indicated during the meeting that a statement of support for the area navigation (RNAV) implementation was needed from the MAC by the end of November 2012, to avoid lengthy delays in procedure publications. This support was needed to meet FAA ATO requirements under FAA Order 7400.2. In response, the NOC moved forward with hosting two public open houses prior to the November 2012 NOC meeting. (The NOC facilitated the public information process.)	
	Subsequently, at the Nov. 14, 2012, NOC meeting, the Committee determined the FAA's process adequately considered the Committee's noise criteria, and the NOC sent its recommendations to the MAC. However, based on extensive input from community leaders and Airport neighbors, the MAC voted on Nov. 19, 2012, to provide support for the FAA's plan, except for departures on Runways 30L and 30R, which fly to the northwest of the Airport over communities such as South Minneapolis and Edina. The FAA ATO is currently evaluating the partial implementation supported by the MAC.	

SOURCE: HNTB Corporation, 2013.

Table 1-25: Historical Proposed Airport Projects Previously Identified for Consideration of Cumulative Environmental Impacts at the Airport

Project	Description	Construction Year
Proposed T2 North Terminal Expansion	Proposed concourse and apron extension of the north end of T2. The 2030 LTP discussed an additional 178% of demand capacity over the existing system.	TBD
Proposed T2 South Terminal Expansion	Proposed concourse and apron extension of the south end of T2. The 2030 LTP discussed an additional 178% of demand capacity over the existing system.	TBD
Concourse G Extension	Proposed concourse extension on the south end of the existing Concourse G. The 2030 LTP discussed an additional 54% demand capacity over the existing system.	TBD

SOURCE: HNTB Corporation, 2013.



LEGEND

- Proposed Terminal Projects
- Proposed Landside/Roadway Projects
- Proposed Airside Projects
- Planned Post 2020
- Projects that are Underway
- Remove and/or Relocate
- MAC Property

SOURCE: HNTB, *Minneapolis-Saint Paul International Airport* 2020 Improvements Final Environmental Assessment / Environmental Worksheet, January 2013

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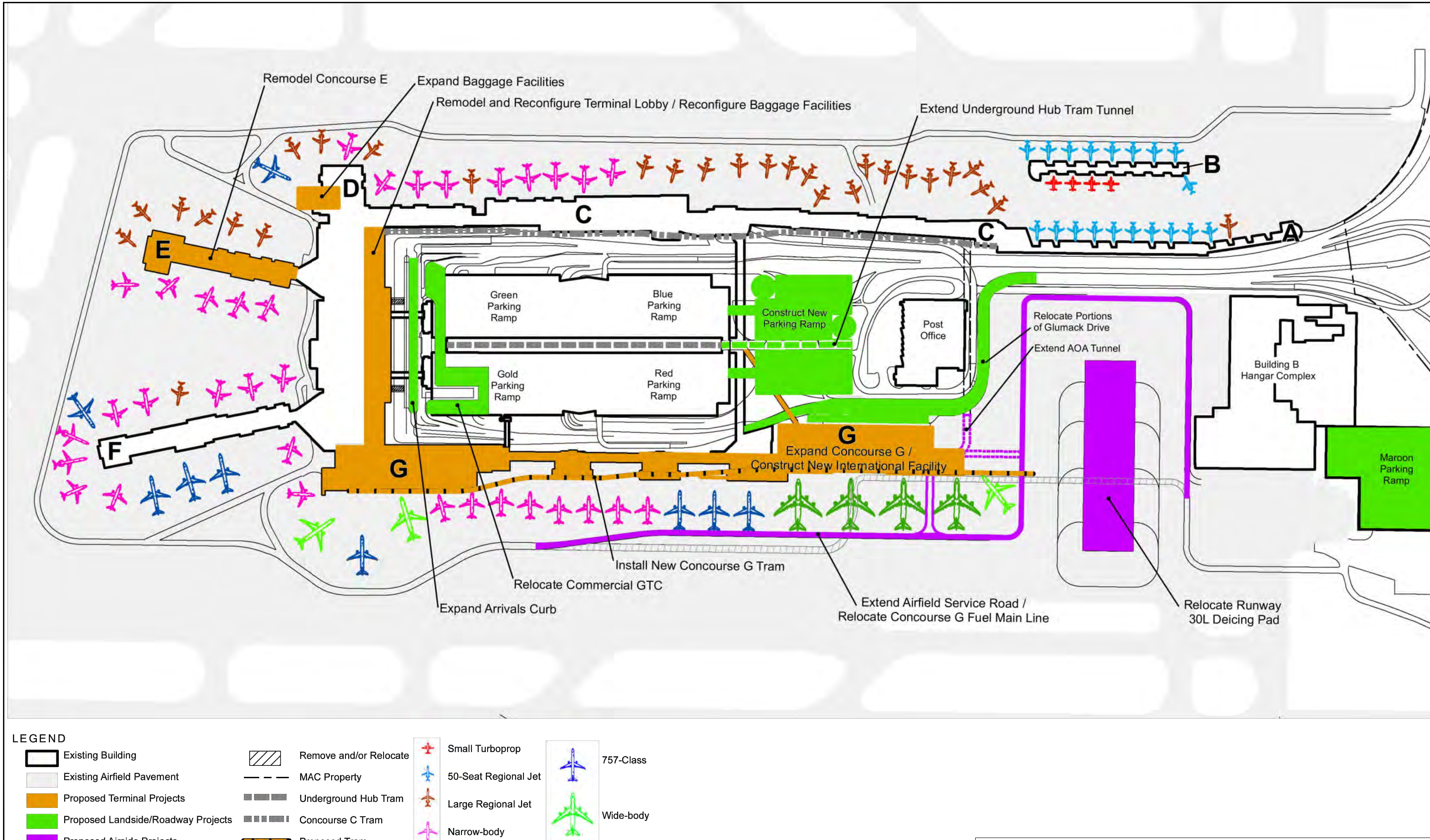
EXHIBIT 1-14

2013 Approved Environmental Review Projects - Non-Terminal



SOURCE: HNTB, *Minneapolis-Saint Paul International Airport* 2020 Improvements Final Environmental Assessment / Environmental Worksheet, January 2013

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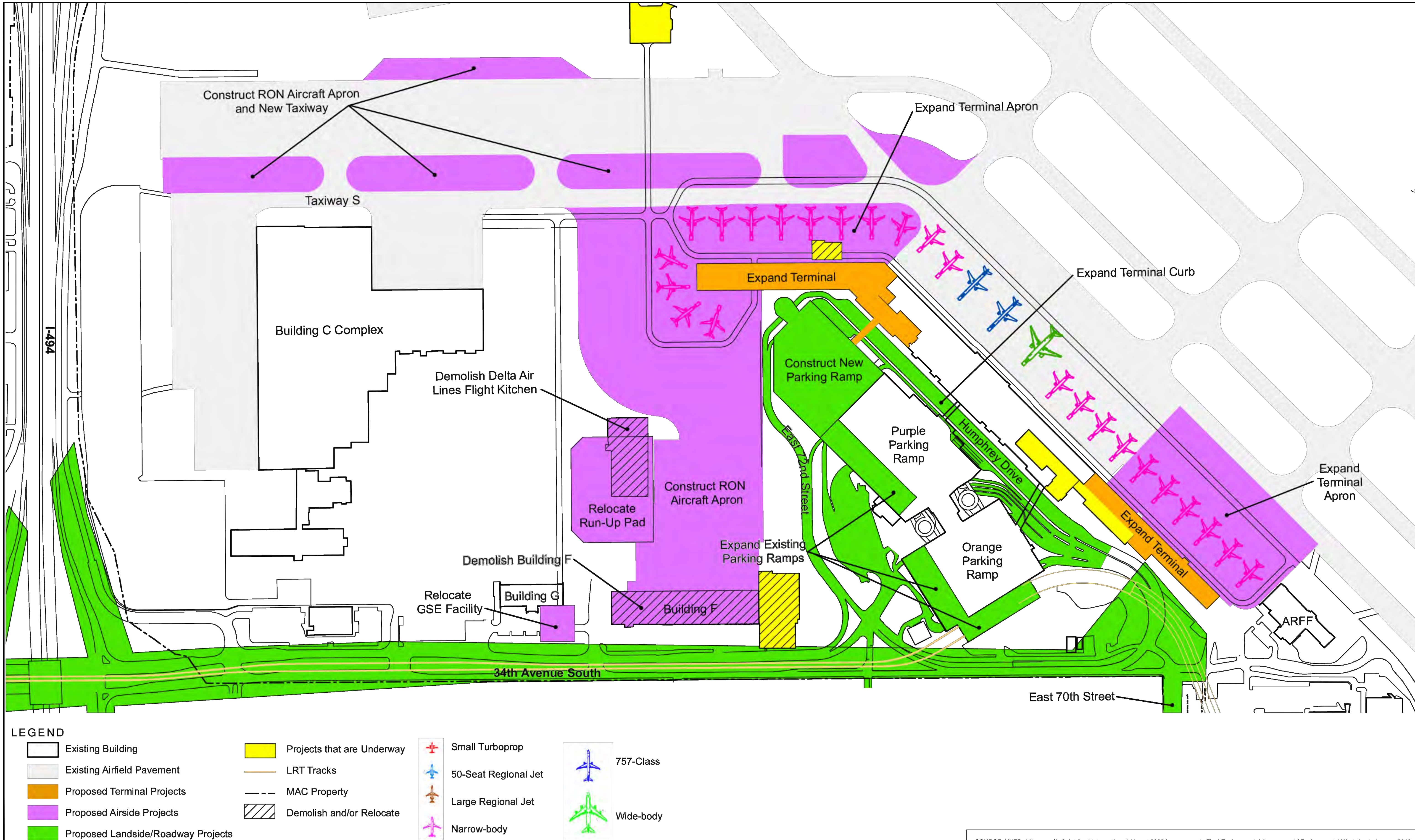
EXHIBIT 1-15

2013 Approved Environmental Review Projects - Terminal 1



SOURCE: HNTB, *Minneapolis-Saint Paul International Airport* 2020 Improvements Final Environmental Assessment / Environmental Worksheet, January 2013

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EXHIBIT 1-16

2013 Approved Environmental Review Projects - Terminal 2

Chapter 2. Forecast

List of Tables

List of Exhibits

Chapter 2 Forecast

2.1 OVERVIEW OF THE FORECAST PROCESS AND OBJECTIVES

In February 2019, the Metropolitan Airports Commission (MAC) began developing forecasts of aviation demand to inform its 2040 Long-Term Plan (LTP). The effort was completed in July 2020, but the resulting forecasts did not account for the potential effects of widespread disruptions in air service due to the COVID-19 pandemic. In October 2021, the MAC updated the forecasts and incorporated COVID-19 pandemic impacts into the forecast of aviation demand, retaining calendar year 2018 as its base year. The forecasts were developed for both passenger-related activity (passenger volumes and aircraft operations) and non-passenger-related activity (air cargo, general aviation (GA) / air taxi, and military aircraft operations) by year between 2018 and 2040.

The overall objective for the 2040 LTP forecasts was to identify a potential range of demand scenarios for aviation services in a manner that would facilitate a meaningful evaluation of facility performance. This chapter reviews the forecasts and serves as the basis for formulating the facility requirements analysis presented in Chapter 3.

This chapter is divided into two sections: **Sections 2.2** through **2.8** discuss the original forecasts, and **Sections 2.9** through **2.10** present the post-pandemic aviation activity forecast updates.

2.1.1 Forecast Process

Exhibit 2-1 illustrates the high-level forecast process, which is described in the following subsections. The process began with the data collection and market analysis phase, which presented an opportunity to research the factors that have historically influenced the Airport's activity and understand how those factors may evolve and ultimately shape future activity. As part of this phase, a group of internal and external stakeholders was engaged, either directly or indirectly, to inform the research and subsequently provide feedback throughout the forecast process including:

- MAC staff and board members;
- passenger airlines;
- cargo airlines; and
- local community, including the Metropolitan Council (Met Council).

Exhibit 2-1: Forecast Process

SOURCE: Ricondo & Associates, Inc. 2019

The forecast process resulted in annual forecasts of both passenger-related activity and non-passenger-related activity between 2018 and 2040. The percentage of aircraft operations generated by each category in 2018 were passenger airline (91%), GA/Air Taxi (5%), Air Cargo (4%), and Military (less than 1%).

Annual forecasts were originally prepared for a baseline scenario (the expected outcome), as well as a single high and a single low scenario. In addition to the annual forecasts, design day flight schedules (DDFSs) representing single days of Airport activity were created for the baseline scenario for 2018 and years 2025, 2030, and 2040. For each year, DDFSs were developed for both the summer and spring peak activity periods experienced at the Airport. The forecasts (both the annual and DDFSs) were not constrained by any assumptions regarding the availability of Airport facilities, such as additional gates that would be needed to accommodate demand.

2.1.2 Forecast Objectives

The overall objective for the 2040 LTP forecasts was to identify a likely range of demand levels for aviation services in a manner that would facilitate a meaningful evaluation of facility performance. More specifically, the parameters used to develop the forecast included:

- a level of detail that informs the development of facilities necessary to meet future demand levels, provide high levels of customer service, and maximize economic benefit;
- a reasonable range of possible forecast activity outcomes, considering the inherent uncertainty in the forecasting process, which enables facility planning and promotes operational efficiency and flexibility; and
- engaging stakeholders to provide insights and input into the forecast development, as well as to review and comment on forecast results.

2.1.3 COVID-19 Pandemic Impact on Forecasts

The pandemic has disrupted the relationships between passenger volumes and drivers traditionally used to forecast demand, such as employment, personal income, and other socioeconomic factors. Passenger travel has more recently been influenced by factors such as travel restrictions, fear of illness, or work policies that have emerged since the onset of the pandemic.

As the effects of the pandemic subside, passenger demand is expected to return to pre-pandemic levels. However, the return to that point will not be immediate, and the timing will depend on factors such as regional economic recoveries, seat capacity allocation decisions by airlines, and local or national travel restrictions. The return to pre-pandemic growth will likely be uneven across markets and passenger types. As such, pre-pandemic factors used in aviation activity forecasting were used rather than pandemic-related concerns. These factors included qualitative and quantitative elements regarding:

- airline capacity and load factor recovery at MSP;
- airline capacity recovery at airports served by MSP and in the industry overall;
- economic recovery projected for the region and in regions served from MSP;
- historical revenue produced by passengers in the individual markets served from MSP; and
- other forecasts developed for the Airport and the industry.

Using a combination of these factors, the return to pre-pandemic levels was estimated on a passenger-by-passenger basis according to the origin and destination of their travel. As modeled, pandemic-related influences continue to impact certain segments of passenger activity through 2026 (although growth continues during that period), after which traditional forecast influences prevail throughout the remainder of the forecast period. A more aggressive forecast of recovery to traditional drivers was also developed that considered more favorable economic conditions and airline response. In the more aggressive scenario, pandemic-related influences were modeled to cease by the end of 2024. The more aggressive results are presented as the updated forecasts that serve as the basis of the DDFS development and that are compared to the Federal Aviation Administration's (FAA's) Terminal Forecast (TAF) results.

2.1.4 Chapter Organization

This chapter is organized as follows:

- Original forecast (**sections 2.2** through **2.8**)
  - Data collection and market analysis of historical activity
  - Forecast of underlying passenger demand and factors shaping future passenger activity
  - Forecast of non-passenger aircraft operations
  - Comparison to other forecasts
  - Forecast scenarios
  - DDFS development
  - Original forecast and DDFS tables
- Post-COVID revised forecast (**sections 2.9** and **2.10**)
  - Aviation activity forecast review and update
  - Revised baseline forecast and DDFS tables

2.2 DATA COLLECTION AND MARKET ANALYSIS OF HISTORICAL ACTIVITY

2.2.1 Data and Information Sources

The 2040 LTP forecasts incorporated data from several sources traditionally used to illustrate historical activity and/or provide insight into potential future activity. The primary sources of information used were:

- MSP data reports: MAC-reported activity data specific to MSP;
- MAC Noise and Operations Monitoring System (MACNOMS) data: MAC-reported data with granular detail of actual operations, including gate use, runway times, and gate times;
- U.S. Department of Transportation (USDOT) Airline Origin and Destination (O&D) Survey (DB1B): passenger ticket information with data specific to passenger journeys, including routing, carriers, and airfares;
- USDOT T-100: flight segment report with details of passenger flights to or from U.S. airports, including carrier, aircraft type, passenger volumes, and available seats;
- Published airline schedules;
- economic projections provided by the Met Council and Woods & Poole Economics, Inc. (Woods & Poole);

- FAA Aerospace and Terminal Area Forecasts (TAFs); and
- Inputs and feedback from airlines and other users of the Airport.

2.2.2 Review of Historical Passenger-Related Activity

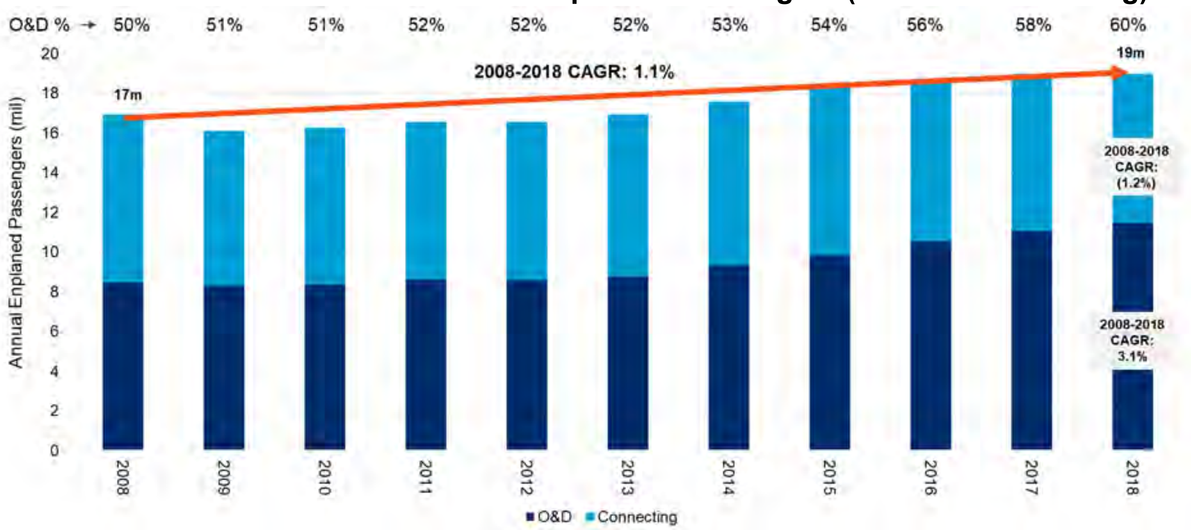
2.2.2.1 Types and Volumes of Passengers Using the Airport

In 2018, the base year for the 2040 LTP forecasts, MSP served approximately 38 million passengers (both revenue and non-revenue passengers) arriving at and departing from the Airport. Historical passengers were analyzed to understand the characteristics of the travelers the Airport serves.

2.2.2.2 Origin and Destination Versus Connecting

In 2018, MSP served as an origin or a destination point for approximately 60% of the passengers using the Airport (O&D passengers) and as a waypoint on a journey between two other airports for the remaining 40% (connecting passengers). **Exhibit 2-2** shows the growth of annual enplaned passengers since 2008, with the corresponding annual percentage of O&D passengers. Between 2008 and 2018, annual enplaned passengers at MSP grew from approximately 17 million to 19 million, a compound annual growth rate (CAGR) of 1.1%. During this time, the O&D share of passengers grew from 50% to 60%, with the connecting percentage falling from 50% to 40%, due mainly to the effects of the route network optimization undertaken by Delta following its merger with Northwest. Connecting passengers declined at a rate of 1.2% during this period.

Exhibit 2-2: MSP Historical Annual Enplaned Passengers (O&D vs. Connecting)

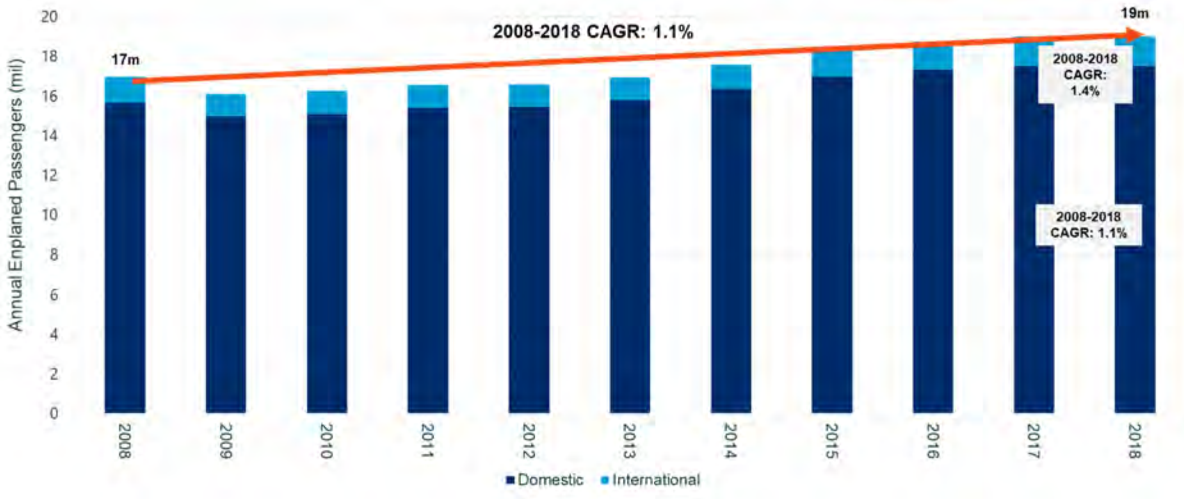


NOTES: O&D – Origin and Destination; CAGR – Compound Annual Growth Rate
SOURCES: U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2019; U.S. Department of Transportation, T-100, 2019; Sabre, Market Information Data Tapes (MIDT), 2019; MAC Activity Reports.

2.2.2.3 Domestic Versus International

Exhibit 2-3 presents enplaned passenger growth during the period 2008 to 2018, with passengers categorized as domestic or international based on the destination point of their nonstop flight from MSP. A portion of passengers shown as domestic may ultimately be on journeys to international points. During the period, the domestic share of nonstop passengers remained constant at approximately 92%, albeit with modestly higher growth on international flight segments.

Exhibit 2-3: MSP Historical Annual Enplaned Passengers (Domestic vs. International)



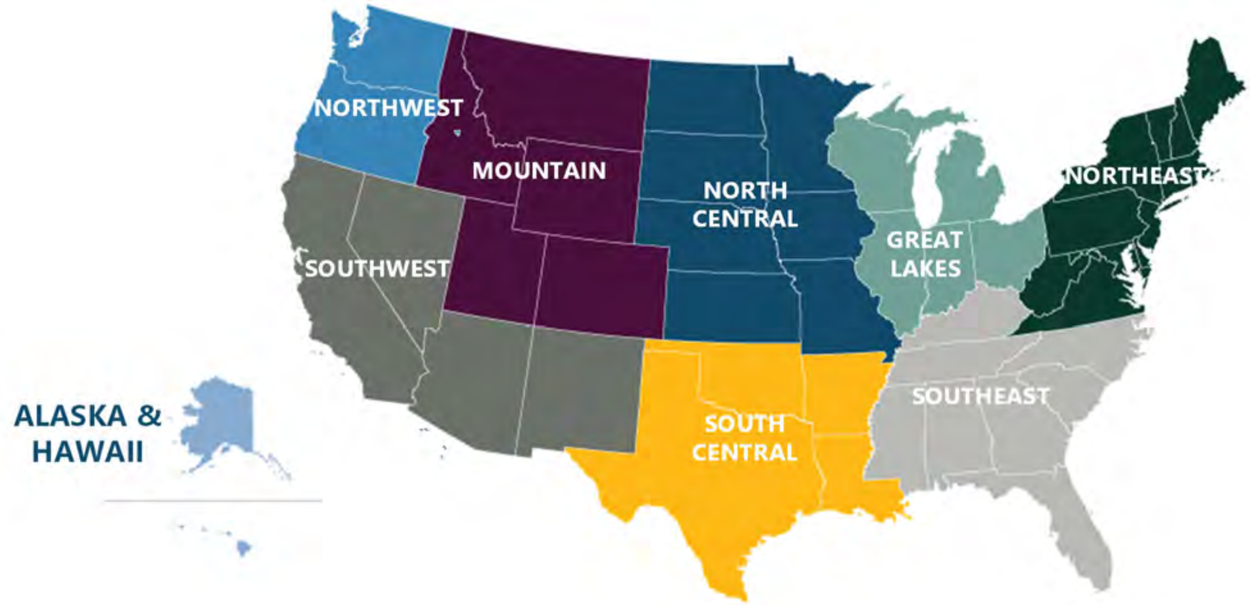
NOTE: CAGR – Compound Annual Growth Rate
SOURCES: U.S. Department of Transportation, T-100, 2019; MAC Activity Reports.

2.2.2.4 Identification of Passenger Journeys Served

For analytical purposes, O&D and connecting passengers were subsequently grouped by passenger flow according to the region-to-region starting and ending points of their respective journeys. The O&D points for each passenger were placed into one of 19 regions (9 domestic U.S. regions and 10 international regions), as illustrated in **Exhibits 2-4** and **2-5**. In 2018, 84% of MSP passenger journeys were between domestic regions, while 16% of MSP passenger journeys involved travel to or from an international region.

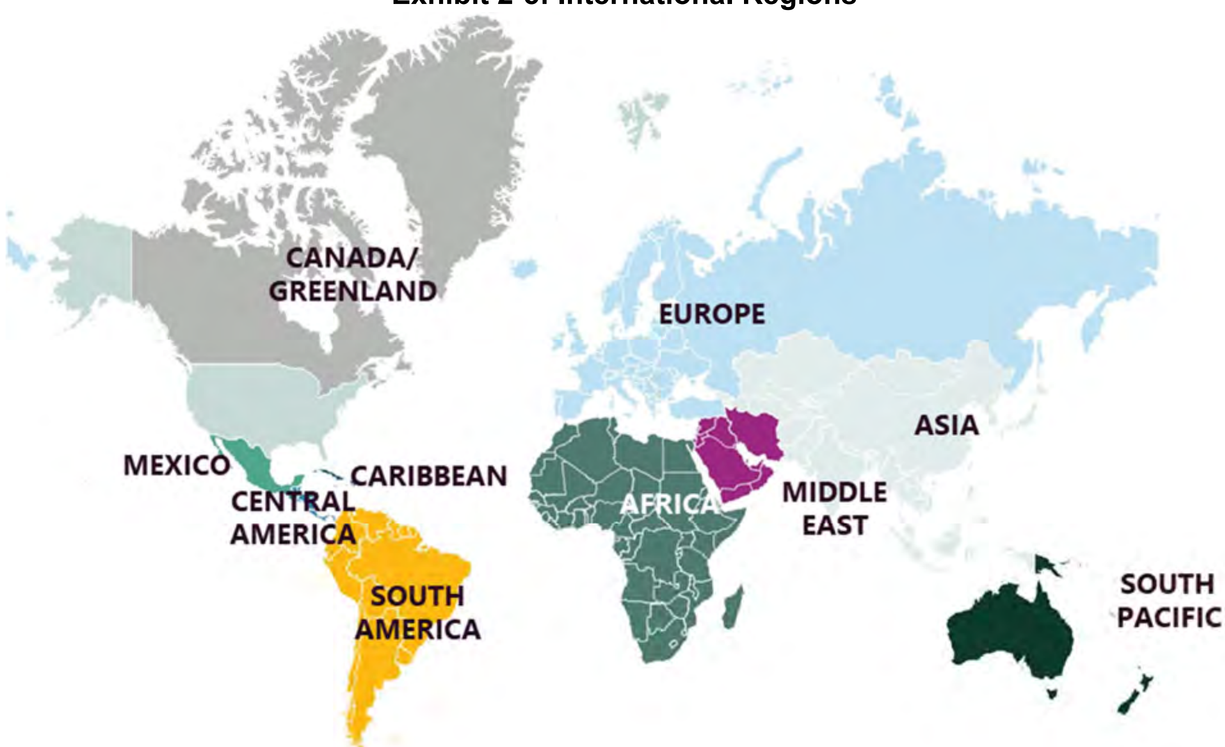
Table 2-1 lists the Airport's passenger flows that experienced the greatest change between 2008 and 2018 including, where applicable, specific flows to or from MSP. Passenger declines reflect the reduced connecting percentage of passenger volumes served at the Airport following the merger of Delta and Northwest. The decline also reflects the increase of competition presented by other competing hubs and the growth of low-cost carriers (LCCs) offering new nonstop services to many passenger markets otherwise served on a connecting basis at MSP. Larger, growing flows reflect the Airport's increased volume of O&D passengers served by Delta, Sun Country, and the Airport's growing contingent of LCCs.

Exhibit 2-4: Domestic Regions



SOURCE: Ricondo & Associates, Inc., 2020.

Exhibit 2-5: International Regions



SOURCE: Ricondo & Associates, Inc., 2020.

Table 2-1: Top Growing and Declining Passenger Flows

Top Growing Passenger Flows 2008–2018			Top Declining Passenger Flows 2008–2018		
From	To	% of Gains	From	To	% of Losses
MSP	Southwest	15%	Great Lakes	Southwest	22%
MSP	Southeast	15%	North Central	Northeast	9%
MSP	Great Lakes	11%	Great Lakes	Northwest	8%
MSP	Northeast	9%	North Central	Southwest	7%
MSP	Mountain	8%	Great Lakes	Mountain	7%
MSP	South Central	7%	Canada	Southeast	6%
MSP	Europe	5%	Alaska and Hawaii	Great Lakes	5%
Northeast	Southwest	4%	Mountain	Northeast	4%
MSP	Northwest	4%	Alaska and Hawaii	Northeast	4%
Southeast	Southwest	3%	North Central	Northwest	3%
Total Top 10		81%	Total Top 10		76%

NOTE: Figures may not add due to rounding.
SOURCES: U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2019; U.S. Department of Transportation, T-100, 2019; Sabre, Market Information Data Tapes (MIDT), 2019; MAC Activity Reports.

2.2.2.5 Airlines Serving the Airport

In 2018, 16 passenger airlines served the Airport: 5 foreign-flag airlines, 2 airlines (Delta and Sun Country) with a hub or primary base of operations at the Airport, and a mix of low-cost and full-service airlines. **Table 2-2** shows the passenger airlines and their shares of scheduled departing seat capacity since 2008.

Airline departing seat capacity at MSP decreased between 2008 and 2012, which was a common trend across the industry. During this period, the airline industry underwent significant changes, ultimately leading to improved overall financial performance after the Great Recession. These changes included consolidation among several airlines, enhanced airline partnerships to make more efficient use of resources and regional strengths, and a focus on revenue growth through higher airfares rather than passenger volumes. From 2008 to 2018, Delta's share of seat capacity at MSP declined approximately 10 percentage points, from 81% to 71%. This coincided with the period after the Delta/Northwest merger, when the consolidated airline subsequently reworked its overall route network. In addition, several LCCs commenced or increased service at the Airport during the period which coincided with growth for that airline segment industry wide.

Table 2-2: MSP Historical Passenger Airline Scheduled Seat Shares

Airline Type	Airline	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Domestic	Delta Air Lines	81.10%	78.80%	79.00%	78.10%	76.00%	74.00%	73.40%	72.40%	70.90%	69.90%	71.00%
	Sun Country Airlines	4.00%	3.10%	3.00%	3.50%	3.90%	4.80%	5.30%	6.00%	6.20%	6.50%	6.20%
	American Airlines	6.60%	6.70%	6.10%	6.20%	6.70%	6.70%	6.20%	6.20%	6.70%	6.60%	6.00%
	Southwest Airlines	1.60%	3.60%	5.00%	5.60%	5.90%	6.10%	5.90%	5.50%	5.80%	5.90%	5.40%
	United Airlines	5.00%	5.20%	4.60%	4.20%	4.40%	3.90%	3.80%	4.40%	4.60%	4.70%	4.20%
	Spirit Airlines					0.70%	1.90%	3.00%	3.00%	3.50%	3.60%	3.30%
	Frontier Airlines	1.40%	1.60%	1.40%	1.50%	1.00%	0.90%	1.20%	1.20%	0.90%	0.90%	1.30%
	Alaska Airlines	0.10%	0.60%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.70%	0.90%	0.90%
	JetBlue Airways										0.00%	0.50%
	Air Choice One										0.10%	0.00%
	Boutique Air									0.00%	0.00%	0.00%
	Bemidji Aviation	0.00%	0.00%	0.00%								
	Great Lakes Airlines				0.00%	0.60%	0.70%	0.10%	0.10%	0.00%		
	Subtotal	99.70%	99.80%	99.70%	99.60%	99.60%	99.40%	99.40%	99.30%	99.30%	99.10%	98.90%
International	Air Canada	0.10%	0.10%	0.20%	0.20%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.40%
	Icelandair	0.20%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.20%	0.20%	0.30%	0.30%
	KLM Royal Dutch Airlines										0.10%	0.20%
	Air France						0.10%	0.10%	0.20%	0.20%	0.20%	0.20%
	Condor									0.10%	0.10%	0.10%
	Subtotal	0.30%	0.20%	0.30%	0.40%	0.40%	0.60%	0.50%	0.60%	0.70%	0.90%	1.10%
	Departing Seats (mil)	21.3	20.6	20.3	20.1	19.9	20.5	20.6	21.1	22	22.5	22.3

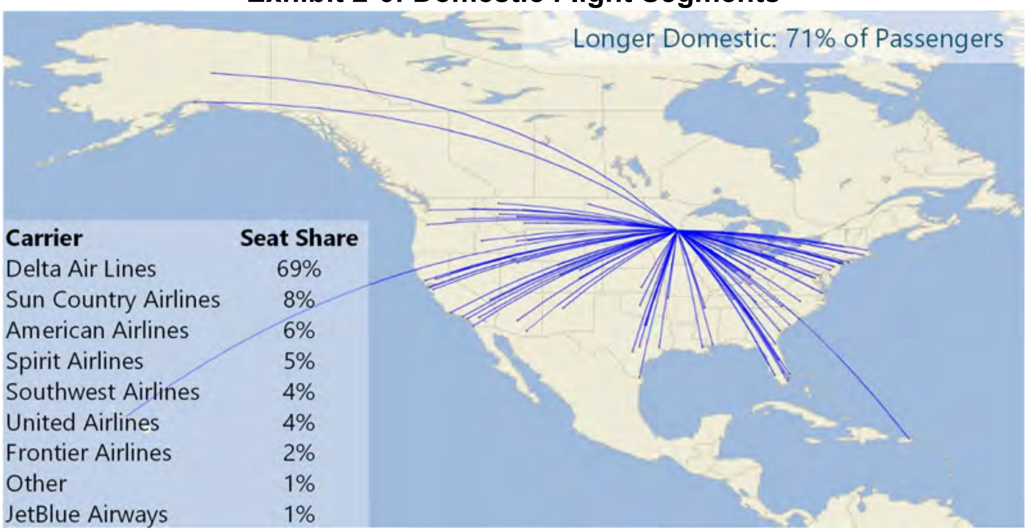
NOTE: Figures may not add due to rounding.
SOURCE: Cirium, 2019 (schedule data).

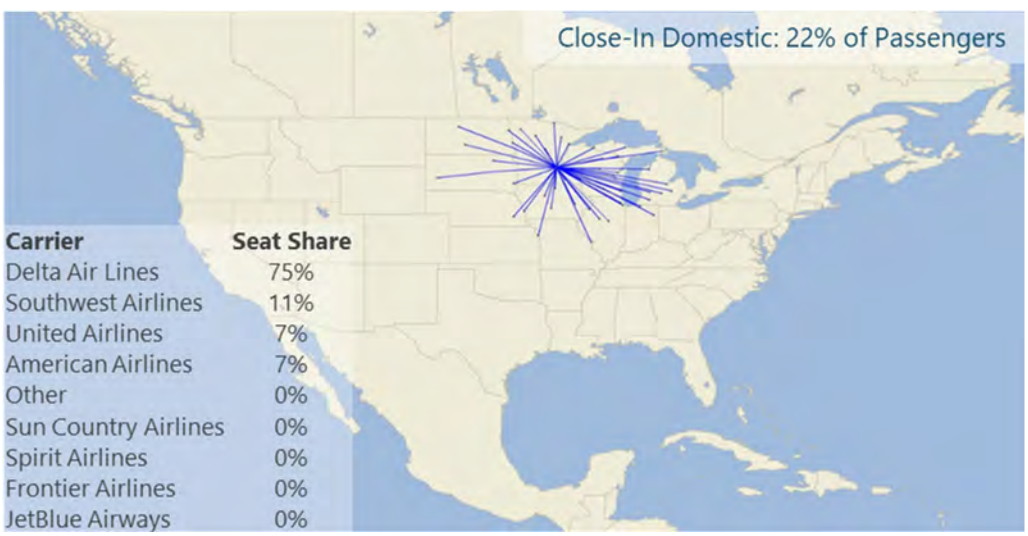
2.2.2.6 Flight Segments Used by Passengers

The Airport's 38 million passengers in 2018 traveled to, from, or connected in MSP through a network of flights served by its various airlines. For analytical purposes, nonstop passenger airline flight segments served at MSP in 2018 were grouped into four categories:

- Domestic Flight Segments (Two categories as shown in **Exhibit 2-6**)
    - Longer domestic flights to U.S. destinations beyond 500 miles of MSP: 71% of enplaned passengers flew on longer domestic flights, with Delta providing 69% of the available seats.
    - Close-in domestic flights to U.S. destinations within 500 miles of MSP: 22% of enplaned passengers flew on close-in domestic segments, with Delta providing 75% of the available seats.

Exhibit 2-6: Domestic Flight Segments

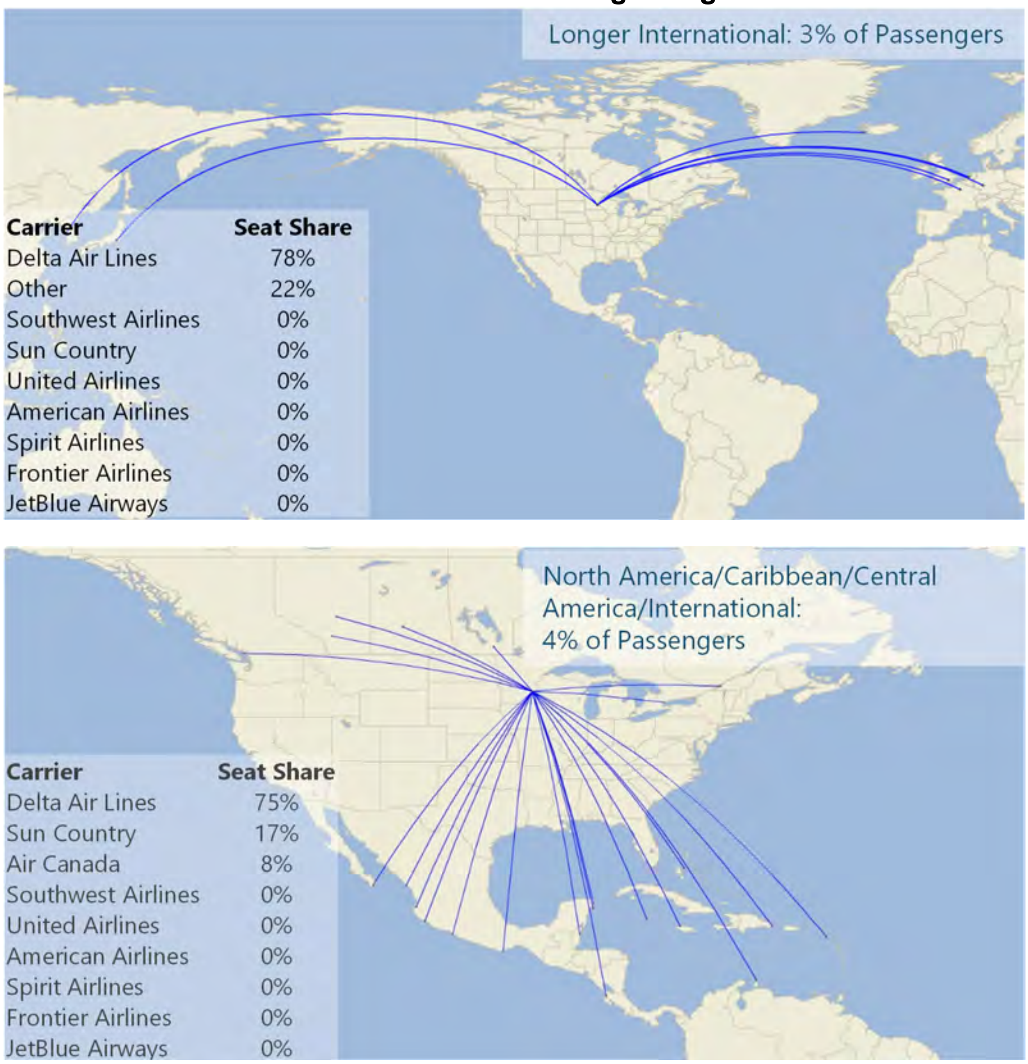




SOURCES: Cirium, 2019 (schedule data); U.S. Department of Transportation, T-100, 2019.

- International Flight Segments (Two categories as shown in **Exhibit 2-7**)
    - o Longer international flights from MSP to points in Asia and Europe: 3% of enplaned passengers flew on these services, with Delta providing 78% of available seats.
    - o North American/Caribbean/Central American flights from MSP (closer-in international points): 4% of enplaned passengers flew on these services, with Delta providing 75% of available seats.

Exhibit 2-7: International Flight Segments

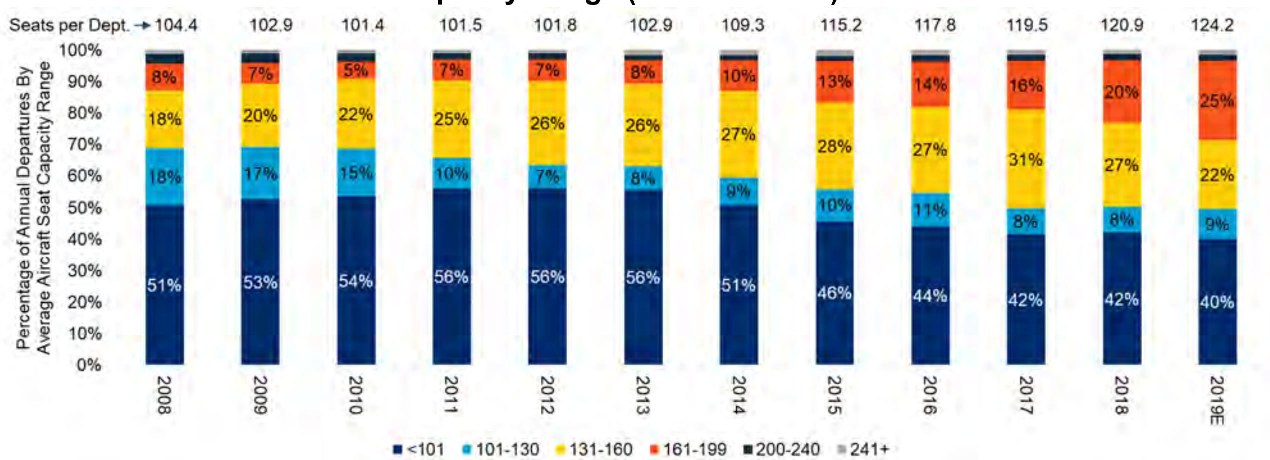


SOURCES: Cirium, 2019 (schedule data); U.S. Department of Transportation, T-100, 2019.

2.2.2.7 Passenger Aircraft Fleet Evolution

To efficiently serve the flight segments previously identified, the Airport's airlines have used a variety of aircraft of different sizes and operational capabilities, ranging from an 8-seat turboprop Cessna Caravan to a 296-seat Boeing 777-200. Since 2008, the average seat capacity per aircraft has been increasing, from approximately 104 seats in 2008 to approximately 124 seats in 2019 (as scheduled). During this period, airlines reduced their use of smaller aircraft, such as the 50-seat Canadair CRJ, and smaller narrowbody aircraft, such as the McDonnell Douglas MD-88, and increased flying in larger aircraft, including the Boeing 737-900 and Airbus A321. In addition, the airlines added seat capacity in several aircraft types. **Exhibit 2-8** illustrates the percentage of the Airport's annual scheduled passenger airline aircraft operations by ranges of average seat capacity.

Exhibit 2-8: MSP Historical Percentage of Passenger Aircraft Operations by Seat Capacity Range (As Scheduled)



NOTE: 2019E – Estimated 2019 Values
SOURCE: Cirium, 2019 (schedule data).

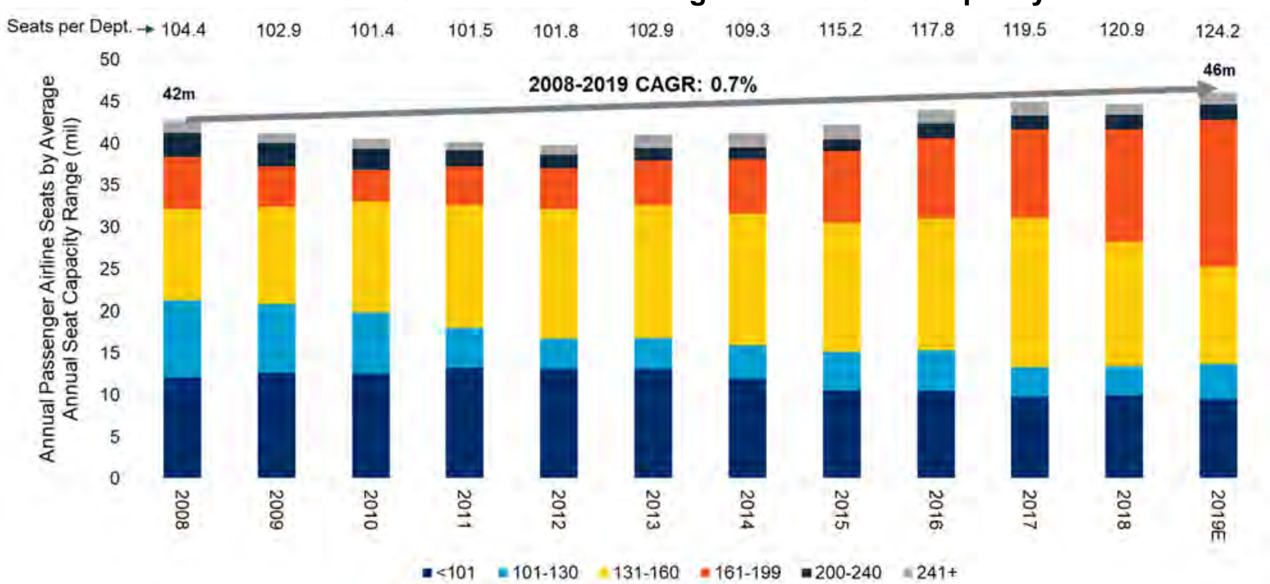
2.2.2.8 Passenger Aircraft Operations and Seat Capacity Levels

Exhibit 2-9 illustrates the Airport's annual passenger aircraft operations since 1990, split by international and domestic nonstop flight segments. Passenger aircraft operations peaked in 2004 and generally declined in the years following. Beginning in 2008, annual passenger aircraft operations declined at a rate of 0.9% per year. Despite the decrease in passenger aircraft operations since 2008, total airline seat capacity grew at a CAGR of 0.7% in the years between 2008 and 2019 (as scheduled), due to the increase in average aircraft seat capacity, as illustrated in **Exhibit 2-10**.

Exhibit 2-9: MSP Passenger Aircraft Operations Since 1990

NOTES: 2019E – Estimated 2019 Values
Prior to 2008, some Canadian operations were counted as domestic. The 2019E data are based on scheduled operations as of March 2019.
SOURCES: MAC Activity Reports; Cirium, 2019 (schedule data).

Exhibit 2-10: MSP Historical Passenger Aircraft Seat Capacity



NOTES: CAGR – Compound Annual Growth Rate; 2019E – Estimated 2019 Values
SOURCE: Cirium, 2019 (schedule data).

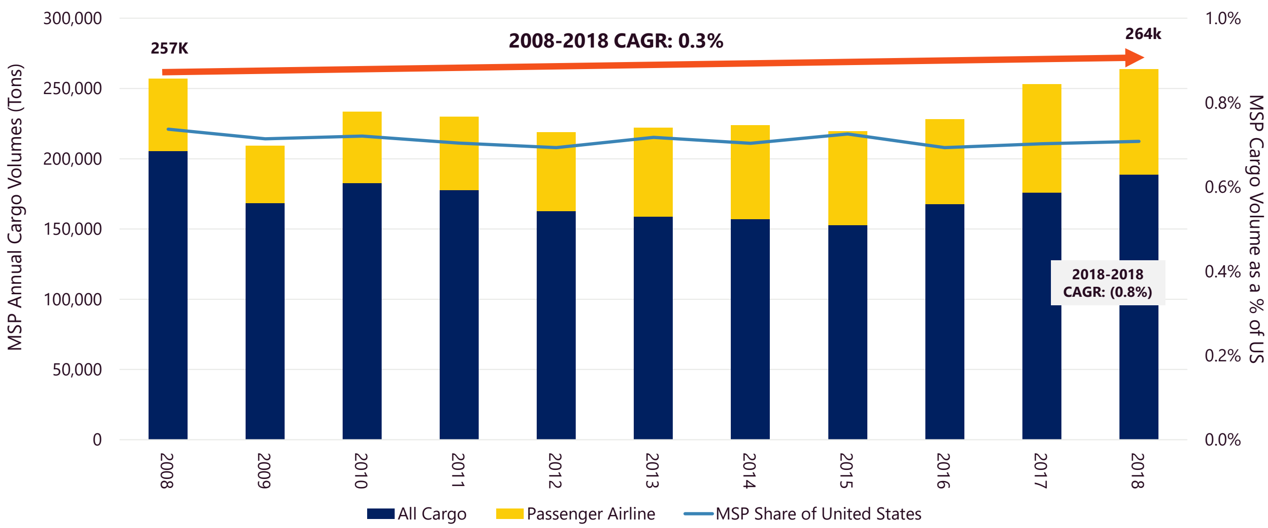
2.2.3 Review of Historical Non-Passenger Aircraft Operations

The following subsections describe the Airport's historical non-passenger airline activity, including air cargo, GA and air taxi, and military.

2.2.3.1 Air Cargo Volumes and Operations

MSP has maintained a relatively constant share of air cargo volumes relative to U.S. industry levels since 2008, at approximately 0.7%, as measured by revenue cargo tons. Between 2008 and 2018, cargo volumes at MSP grew at a CAGR of 0.3%. However, a significant portion of that cargo volume growth was attributable to the cargo carried by passenger airline aircraft. Cargo volume growth carried by dedicated cargo aircraft decreased during that period at an annual rate of 0.8%. **Exhibit 2-11** illustrates the Airport's historical air cargo volumes and the split between passenger and dedicated air cargo carriers along with the Airport's historical share of U.S. cargo volumes.

Exhibit 2-11: MSP Historical Cargo Volumes and Share of U.S. Industry

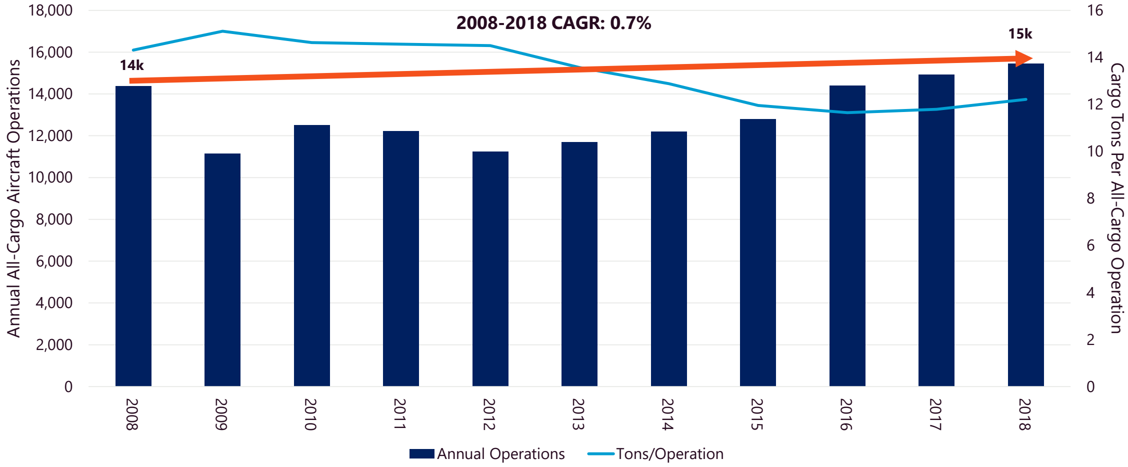


NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019.

In 2018, cargo volumes flown by dedicated air cargo carriers were served by a fleet spanning a wide payload range, from a Cessna Caravan to a Boeing 747-400. Between 2008 and 2018, the average cargo volume carried per operation declined, as illustrated in **Exhibit 2-12**. FedEx and UPS, for example, increased their use of lower payload Boeing 757 aircraft in place of higher capacity Airbus A300 and McDonell Douglas DC-10 aircraft. Thus, despite the decrease in cargo volumes carried by dedicated air cargo carriers, air cargo operations increased at a CAGR of 0.7%.

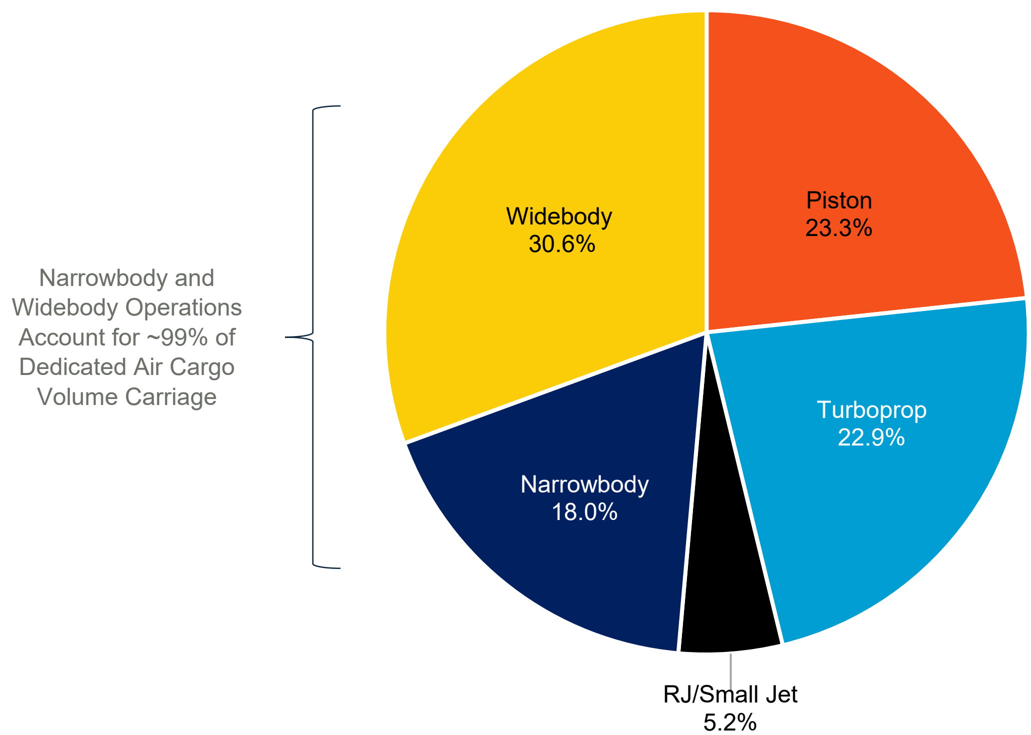
In 2018, nearly 99% of dedicated air cargo carrier volume was carried by narrowbody and widebody aircraft, which together accounted for nearly 50% of dedicated air cargo operations, as illustrated in **Exhibit 2-13**.

Exhibit 2-12: MSP Historical All-Cargo Aircraft Operations and Per-Aircraft Volume Trends



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019.

Exhibit 2-13: Share of 2018 All-Cargo Operations by Aircraft Type

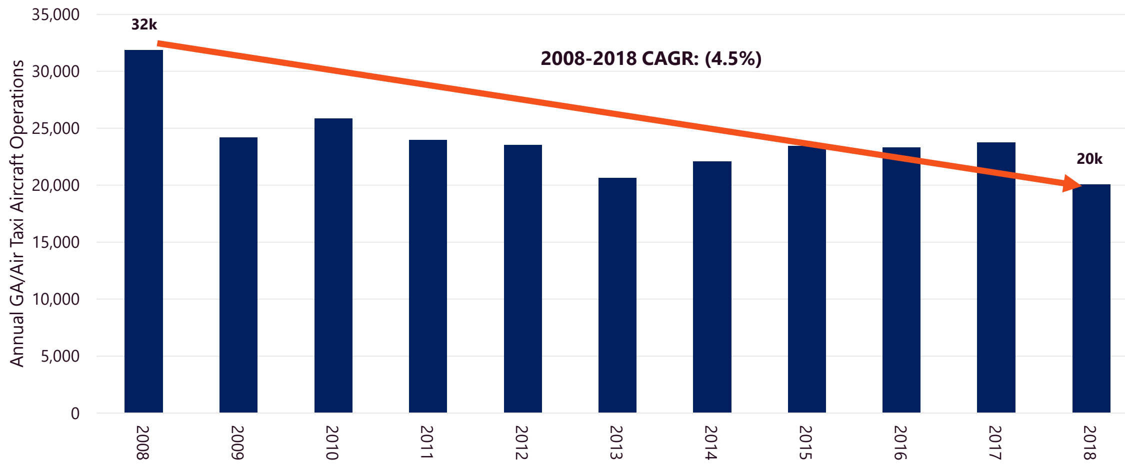


NOTE: RJ – Regional Jet
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019.

2.2.3.2 General Aviation and Air Taxi

As illustrated in **Exhibit 2-14**, GA/air taxi activity at MSP decreased at an annual rate of 4.5% between 2008 and 2018. A significant portion of this category's decline came in 2009, due, in large part, to the impact of the Great Recession, a trend experienced nationwide. After 2009, the Airport's annual GA and air taxi activity remained between approximately 20,000 and 26,000 operations.

Exhibit 2-14: MSP Historical General Aviation / Air Taxi Operations

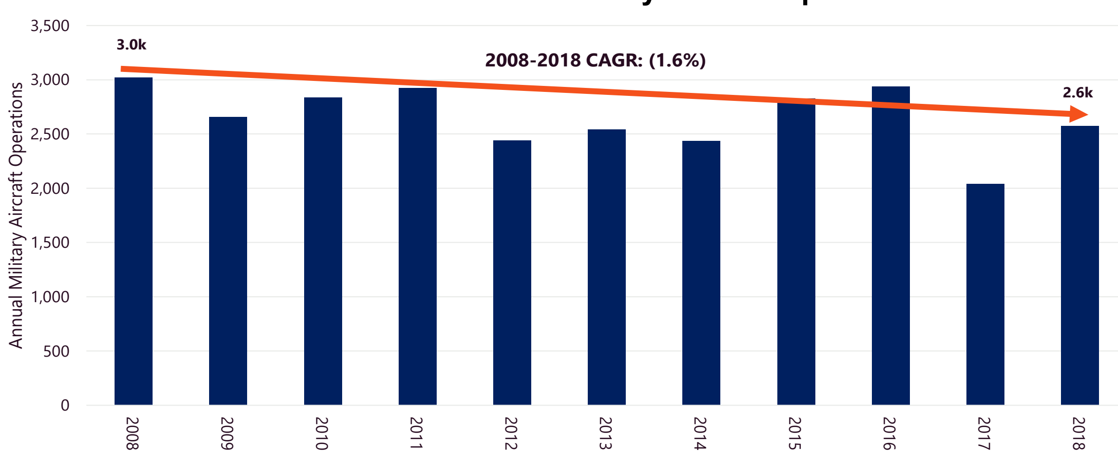


NOTES: GA – General Aviation; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; U.S. Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2019.

2.2.3.3 Military

Military activity constitutes less than 1% of aircraft operations at MSP. The Airport is home to the Minnesota Air National Guard (MNANG) 133rd Airlift Wing, which operates a fleet of C-130 cargo aircraft. Between 2008 and 2018, military operations declined at a rate of 1.6% per year, as illustrated in **Exhibit 2-15**.

Exhibit 2-15: MSP Historical Military Aircraft Operations

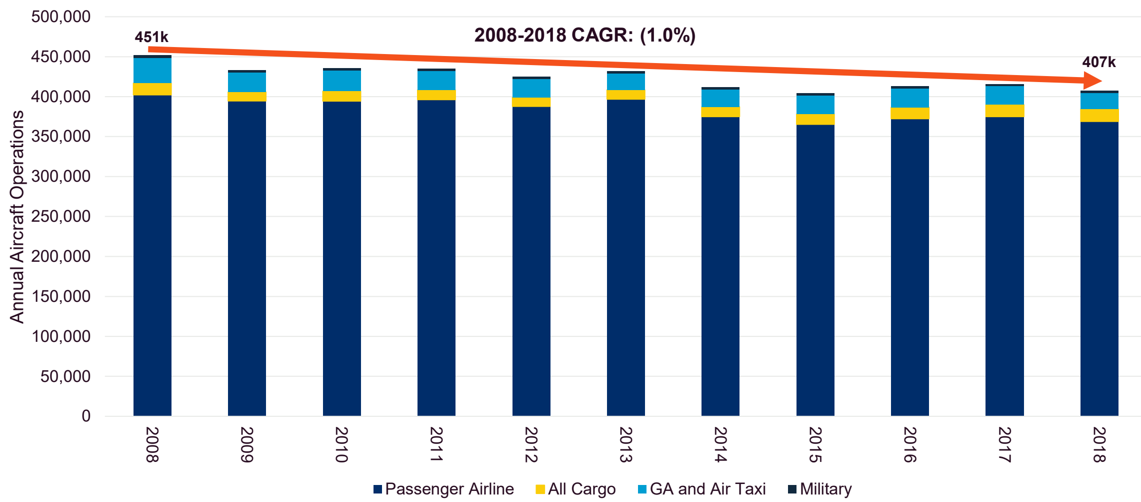


NOTE: CAGR – Compound Annual Growth Rate
SOURCE: U.S. Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2019.

2.2.4 Total Aircraft Operations

Exhibit 2-16 illustrates the total historical aircraft operations at MSP. Total operations declined at a CAGR of 1.0% during the period shown, due primarily to the decline in passenger airline operations.

Exhibit 2-16: MSP Historical Total Aircraft Operations



NOTES: GA – General Aviation; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; U.S. Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2019.

2.3 FORECAST OF UNDERLYING PASSENGER DEMAND AND FACTORS SHAPING FUTURE PASSENGER ACTIVITY

2.3.1 Determination of Underlying Demand

The individual region-to-region passenger flows discussed earlier in this document were analyzed alongside socioeconomic data to identify possible predictive statistical relationships between socioeconomic growth and the growth of passenger volumes. This resulted in a series of statistical equations (regression models) that enabled the forecasting of passenger demand in conjunction with independent projections of several socioeconomic metrics.

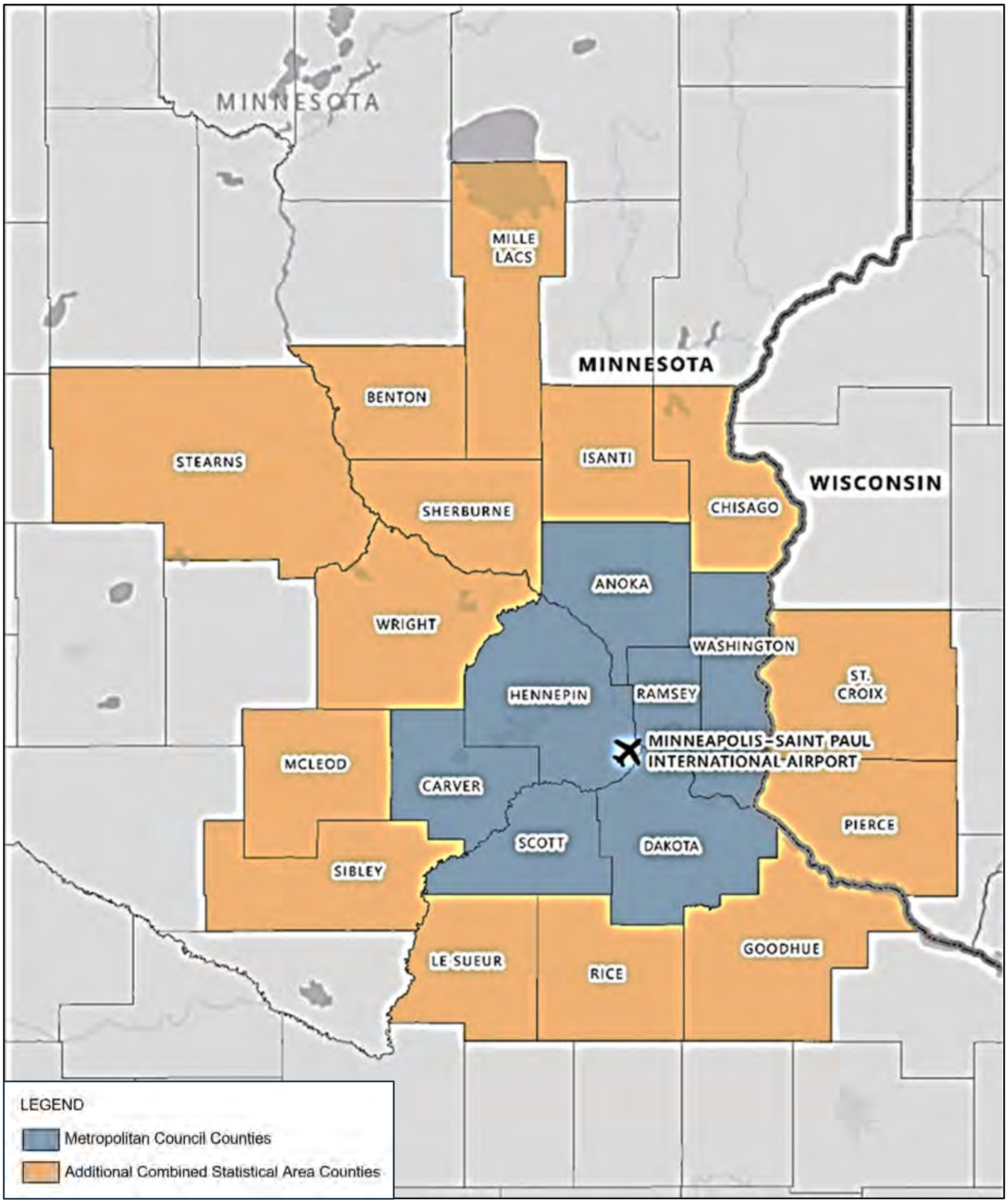
To inform the statistical analysis of O&D passenger flows, socioeconomic data were sourced from the Met Council (data for the 7-county region surrounding MSP) and Woods & Poole (data for the 21-county Minneapolis–Saint Paul combined statistical area and the greater United States). **Table 2-3** summarizes the data from these sources and **Exhibit 2-17** shows the counties included in the two sources of regional statistical data. These two sources provide independent projections of several common socioeconomic statistics for the MSP region that were used in the development of forecasts of underlying demand. Woods & Poole provides data for the United States as well. The regional projections are directionally similar; however, the Met Council's outlook on regional personal income and gross domestic product (GDP) growth is more aggressive than that provided by Woods & Poole. Woods & Poole is more aggressive in its projection of regional population and non-farm employment growth.

Table 2-3: Comparative Socioeconomic Projections (20-Year CAGR)

Socioeconomic Value	Area	Woods & Poole Economics, Inc.	Metropolitan Council
Population	U.S.	0.90%	
	Region	1.00%	0.80%
Non-Farm Employment	U.S.	1.20%	
	Region	1.30%	0.60%
Non-Farm Earnings	U.S.	1.70%	
	Region	1.70%	
Personal Income	U.S.	1.80%	
	Region	1.90%	2.20%
Net Earnings	U.S.	1.70%	
	Region	1.80%	
Per-Capita Personal Income	U.S.	0.90%	
	Region	0.80%	
Gross Domestic Product	U.S.	1.60%	
	Region	1.70%	2.20%

NOTE: CAGR – Compound Annual Growth Rate
SOURCES: Metropolitan Council, 2017; Woods & Poole Economics, Inc., 2019.

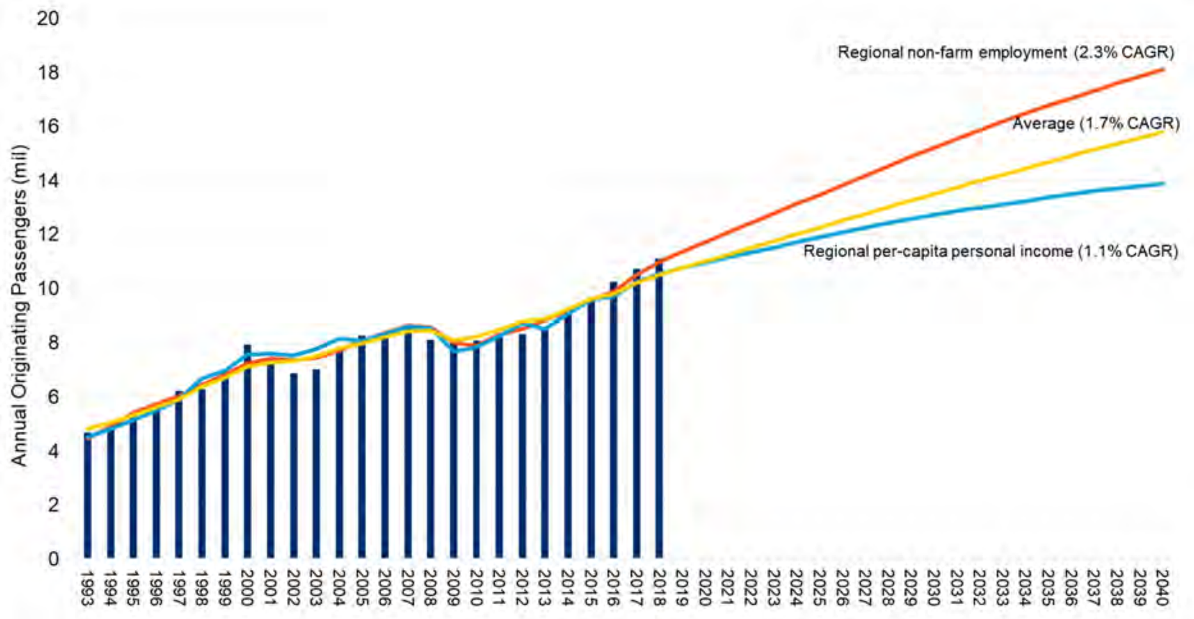
Exhibit 2-17: Counties Represented in Socioeconomic Projections



SOURCES: Metropolitan Council, 2019; Woods & Poole Economics, Inc., 2019.

Statistical analysis of O&D passenger flows incorporated a blend of regional and national socioeconomic inputs and generated a forecast range of total O&D passenger growth between 2018 and 2040, from a high of 2.3% per year to a low of 1.1% per year, and an average of 1.7%, as illustrated in **Exhibit 2-18**.

Exhibit 2-18: Forecast Range of Origin and Destination Demand Growth Generated by Socioeconomic Drivers



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: BTS RITA data; Metropolitan Council, 2017; Woods & Poole Economics, Inc., 2019; Ricondo & Associates, Inc., 2019 (analysis).

Connecting passenger demand growth was modeled using a similar approach to that used for O&D passengers. However, because MSP competes for these passengers with other connecting hubs and nonstop services, the total of all passengers in each flow (regardless of historical routing) was modeled to size the market potential that might be served by the Airport, with assumptions subsequently made on the allocation of passengers among competing hubs and nonstop services.

For several region-to-region passenger flows, statistical modeling was not a valid option alone for predicting future growth due to a low sample size or a lack of a strong statistical relationship between passenger volumes and socioeconomic factors. In those cases, data sets were aggregated where possible and estimated using a broader statistical relationship (for example, if a passenger flow from Asia to a particular region in the United States did not have a strong statistical relationship with socioeconomic factors, then that flow might have been blended with all Asia-to-U.S. activity for a stronger statistical model). Additionally, other forecasts developed by the FAA and other industry groups (for example, aircraft manufacturers) were referenced to help validate predictions of future growth.

This process produced a forecast of underlying demand at a more granular level than traditionally provided. Activity forecasts are usually conducted at a level of detail that estimates growth at four broad levels: domestic and international O&D passengers, and domestic and international connections. For this effort, forecasts at the passenger-flow level provided details that were helpful for determining the destinations and timings of future flight segments, providing more robust data to inform the airport planning process.

2.3.2 Factors Shaping Future Activity at the Airport

Several factors were examined to help estimate the portion of underlying demand that might materialize as future activity at MSP, considering that not all passenger demand growth would necessarily be accommodated by the airlines serving the Airport.

2.3.2.1 Supportability of Growth by Airlines Serving the Airport

In addition to forecasts of underlying passenger demand, individual passengers were examined for the value they contribute to the airlines that carry them, including estimates of the revenue they provide and the cost the airlines must expend to serve them. Each passenger was categorized as one of the following: driving capacity growth by airlines (the airline would add capacity to accommodate future demand growth of that passenger type), or as supplemental (airlines would accommodate those passenger types provided the seat capacity exists to carry those passengers without adding additional seats). For forecasting purposes, the number of available seats per capacity-driving passenger type was estimated based on historical ratios, which resulted in the number of available seats capable of accommodating supplemental passengers, considering assumptions of load factors (the percentage of available seats the airlines would choose to fill with passengers).

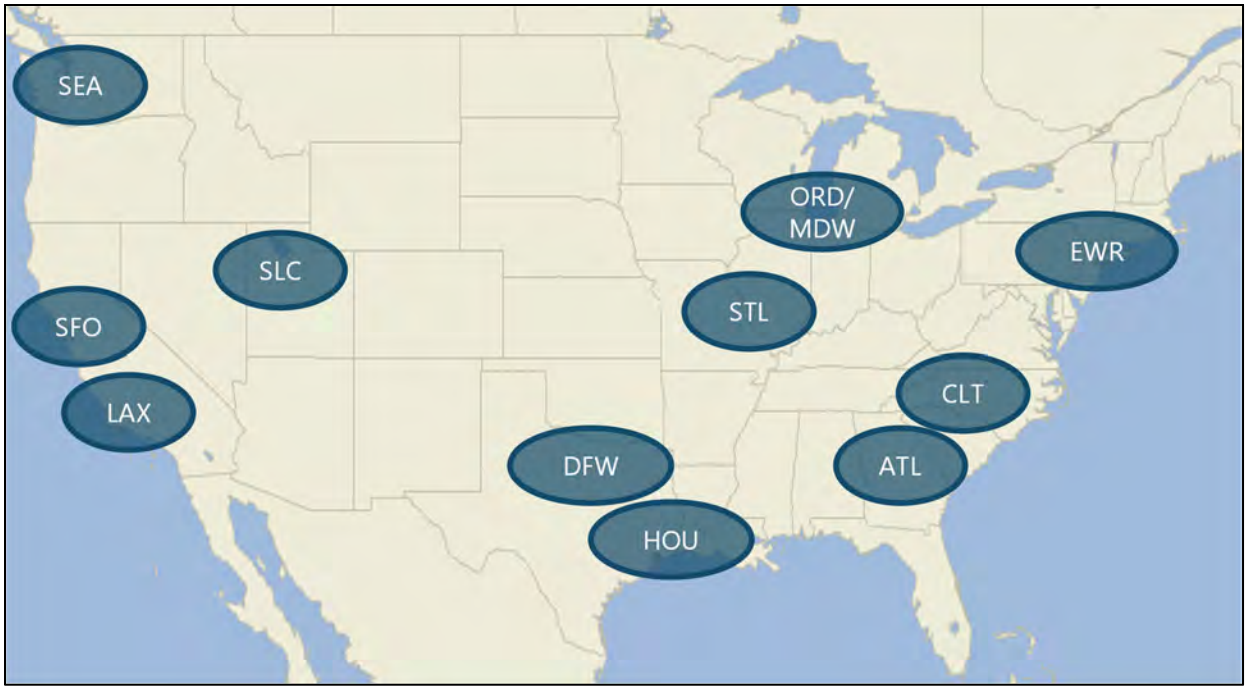
2.3.2.2 Leakage Considerations for Origin and Destination and Connecting Passengers

Leakage refers to the potential for passengers to choose among competing airports for their travel. Passenger leakage was examined for all passenger types, with analysis of the potential for these passengers to either leak to or leak away from the Airport. O&D passengers were examined for possible leakage to or from other area airports, while connecting passengers were evaluated for their likelihood to choose among MSP and other hub airports as a connecting point on their journeys. Regional commercial airports within a 4-hour drive of MSP were examined for potential competition with MSP for O&D passengers. Various analyses, including an analysis of O&D passenger share relative to income-weighted population share among these airports, suggested that any leakage among the airports was to the benefit of MSP.

MSP competes for connecting passengers with a group of domestic and international hub airports. With the merger of Northwest and Delta in 2008 and their subsequent network optimization, a decline of connecting passengers occurred at MSP in the last decade. Several U.S. hubs were the primary beneficiaries of leakage from MSP. **Exhibit 2-19** illustrates those airports. Since 2008, domestic connecting passengers traveling through these hubs increased by 16% in total but declined at MSP.

Several aviation industry trends or expected developments at competing hubs could have an impact on the Airport's future connecting demand levels, both positively and negatively, as displayed in **Table 2-4**.

Exhibit 2-19: Hubs Experiencing Increased Connectivity (2008–2018)



NOTES: ATL – Hartsfield-Jackson Atlanta International Airport, CLT – Charlotte Douglas International Airport, DFW – Dallas/Fort Worth International Airport, EWR – Newark Liberty International Airport, HOU – William P. Hobby International Airport, LAX – Los Angeles International Airport, MDW – Chicago Midway International Airport, ORD – Chicago O'Hare International Airport, SEA – Seattle-Tacoma International Airport, SFO – San Francisco International Airport, SLC- Salt Lake City International Airport, STL – St. Louis Lambert International Airport.
SOURCE: U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2019 (domestic itineraries).

Table 2-4: Impacts of Industry Trends and Development

Negative Impact	Positive Impact
Gates will be added at Chicago O'Hare International Airport, which could increase airline capacity competing with MSP.	Chicago Midway International Airport is becoming full and may not be able to sustain growth in connecting passengers.
Ultra-low-cost carriers are growing and may overfly MSP.	Delta Air Lines' growth at Seattle-Tacoma International Airport has slowed, reducing the growth of competing flights.
Canadian carriers are offering connections between the United States and international points at Canadian airports.	

SOURCE: Ricondo & Associates, Inc., 2019.

2.3.2.3 Primary Assumptions Underpinning the Forecasts

The assumptions for the forecasts are based on input from airline and Airport officials, previous studies, relevant literature, and professional experience. Forecasting is not an exact science, and departures from projected levels in the local and national economies and airline business environment may have a significant effect on the aviation activity forecasts presented herein. The forecasts should be periodically compared with actual Airport activity levels, and Airport plans and policies should be adjusted accordingly. The 2040 LTP forecasts incorporated a set of assumptions surrounding the factors previously noted that could shape demand growth at MSP through 2040. The primary assumptions are the following:

- Projections of socioeconomic variables (e.g., GDP growth, personal income, population) will materialize as presented by Woods & Poole and the Met Council and will not be subject to major shocks.
- The statistical relationships identified between passenger flows and socioeconomic variables will remain intact through the forecast period.
- Airlines will continue to seek a level of profitability similar to that achieved in recent years; airfares and airline costs will grow in line with inflation.
- MSP will continue to garner a similar share of connecting passenger demand in the passenger flows it has experienced in the last year; connecting passenger reductions due to the Northwest/Delta merger have fully ended.
- Airlines will increase capacity to accommodate supportable demand growth and will accommodate others if capacity exists, assuming reasonable load factors.

2.3.3 Enplaned Passenger Forecast Results

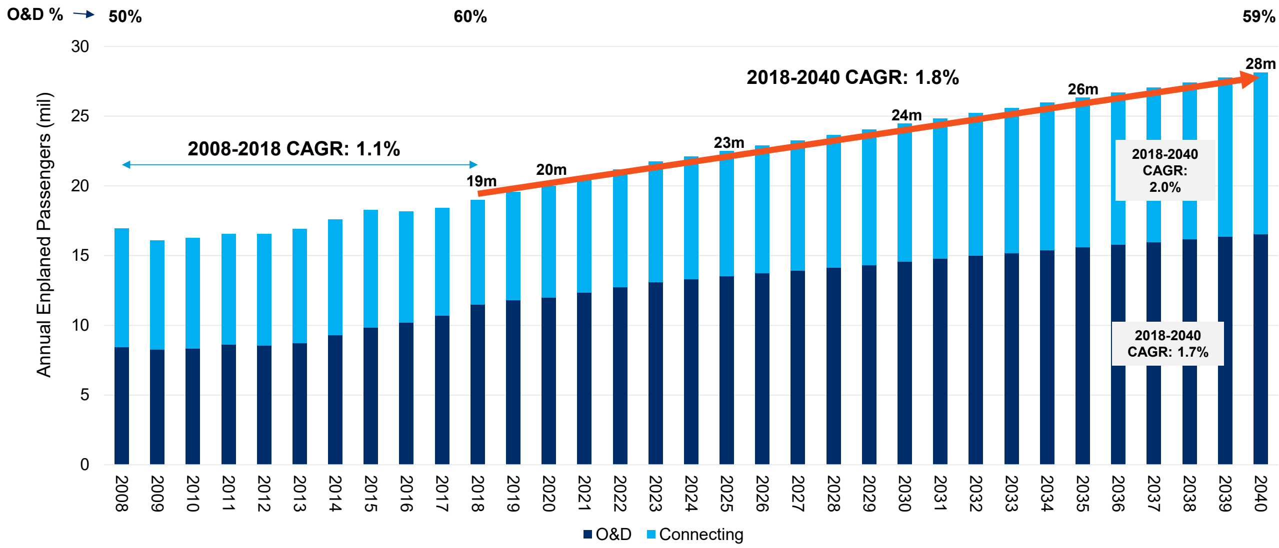
Exhibit 2-20 presents the forecast of enplaned passengers split by O&D versus connecting journeys, while **Exhibit 2-21** presents the forecast of enplaned passengers split by domestic and international flight segments (based on the nonstop destination from MSP). Total passenger growth is forecast to grow at a CAGR of 1.8% between 2018 and 2040, from approximately 19 million enplaned passengers to approximately 28 million. Connecting passengers are expected to grow at a faster rate than O&D passengers (2.0% CAGR versus 1.7% CAGR, respectively). This is due, in part, to a higher forecast of U.S.–international passenger flows overall for the industry, many of which use the Airport on a connecting basis. Further indication of the influence of international passenger growth is illustrated in **Exhibit 2-21**, which shows international enplaned passengers are expected to grow at a CAGR of 2.7%, versus 1.7% for domestic enplaned passengers. Components of growth by passenger journey type are detailed in **Table 2-5**, which shows international passengers, and particularly those on connecting journeys at MSP, are forecast to grow more rapidly than domestic passenger types.

Table 2-5: Forecast of Total Growth by Passenger Type (2018–2040)

Passenger Journey Type	Share of 2018 Passengers	Forecast Increase 2018–2040
Domestic O&D	53%	36%
Domestic Connection	32%	38%
International O&D	7%	58%
International Connection	8%	68%

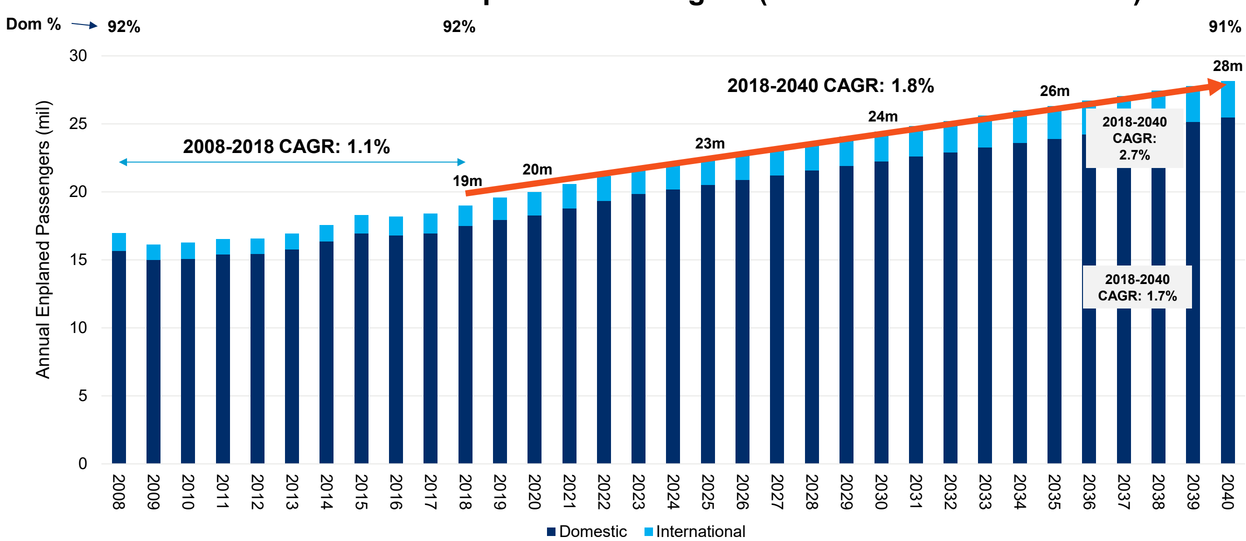
NOTE: O&D – Origin and Destination
SOURCES: U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2019; U.S. Department of Transportation, T-100, 2019; Sabre, Market Information Data Tapes (MIDT), 2019; Ricondo & Associates, Inc., 2019 (forecast).

Exhibit 2-20: Forecast of Enplaned Passengers (O&D vs. Connecting)



NOTES: CAGR – Compound Annual Growth Rate; O&D – Origin and Destination
SOURCES: MAC Activity Reports; U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2019; U.S. Department of Transportation, T-100, 2019; Sabre, Market Information Data Tapes (MIDT), 2019; Ricondo & Associates, Inc., 2019 (forecast).

Exhibit 2-21: Forecast of Enplaned Passengers (Domestic vs. International)



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; Ricondo & Associates, Inc., 2019 (forecast).

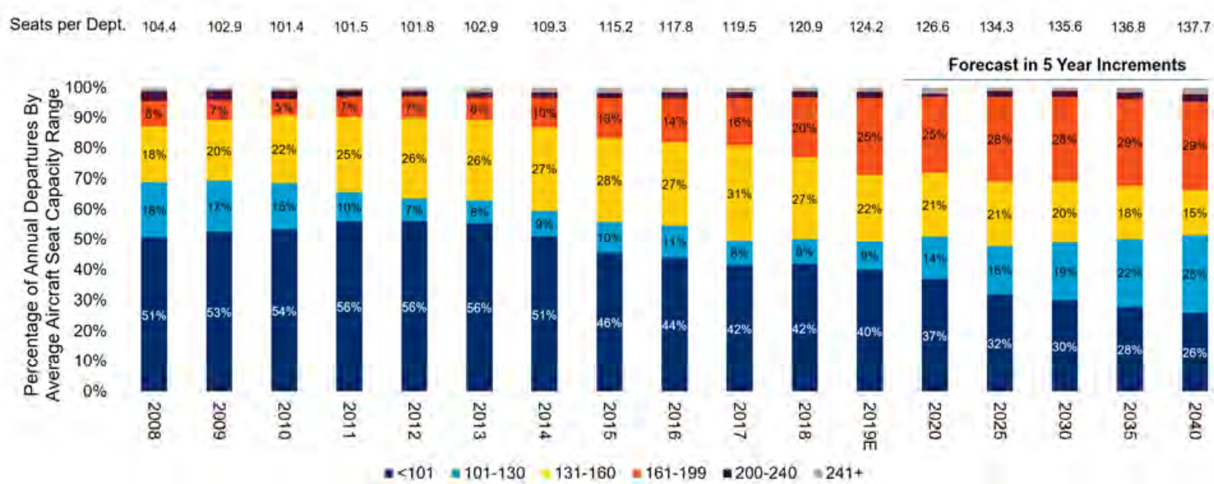
2.3.4 Passenger Aircraft Operations Forecast

The forecast of passenger airline operations was developed using the enplaned passenger forecast and an analysis of airline schedule completion rates, load factors, and published and estimated airline fleet plans. Long-term passenger growth was forecast to be accommodated primarily through a combination of higher average seats per departure and growth in operations to both existing and new markets.

2.3.4.1 Future Fleet

The passenger airline fleet mix was informed by published airline fleet plans, future aircraft orders, and expected retirements of certain aircraft. In general, it is expected that the average aircraft size at MSP will continue to grow over the forecast period, as airlines continue to implement up gauging throughout their networks. **Exhibit 2-22** presents the forecast passenger airline fleet mix by aircraft seat capacity range, as considered in the forecast (note: the values between 2008 and 2019E are shown as scheduled).

Exhibit 2-22: Forecast Percentage of Passenger Aircraft Fleet by Aircraft Seat Capacity Range



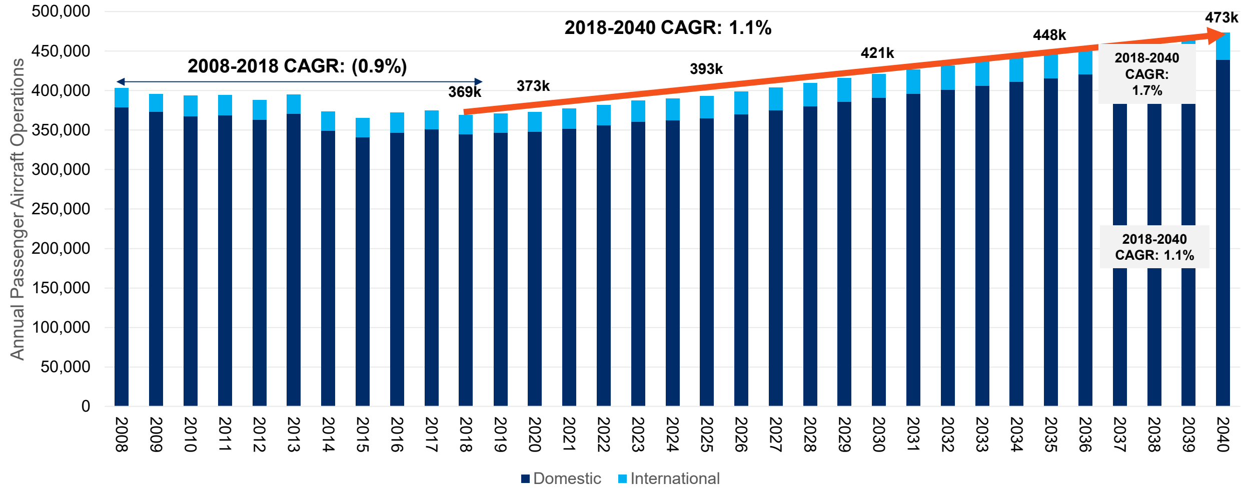
NOTE: 2019E – Estimated 2019 Values
SOURCES: Cirium, 2019 (schedule data); Ricondo & Associates, Inc., 2019 (forecast).

Average seats per aircraft are forecast to increase from approximately 121 in 2018 to approximately 138 in 2040, with much of that growth occurring between 2018 and 2025. Over the forecast period, an exchange of flying in smaller capacity aircraft types to larger types is expected to occur as airlines up gauge flying from regional jet aircraft to aircraft such as the Airbus A220-100 and 300 types.

2.3.4.2 Passenger Aircraft Operations Forecast Results

Exhibit 2-23 illustrates the forecast of passenger aircraft operations through 2040. Operations are forecast to increase from approximately 369,000 in 2018 to approximately 473,000 in 2040, a CAGR of 1.1%. Higher growth of international passenger demand results in a higher growth rate of nonstop international operations, having a 1.7% CAGR compared to a 1.1% CAGR for domestic operations.

Exhibit 2-23: Forecast of Passenger Aircraft Operations



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; Ricondo & Associates, Inc., 2019 (forecast).

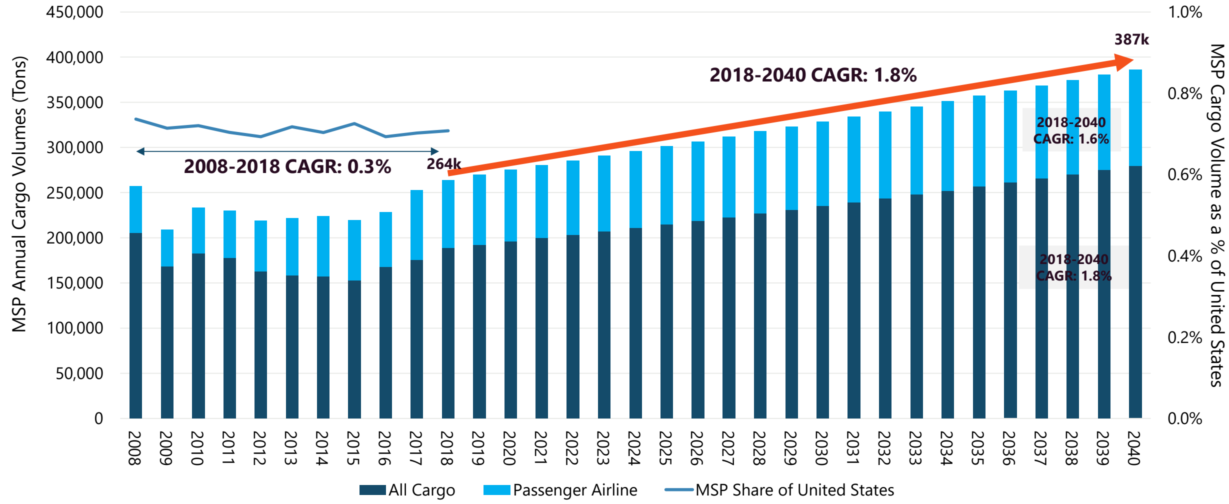
2.4 FORECAST OF NON-PASSENGER AIRCRAFT OPERATIONS

2.4.1 Forecast of Air Cargo Volumes and Operations

Historical cargo volumes were analyzed to explore statistical relationships with socioeconomic data; however, no meaningful predicative statistical relationships were identified. The Airport's cargo volume share relative to the U.S. market was explored as an alternative approach, and it was found that the Airport in total has maintained a relatively constant market share of approximately 0.7% of total U.S. air cargo volumes. For forecasting purposes, it was assumed that this market share would remain constant, and the Airport's cargo volumes would grow in line with U.S. industry air cargo volumes (measured in revenue ton miles [RTMs]) as forecast in the FAA's *Aerospace Forecast Fiscal Years 2018–2038* (extrapolated to 2040). When adjusted for the relative domestic and international components specific to MSP, this equates to a CAGR of 1.9%.

This forecast was further refined, considering that all-cargo carrier volumes at MSP have lost share to other airports in the United States, and the Airport's relatively steady share of U.S. cargo has been supported by passenger carrier cargo volume growth. Passenger carrier cargo volumes at the Airport grew in relation to forecast seat capacity growth, and the resulting cargo volume not attributable to passenger aircraft was considered the forecast of all-cargo carrier volumes. The overall cargo volume forecast resulted in a CAGR of 1.8%, with a similar growth rate for all-cargo carriers. **Exhibit 2-24** shows the results of the forecast of cargo volumes.

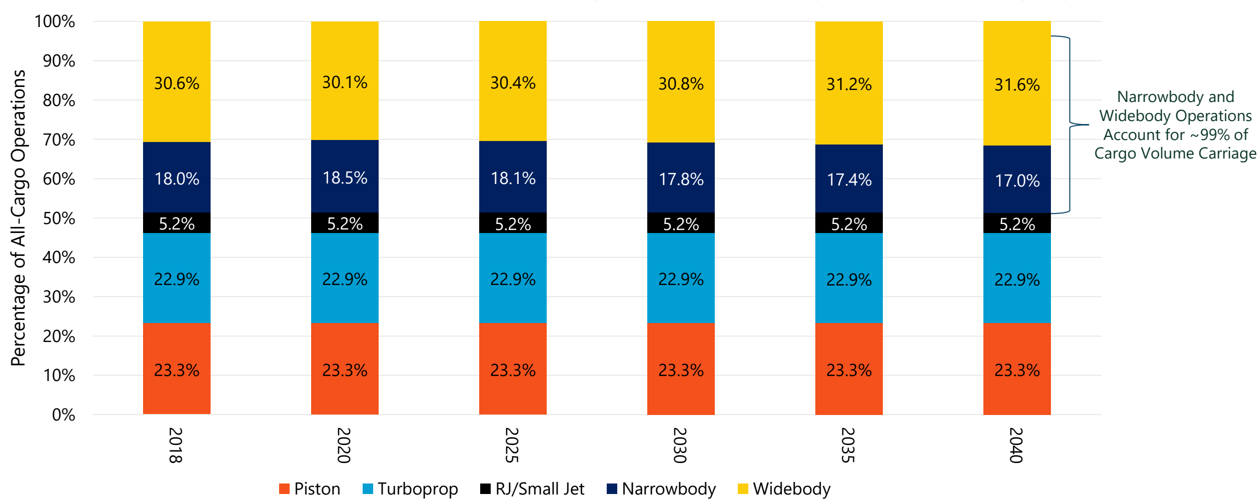
Exhibit 2-24: Forecast of Cargo Volumes (Passenger vs. All-Cargo)



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; Ricondo & Associates, Inc., 2019 (analysis and forecast).

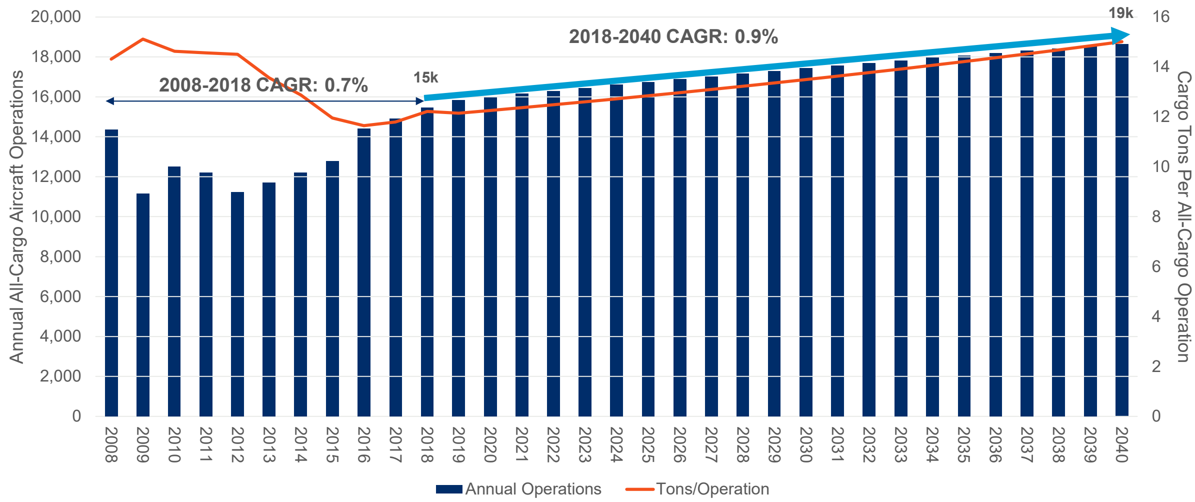
The all-cargo carrier fleet at MSP is forecast to transition to a slightly higher proportion of widebody aircraft capable of carrying a higher per-operation volume, as depicted in **Exhibit 2-25**. Considering the higher volume per operation, all-cargo carrier aircraft operations are forecast to increase from approximately 15,000 in 2018 to approximately 19,000 in 2040, a CAGR of 0.9%, as illustrated in **Exhibit 2-26**.

Exhibit 2-25: Forecast of All-Cargo Operations by Aircraft Category



NOTE: RJ – Regional Jet
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; Ricondo & Associates, Inc., 2019 (forecast).

Exhibit 2-26: Forecast of All-Cargo Aircraft Operations

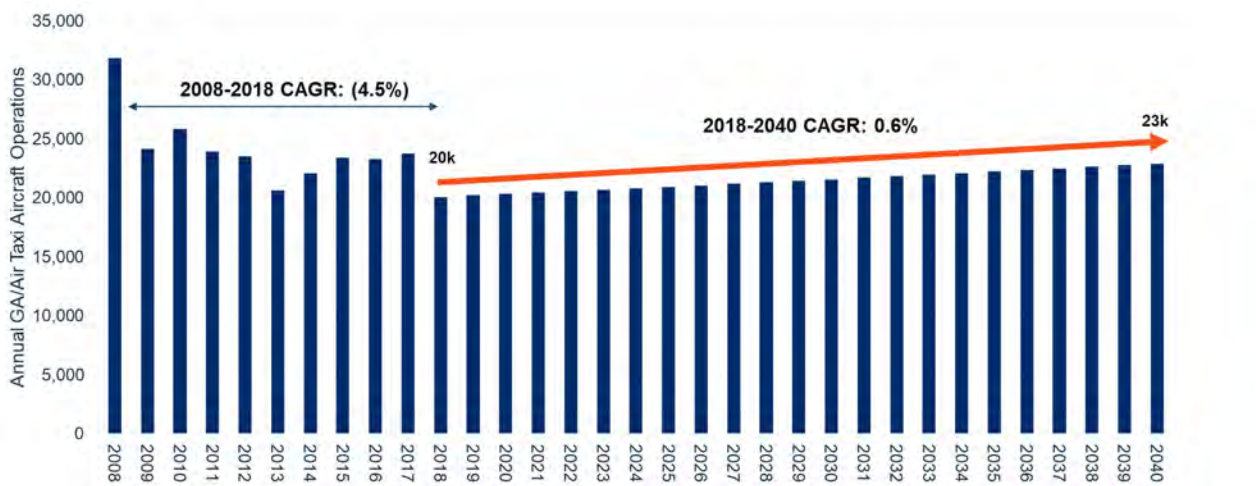


NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; Ricondo & Associates, Inc., 2019 (forecast).

2.4.2 General Aviation and Air Taxi

MSP GA and air taxi operations are forecast to grow at a 0.6% CAGR, a rate slightly lower than that forecast for the approximate period for GA and air taxi hours in the FAA's *Aerospace Forecast Fiscal Years 2018–2038*. **Exhibit 2-27** presents the forecast of GA and other air taxi operations.

Exhibit 2-27: Forecast of General Aviation and Air Taxi Operations

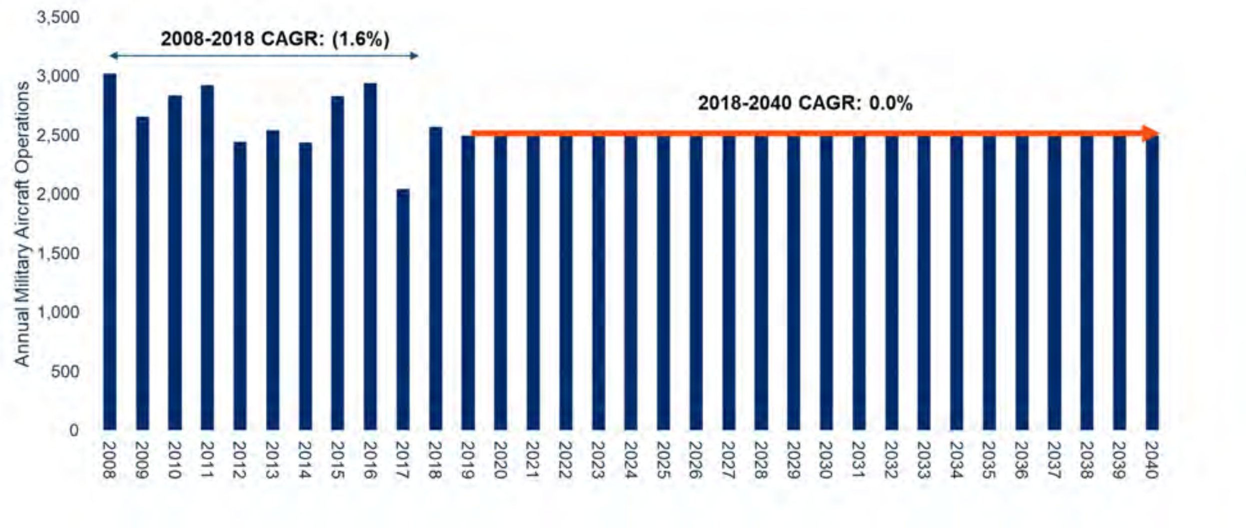


NOTES: CAGR – Compound Annual Growth Rate; GA – General Aviation
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; U.S. Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2019; Ricondo & Associates, Inc., 2019 (forecast).

2.4.3 Military

The U.S. Department of Defense determines future levels of military aircraft operations, but it does not publish guidance on future activity levels. The forecast of military aircraft operations is based on the FAA's 2018 TAF for the Airport, which reflects no growth for the period, as illustrated on **Exhibit 2-28**.

Exhibit 2-28: Forecast of Military Aircraft Operations

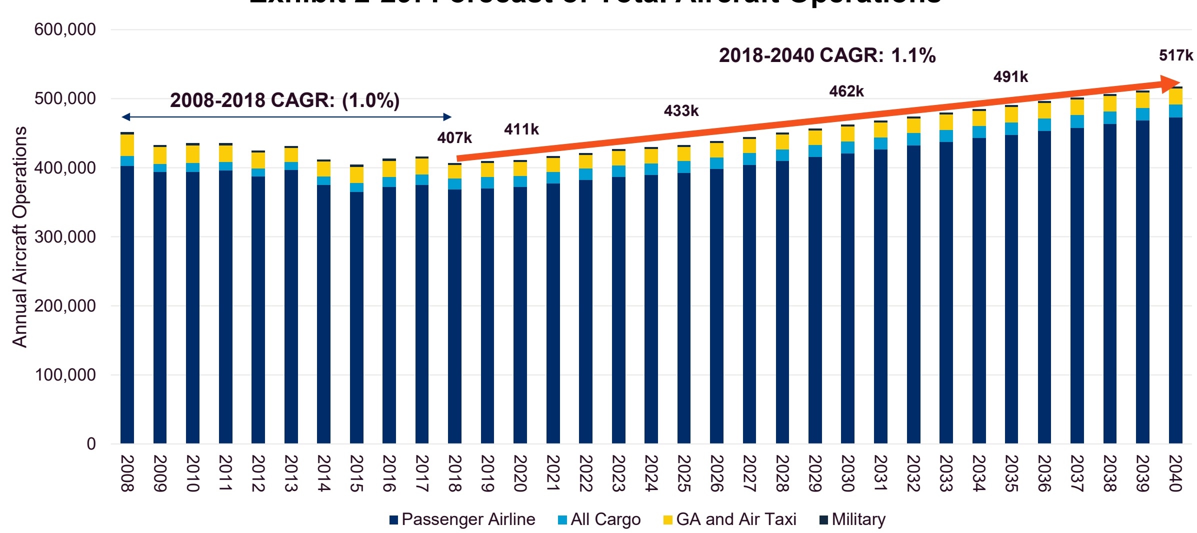


NOTE: CAGR – Compound Annual Growth Rate
SOURCES: U.S. Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2019 (actual); U.S. Department of Transportation, Federal Aviation Administration, *Terminal Area Forecast*, 2019 (forecast).

2.4.4 Total Operations Forecast

As illustrated in **Exhibit 2-29**, total aircraft operations at MSP are forecast to increase from approximately 407,000 in 2018 to approximately 517,000 in 2040, a CAGR of 1.1%. The passenger airline operations share of total operations remains consistent throughout the period at approximately 91%.

Exhibit 2-29: Forecast of Total Aircraft Operations



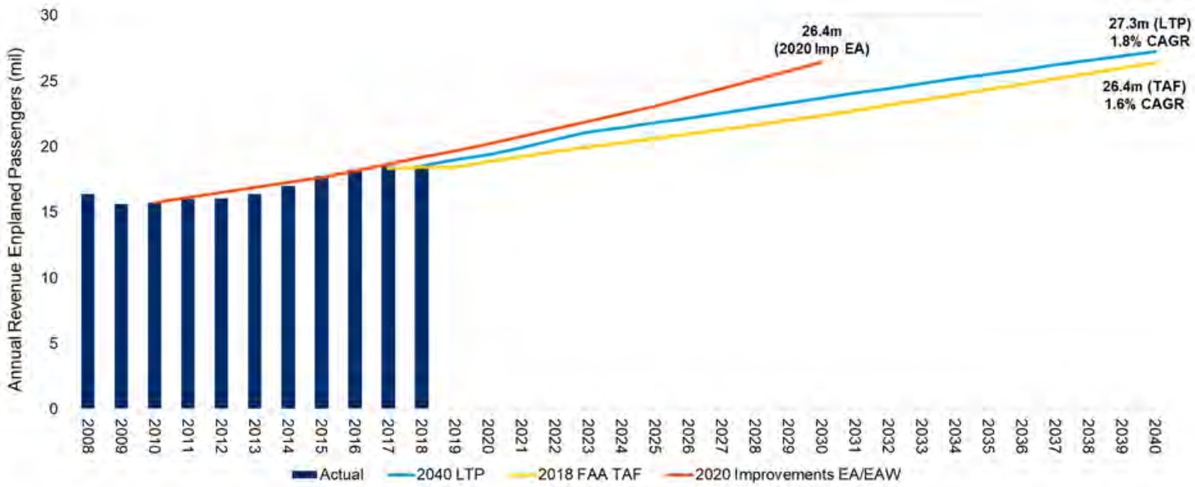
NOTES: CAGR – Compound Annual Growth Rate; GA – General Aviation
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; U.S. Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2019; Ricondo & Associates, Inc., 2019 (forecast).

2.5 COMPARISON TO OTHER FORECASTS

The results of the 2040 LTP forecast were compared to the 2020 Improvements EA/EAW forecast (completed in June 2012) and the FAA's 2018 TAF for the Airport. **Exhibit 2-30** compares revenue enplaned passengers. The 2040 LTP forecast anticipates 27.3 million revenue enplaned passengers in 2040, reflecting a CAGR of 1.8%. In comparison, the 2018 TAF anticipates 26.4 million revenue enplaned passengers for 2040, a CAGR of 1.6%. The 2020 Improvements EA/EAW forecast anticipates 26.4 million revenue enplaned passengers in 2030, the last year of that forecast. Revenue enplaned passengers are compared to be consistent with TAF reporting.

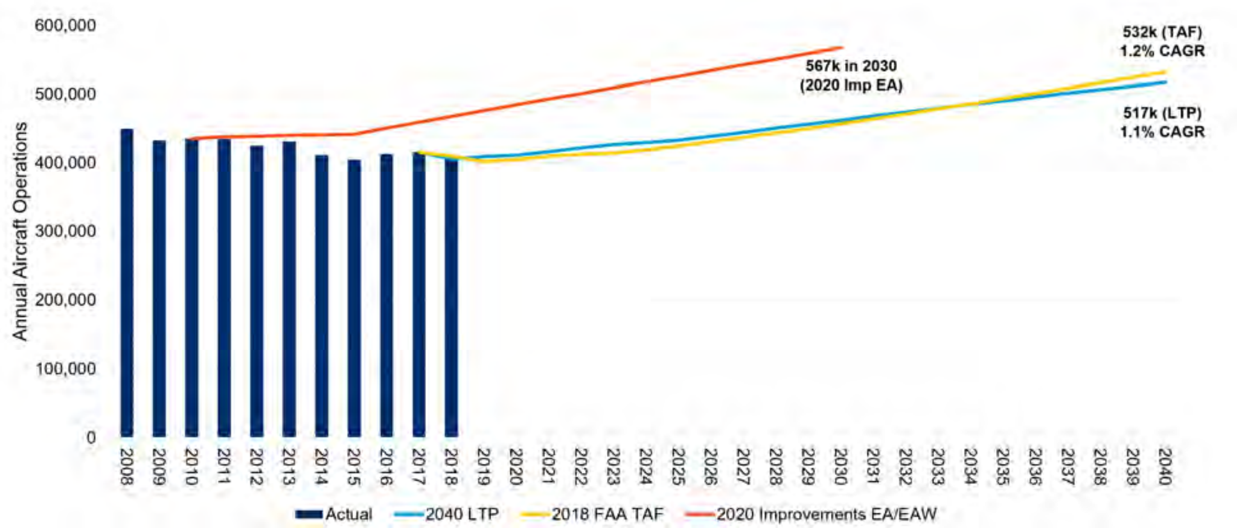
The 2040 LTP forecasts approximately 517,000 annual aircraft operations in 2040, a CAGR of 1.1%. This compares to approximately 532,000 operations forecast in the 2018 TAF and 567,000 operations (in 2030) in the 2020 Improvements EA/EAW forecast, as illustrated in **Exhibit 2-31**.

Exhibit 2-30: Comparison of Revenue Enplaned Passenger Forecasts



NOTES: LTP – Long-Term Plan; FAA – Federal Aviation Administration; TAF – Terminal Area Forecast; EA – Environmental Assessment; EAW – Environmental Assessment Worksheet; CAGR – Compound Annual Growth Rate
The TAF is for the 12 months ending September (federal fiscal year).
SOURCES: As shown for individual elements. Ricondo & Associates, Inc., 2019

Exhibit 2-31: Comparison of Total Aircraft Operations Forecasts



NOTES: LTP – Long-Term Plan; FAA – Federal Aviation Administration; TAF – Terminal Area Forecast; EA – Environmental Assessment; EAW – Environmental Assessment Worksheet; CAGR – Compound Annual Growth Rate
The TAF is for the 12 months ending September (federal fiscal year).
SOURCES: As shown for individual elements Ricondo & Associates, Inc., 2019

2.6 FORECAST SCENARIOS

In addition to the baseline forecast, two scenarios were modeled to reflect comparatively higher and lower activity.

2.6.1 High Scenario

The high-growth scenario incorporated the Met Council's projection of gross regional product (GRP) / GDP as the single driver of O&D demand. The high scenario assumes the stronger local demand environment will support additional seat capacity, enabling MSP to take a larger share of the underlying industry connecting passenger demand. The percentage of O&D and connecting passengers is modeled to be similar to that in the baseline forecast, albeit with higher volumes. Cargo volumes were also modeled to grow at a higher rate with the higher GDP growth assumption. No changes were made to the assumptions regarding GA/air taxi or military aircraft operations.

2.6.2 Low Scenario

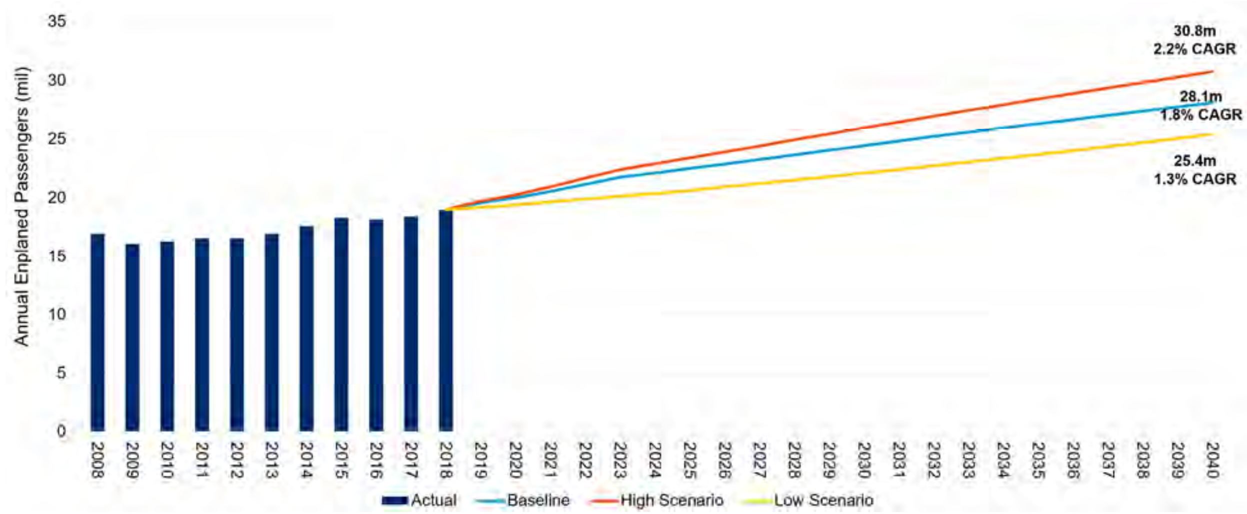
The low-growth scenario considered the *Draft 2019 Financial Feasibility Forecast* developed by Landrum & Brown, Inc., as the basis of the lower growth scenario. The draft feasibility forecast was developed through 2025 and assumed lower passenger growth at the Airport as a result of reduced passenger connections. Passenger volumes were subsequently extrapolated through 2040 using guidance provided by Landrum & Brown, Inc.

Exhibit 2-32 compares the baseline, high, and low scenario enplaned passenger forecasts, and **Exhibit 2-33** compares the respective aircraft operations forecasts. The more aggressive socioeconomic metric used to model the high scenario resulted in an enplaned passenger forecast of approximately 31 million in 2040, which is 9% higher than the baseline forecast.

Increased passenger and cargo volumes helped drive total high-scenario aircraft operations of approximately 555,000 in 2040.

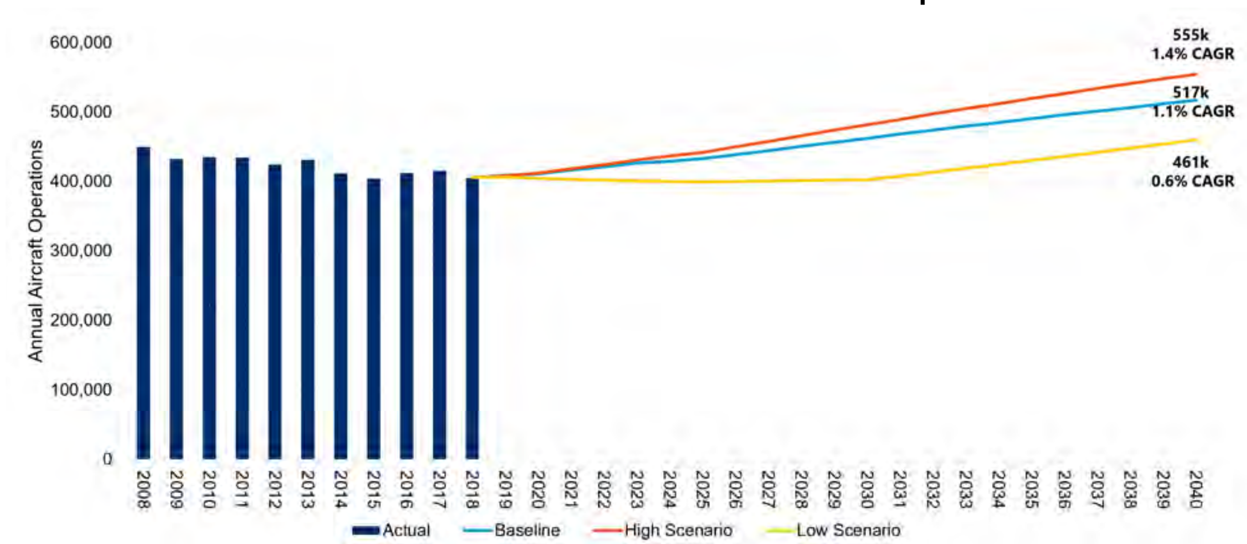
Low-scenario modeling impacted the passenger-related activity only. Low-scenario enplaned passengers in 2040, approximately 25 million, are nearly 10% lower than the amount reflected in the baseline forecast. As a result of lower passenger volumes, total operations are approximately 56,000 fewer than the baseline forecast.

Exhibit 2-32: Scenario Forecasts of Enplaned Passengers



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; Landrum & Brown, Inc., *Draft 2019 Feasibility Forecast*, 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Exhibit 2-33: Scenario Forecasts of Total Aircraft Operations



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2019; Landrum & Brown, Inc., *Draft 2019 Feasibility Forecast*, 2019; Ricondo & Associates, Inc., 2019 (forecasts).

2.7 DESIGN DAY FLIGHT SCHEDULE DEVELOPMENT

The Airport experiences two primary peak periods throughout the year: the summer months and the spring break period. These two periods represent two different profiles of activity that were deemed to warrant separate DDFS development for purposes of future planning around these profiles. Representative daily schedules for the spring and summer periods were developed for the base year (2018), and for years 2025, 2030, and 2040 for the baseline forecast for all segments of Airport activity. Schedules were also developed to represent the high and low scenarios for 2030 and 2040.

DDFSs were developed considering the overall forecast growth of individual passenger flows, as well as the flight segments and timings those passengers may demand. With demand growth, capacity was added in the form of larger aircraft and/or additional flight frequencies to accommodate that demand. Flight frequencies were added in accordance with traditional airline planning techniques (for passenger airline flights), as well as patterns of service identified for non-passenger flight operations. DDFSs were developed with guidance provided by several of the Airport's larger carriers, and results were ultimately shared and discussed with those carriers.

2.8 ORIGINAL FORECAST AND DESIGN DAY FLIGHT SCHEDULE TABLES

Tables 2-6 through **2-15** present the original historical and forecast data in relation to enplaned passengers, passenger activity, air cargo, and aircraft operations. Additionally, these tables present high and low scenario passenger metrics, as well as peak day and peak hour metrics.

Table 2-6: Historical and Forecast Enplaned Passengers

		Enplaned Passengers (mil)						
	Year	Total	O&D	Connecting	% O&D	Domestic	International	% Domestic
Actual	2008	17.0	8.5	8.5	49.9%	15.7	1.3	92%
	2009	16.1	8.3	7.8	51.4%	15.0	1.1	93%
	2010	16.3	8.4	7.9	51.4%	15.1	1.2	93%
	2011	16.5	8.6	7.9	52.1%	15.4	1.1	93%
	2012	16.6	8.6	8.0	51.7%	15.5	1.1	93%
	2013	16.9	8.8	8.2	51.7%	15.8	1.2	93%
	2014	17.6	9.3	8.3	53.0%	16.4	1.2	93%
	2015	18.3	9.8	8.5	53.8%	17.0	1.3	93%
	2016	18.7	10.5	8.2	56.2%	17.3	1.4	92%
	2017	19.0	11.0	8.0	58.1%	17.5	1.5	92%
	2018	19.0	11.5	7.5	60.4%	17.5	1.5	92%
Forecast	2019	19.6	11.8	7.8	60.3%	17.9	1.6	92%
	2020	20.0	12.0	8.0	59.8%	18.3	1.7	91%
	2021	20.6	12.3	8.2	60.0%	18.8	1.8	91%
	2022	21.2	12.7	8.4	60.2%	19.3	1.8	91%
	2023	21.8	13.1	8.6	60.3%	19.9	1.9	91%
	2024	22.1	13.3	8.8	60.2%	20.2	1.9	91%
	2025	22.5	13.5	9.0	60.1%	20.5	2.0	91%
	2026	22.9	13.7	9.2	60.0%	20.9	2.0	91%
	2027	23.3	13.9	9.3	59.9%	21.2	2.1	91%
	2028	23.7	14.1	9.5	59.7%	21.6	2.1	91%
	2029	24.0	14.3	9.7	59.6%	21.9	2.2	91%
	2030	24.4	14.6	9.9	59.6%	22.2	2.2	91%
	2031	24.8	14.8	10.1	59.5%	22.6	2.2	91%
	2032	25.2	15.0	10.2	59.4%	22.9	2.3	91%
	2033	25.6	15.2	10.4	59.4%	23.2	2.3	91%
	2034	26.0	15.4	10.6	59.3%	23.6	2.4	91%
	2035	26.3	15.6	10.7	59.2%	23.9	2.4	91%
	2036	26.7	15.8	10.9	59.1%	24.2	2.5	91%
	2037	27.1	16.0	11.1	59.1%	24.5	2.5	91%
	2038	27.4	16.2	11.2	59.0%	24.8	2.6	91%
	2039	27.8	16.4	11.4	58.9%	25.2	2.6	91%
	2040	28.1	16.5	11.6	58.8%	25.5	2.7	91%
CAGR								
2008–2018		1.1%	3.1%	-1.2%		1.1%	1.4%	
2018–2040		1.8%	1.7%	2.0%		1.7%	2.7%	

NOTES: O&D – Origin and Distribution; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2019; U.S. Department of Transportation, T-100, 2019; Sabre, Market Information Data Tapes (MIDT), 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Table 2-7: (1 of 2) Historical and Forecast Passenger Activity Metrics (Average Seats as Flown)

		Domestic (Both Directions)				International (Both Directions)				Total (Both Directions)			
	Year	Ops (000)	Pax (mil)	Avg. Seats	LF	Ops (000)	Pax (mil)	Avg. Seats	LF	Ops (000)	Pax (mil)	Avg. Seats	LF
Actual	2008	378.4	31.3	103	80.1%	24.0	2.6	134.4	80.6%	402.3	33.9	105	80.2%
	2009	372.2	29.9	102	78.7%	22.5	2.3	127.3	79.1%	394.6	32.2	104	78.8%
	2010	367.9	30.2	100	81.7%	26.5	2.4	111.8	79.7%	394.4	32.5	101	81.6%
	2011	369.8	30.8	100	83.1%	26.2	2.3	108.5	80.4%	396.0	33.1	101	82.9%
	2012	362.7	30.9	102	83.8%	25.0	2.2	106.6	83.8%	387.7	33.1	102	83.8%
	2013	372.2	31.5	102	82.7%	24.5	2.3	112.1	85.3%	396.7	33.9	103	82.8%
	2014	351.0	32.7	109	85.6%	24.1	2.4	119.4	84.6%	375.1	35.2	110	85.5%
	2015	341.0	33.9	115	86.6%	24.3	2.7	126.5	86.5%	365.3	36.6	116	86.6%
	2016	346.8	34.6	117	85.3%	25.5	2.8	132.3	84.3%	372.3	37.5	118	85.2%
	2017	351.0	35.0	118	84.6%	24.0	3.0	145.2	85.8%	375.0	38.0	120	84.7%
	2018	344.8	35.0	119	85.6%	24.0	3.0	149.1	83.6%	368.8	38.0	121	85.2%
Forecast	2019	346.3	35.9	122	84.7%	24.4	3.3	159.2	84.2%	370.7	39.2	124	85.2%
	2020	347.6	36.6	124	84.7%	24.9	3.4	161.4	85.6%	372.5	40.0	127	84.8%
	2021	351.9	37.6	126	84.8%	25.5	3.5	162.0	85.7%	377.4	41.1	128	84.9%
	2022	355.9	38.6	128	85.0%	26.2	3.7	163.3	85.7%	382.1	42.3	130	85.1%
	2023	360.2	39.7	130	85.1%	26.9	3.8	164.5	85.7%	387.0	43.5	132	85.1%
	2024	362.4	40.4	131	85.2%	27.4	3.9	164.5	85.8%	389.8	44.3	133	85.2%
	2025	364.8	41.1	132	85.2%	28.0	4.0	164.3	85.9%	392.8	45.0	134	85.3%
	2026	370.0	41.7	132	85.3%	28.4	4.0	164.8	86.0%	398.4	45.8	135	85.3%
	2027	375.1	42.4	133	85.3%	28.8	4.1	165.3	86.1%	403.9	46.5	135	85.4%
	2028	380.5	43.1	133	85.4%	29.3	4.2	166.3	86.2%	409.7	47.3	135	85.5%
	2029	385.8	43.8	133	85.5%	29.8	4.3	167.5	86.3%	415.5	48.1	135	85.6%
	2030	390.7	44.5	133	85.6%	30.2	4.4	168.7	86.4%	420.9	48.9	136	85.6%
	2031	395.9	45.2	133	85.6%	30.6	4.5	169.6	86.5%	426.5	49.7	136	85.7%
	2032	401.0	45.8	133	85.7%	31.1	4.6	170.5	86.5%	432.1	50.4	136	85.8%
	2033	405.9	46.5	134	85.8%	31.5	4.7	171.4	86.6%	437.5	51.2	136	85.9%
	2034	410.7	47.2	134	85.9%	32.0	4.8	172.4	86.7%	442.7	51.9	137	85.9%
	2035	415.4	47.8	134	85.9%	32.4	4.9	173.3	86.8%	447.8	52.7	137	86.0%
	2036	420.3	48.4	134	86.0%	32.8	5.0	174.1	86.8%	453.1	53.4	137	86.1%

NOTES: CAGR – Compound Annual Growth Rate; LF – Load Factor
SOURCES: MAC Activity Reports; U.S. Department of Transportation; U.S. Department of Transportation, T-100, 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Table 2-7: (2 of 2) Historical and Forecast Passenger Activity Metrics (Average Seats as Flown)

		Domestic (Both Directions)				International (Both Directions)				Total (Both Directions)			
	Year	Ops (000)	Pax (mil)	Avg. Seats	LF	Ops (000)	Pax (mil)	Avg. Seats	LF	Ops (000)	Pax (mil)	Avg. Seats	LF
	2037	425.0	49.1	134	86.1%	33.3	5.1	174.9	86.9%	458.3	54.1	137	86.1%
	2038	429.6	49.7	134	86.1%	33.7	5.1	175.7	87.0%	463.3	54.8	137	86.2%
	2039	434.1	50.3	134	86.2%	34.1	5.2	176.4	87.1%	468.3	55.5	137	86.3%
	2040	438.6	50.9	135	86.3%	34.5	5.3	177.2	87.1%	473.1	56.3	138	86.4%
CAGR													
2008–2018		-0.9%	1.1%	1.4%		0.0%	1.4%	1.0%		-0.9%	1.1%	1.4%	
2018–2040		1.1%	1.7%	0.6%		1.7%	2.7%	0.8%		1.1%	1.8%	0.6%	

NOTES: CAGR – Compound Annual Growth Rate; LF – Load Factor
SOURCES: MAC Activity Reports; U.S. Department of Transportation; U.S. Department of Transportation, T-100, 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Table 2-8: Historical and Forecast Air Cargo Volumes and Operations

		Cargo Volume (000 Tons)				
	Year	Air Cargo	Passenger	Total	Air Cargo Operations (000)	Cargo Tons Per Air Cargo Operation
Actual	2008	205.5	51.6	257.1	14.4	14.3
	2009	168.4	40.7	209.1	11.1	15.1
	2010	182.8	50.8	233.6	12.5	14.6
	2011	177.7	52.3	230.0	12.2	14.6
	2012	162.9	56.1	219.0	11.2	14.5
	2013	158.7	63.2	221.9	11.7	13.6
	2014	157.1	66.8	223.9	12.2	12.9
	2015	152.8	66.9	219.7	12.8	12.0
	2016	167.7	60.4	228.1	14.4	11.6
	2017	175.9	77.1	252.9	14.9	11.8
	2018	188.8	75.0	263.8	15.5	12.2
Forecast	2019	192.4	77.8	270.1	15.8	12.1
	2020	196.0	79.4	275.4	16.0	12.3
	2021	199.7	80.7	280.4	16.1	12.4
	2022	203.4	82.2	285.6	16.3	12.5
	2023	207.2	83.6	290.8	16.4	12.6
	2024	211.1	85.0	296.0	16.6	12.7
	2025	215.0	86.4	301.3	16.7	12.8
	2026	218.9	87.8	306.7	16.9	13.0
	2027	222.9	89.2	312.1	17.0	13.1
	2028	227.0	90.7	317.6	17.2	13.2
	2029	231.1	92.1	323.2	17.3	13.4
	2030	235.2	93.5	328.7	17.4	13.5
	2031	239.4	94.9	334.4	17.6	13.6
	2032	243.7	96.3	340.0	17.7	13.8
	2033	248.0	97.7	345.7	17.8	13.9
	2034	252.4	99.0	351.4	17.9	14.1
	2035	256.8	100.4	357.2	18.1	14.2
	2036	261.3	101.7	363.0	18.2	14.4
	2037	265.8	103.0	368.8	18.3	14.5
	2038	270.4	104.3	374.6	18.4	14.7
	2039	275.0	105.5	380.5	18.5	14.8
	2040	279.7	106.8	386.5	18.6	15.0
CAGR						
2008–2018		-0.8%	3.8%	0.3%	0.7%	-1.6%
2018–2040		1.8%	1.6%	1.8%	0.9%	0.9%

NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation; U.S. Department of Transportation, T-100, 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Table 2-9: Historical and Forecast Aircraft Operations

		Annual Aircraft Operations (000)							
		Passenger			Non-Passenger				
	Year	Domestic	International	Total	Air Cargo	GA / Air Taxi	Military	Total	Total
Actual	2008	378.4	24.0	402.3	14.4	31.9	3.0	49.2	451.6
	2009	372.2	22.5	394.6	11.1	24.2	2.7	38.0	432.6
	2010	367.9	26.5	394.4	12.5	25.9	2.8	41.2	435.6
	2011	369.8	26.2	396.0	12.2	23.9	2.9	39.1	435.1
	2012	362.7	25.0	387.7	11.2	23.5	2.4	37.2	424.9
	2013	372.2	24.5	396.7	11.7	20.6	2.5	34.9	431.6
	2014	351.0	24.1	375.1	12.2	22.1	2.4	36.7	411.8
	2015	341.0	24.3	365.3	12.8	23.4	2.8	39.0	404.4
	2016	346.8	25.5	372.3	14.4	23.3	2.9	40.6	412.9
	2017	351.0	24.0	375.0	14.9	23.7	2.0	40.7	415.7
	2018	344.8	24.0	368.8	15.5	20.1	2.6	38.1	406.9
Forecast	2019	346.3	24.4	370.7	15.8	20.2	2.5	38.5	409.3
	2020	347.6	24.9	372.5	16.0	20.3	2.5	38.8	411.3
	2021	351.9	25.5	377.4	16.1	20.4	2.5	39.1	416.5
	2022	355.9	26.2	382.1	16.3	20.6	2.5	39.4	421.5
	2023	360.2	26.9	387.0	16.4	20.7	2.5	39.6	426.7
	2024	362.4	27.4	389.8	16.6	20.8	2.5	39.9	429.7
	2025	364.8	28.0	392.8	16.7	20.9	2.5	40.2	433.0
	2026	370.0	28.4	398.4	16.9	21.1	2.5	40.4	438.9
	2027	375.1	28.8	403.9	17.0	21.2	2.5	40.7	444.6
	2028	380.5	29.3	409.7	17.2	21.3	2.5	41.0	450.7
	2029	385.8	29.8	415.5	17.3	21.4	2.5	41.2	456.8
	2030	390.7	30.2	420.9	17.4	21.6	2.5	41.5	462.4
	2031	395.9	30.6	426.5	17.6	21.7	2.5	41.8	468.3
	2032	401.0	31.1	432.1	17.7	21.8	2.5	42.0	474.1
	2033	405.9	31.5	437.5	17.8	22.0	2.5	42.3	479.7
	2034	410.7	32.0	442.7	17.9	22.1	2.5	42.5	485.3
	2035	415.4	32.4	447.8	18.1	22.2	2.5	42.8	490.6
	2036	420.3	32.8	453.1	18.2	22.4	2.5	43.0	496.2
	2037	425.0	33.3	458.3	18.3	22.5	2.5	43.3	501.6
	2038	429.6	33.7	463.3	18.4	22.6	2.5	43.5	506.9
	2039	434.1	34.1	468.3	18.5	22.8	2.5	43.8	512.1
	2040	438.6	34.5	473.1	18.6	22.9	2.5	44.0	517.2
CAGR									
2008–2018		-0.9%	0.0%	-0.9%	0.7%	-4.5%	0.0%	-2.5%	-1.0%
2018–2040		1.1%	1.7%	1.1%	0.9%	0.6%	0.0%	0.7%	1.1%

NOTES: GA – General Aviation; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation; U.S. Department of Transportation, T-100, 2019; Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Table 2-10: (1 of 2) Passenger Metrics for High and Low Scenarios (Passengers Shown in Both Directions)

		Baseline Forecast			High Scenario			Low Scenario		
	Year	Pax (mil)	% Domestic	% O&D	Pax (mil)	% Domestic	% O&D	Pax (mil)	% Domestic	% O&D
Actual	2008	33.9	92%	49.9%	33.9	92%	49.9%	33.9	92%	49.9%
	2009	32.2	93%	51.4%	32.2	93%	51.4%	32.2	93%	51.4%
	2010	32.5	93%	51.4%	32.5	93%	51.4%	32.5	93%	51.4%
	2011	33.1	93%	52.1%	33.1	93%	52.1%	33.1	93%	52.1%
	2012	33.1	93%	51.7%	33.1	93%	51.7%	33.1	93%	51.7%
	2013	33.9	93%	51.7%	33.9	93%	51.7%	33.9	93%	51.7%
	2014	35.2	93%	53.0%	35.2	93%	53.0%	35.2	93%	53.0%
	2015	36.6	93%	53.8%	36.6	93%	53.8%	36.6	93%	53.8%
	2016	37.5	92%	56.2%	37.5	92%	56.2%	37.5	92%	56.2%
	2017	38.0	92%	58.1%	38.0	92%	58.1%	38.0	92%	58.1%
	2018	38.0	92%	60.4%	38.0	92%	60.4%	38.0	92%	60.4%
Forecast	2019	39.2	92%	60.3%	39.4	92%	60.3%	38.4	92%	60.3%
	2020	40.0	91%	59.8%	40.5	91%	59.8%	38.8	92%	60.6%
	2021	41.1	91%	60.0%	41.9	91%	60.0%	39.3	91%	60.8%
	2022	42.3	91%	60.2%	43.3	91%	60.2%	39.8	91%	61.0%
	2023	43.5	91%	60.3%	44.8	91%	60.3%	40.3	91%	61.2%
	2024	44.3	91%	60.2%	45.8	91%	60.2%	40.8	91%	61.3%
	2025	45.0	91%	60.1%	46.8	91%	60.1%	41.3	91%	61.5%
	2026	45.8	91%	60.0%	47.8	91%	59.9%	41.9	91%	61.7%
	2027	46.5	91%	59.9%	48.8	91%	59.8%	42.4	90%	61.9%
	2028	47.3	91%	59.7%	49.8	91%	59.7%	43.0	90%	62.1%
	2029	48.1	91%	59.6%	50.9	91%	59.6%	43.6	90%	62.3%
	2030	48.9	91%	59.6%	51.9	91%	59.5%	44.2	90%	62.5%
	2031	49.7	91%	59.5%	52.9	91%	59.5%	44.8	90%	62.7%
	2032	50.4	91%	59.4%	53.9	91%	59.4%	45.4	90%	62.9%
	2033	51.2	91%	59.4%	54.9	91%	59.3%	46.1	89%	63.0%
	2034	51.9	91%	59.3%	55.9	91%	59.2%	46.7	89%	63.2%
	2035	52.7	91%	59.2%	56.9	91%	59.2%	47.4	89%	63.4%
	2036	53.4	91%	59.1%	57.8	91%	59.1%	48.0	89%	63.6%

NOTES: O&D – Origin and Destination; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2019; U.S. Department of Transportation, T-100, 2019; Sabre, Market Information Data Tapes (MIDT), 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Table 2-10: (2 of 2) Passenger Metrics for High and Low Scenarios (Passengers Shown in Both Directions)

		Baseline Forecast			High Scenario			Low Scenario		
	Year	Pax (mil)	% Domestic	% O&D	Pax (mil)	% Domestic	% O&D	Pax (mil)	% Domestic	% O&D
	2037	54.1	91%	59.1%	58.8	91%	59.0%	48.7	89%	63.8%
	2038	54.8	91%	59.0%	59.7	91%	58.9%	49.4	89%	64.0%
	2039	55.5	91%	58.9%	60.6	90%	58.8%	50.1	89%	64.2%
	2040	56.3	91%	58.8%	61.5	90%	58.7%	50.8	88%	64.4%
CAGR										
2008–2018		1.1%			1.1%			1.1%		
2018–2040		1.8%			2.2%			1.3%		

NOTES: O&D – Origin and Destination; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2019; U.S. Department of Transportation, T-100, 2019; Sabre, Market Information Data Tapes (MIDT), 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Table 2-11: (1 of 2) Aircraft Operations Metrics for High and Low Scenarios

		Baseline Forecast Operations (000)			High Scenario Operations (000)			Low Scenario Operations (000)		
	Year	Passenger	Cargo	Total	Passenger	Cargo	Total	Passenger	Cargo	Total
Actual	2008	402.3	14.4	451.6	402.3	14.4	451.6	402.3	14.4	451.6
	2009	394.6	11.1	432.6	394.6	11.1	432.6	394.6	11.1	432.6
	2010	394.4	12.5	435.6	394.4	12.5	435.6	394.4	12.5	435.6
	2011	396.0	12.2	435.1	396.0	12.2	435.1	396	12.2	435.1
	2012	387.7	11.2	424.9	387.7	11.2	424.9	387.7	11.2	424.9
	2013	396.7	11.7	431.6	396.7	11.7	431.6	396.7	11.7	431.6
	2014	375.1	12.2	411.8	375.1	12.2	411.8	375.1	12.2	411.8
	2015	365.3	12.8	404.4	365.3	12.8	404.4	365.3	12.8	404.4
	2016	372.3	14.4	412.9	372.3	14.4	412.9	372.3	14.4	412.9
	2017	375.0	14.9	415.7	375.0	14.9	415.7	375.0	14.9	415.7
	2018	368.8	15.5	406.9	368.8	15.5	406.9	368.8	15.5	406.9
Forecast	2019	370.7	15.8	409.3	370.7	16.1	408.7	368.2	15.8	406.7
	2020	372.5	16.0	411.3	372.8	16.5	412.1	366.1	16.0	405.0
	2021	377.4	16.1	416.5	378.8	16.8	418.5	364.3	16.1	403.4
	2022	382.1	16.3	421.5	384.2	17.1	424.4	362.7	16.3	402.1
	2023	387.0	16.4	426.7	391.1	17.4	431.6	361.2	16.4	400.8
	2024	389.8	16.6	429.7	395.8	17.6	436.7	360.4	16.6	400.3
	2025	392.8	16.7	433.0	400.8	17.8	442.0	359.6	16.7	399.8
	2026	398.4	16.9	438.9	408.4	18.1	450.1	359.8	16.9	400.2
	2027	403.9	17.0	444.6	415.9	18.3	457.9	360.0	17.0	400.7
	2028	409.7	17.2	450.7	423.7	18.5	466.1	360.4	17.2	401.3
	2029	415.5	17.3	456.8	431.5	18.8	474.2	360.8	17.3	402.0
	2030	420.9	17.4	462.4	438.8	19.0	481.9	361.3	17.4	402.8
	2031	426.5	17.6	468.3	446.3	19.3	489.8	366.4	17.6	408.1
	2032	432.1	17.7	474.1	453.7	19.5	497.5	371.5	17.7	413.6
	2033	437.5	17.8	479.7	460.9	19.7	505.1	376.8	17.8	419.1
	2034	442.7	17.9	485.3	467.9	20.0	512.5	382.2	17.9	424.7

NOTES: Other operations not shown in table, but are included in the Scenario totals; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation; U.S. Department of Transportation, T-100, 2019; Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Table 2-11: (2 of 2) Aircraft Operations Metrics for High and Low Scenarios

		Baseline Forecast Operations (000)			High Scenario Operations (000)			Low Scenario Operations (000)		
	Year	Passenger	Cargo	Total	Passenger	Cargo	Total	Passenger	Cargo	Total
	2035	447.8	18.1	490.6	474.8	20.2	519.7	387.6	18.1	430.4
	2036	453.1	18.2	496.2	481.7	20.5	527.0	393.2	18.2	436.3
	2037	458.3	18.3	501.6	488.5	20.7	534.2	398.9	18.3	442.2
	2038	463.3	18.4	506.9	495.1	21	541.2	404.7	18.4	448.2
	2039	468.3	18.5	512.1	501.7	21.2	548.1	410.6	18.5	454.4
	2040	473.1	18.6	517.2	508.1	21.5	554.9	416.6	18.6	460.6
CAGR										
2008–2018		-0.90%	0.70%	-1.00%	-0.90%	0.70%	-1.00%	-0.90%	0.70%	-1.00%
2018–2040		1.10%	0.90%	1.10%	1.50%	1.50%	1.40%	0.60%	0.90%	0.60%

NOTES: Other operations not shown in table, but are included in the Scenario totals; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation; U.S. Department of Transportation, T-100, 2019; Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2019; Ricondo & Associates, Inc., 2019 (forecasts).

Table 2-12: Selected Design Day Flight Schedule Daily Metrics

		Aircraft Operations						
Year	Passengers	Passenger Airlines	Air Taxi	Cargo	Charter	General Aviation	Military	Total
Spring Design Day								
Base	119,214	1,113	14	36	20	26	3	1,212
2025	141,409	1,176	14	38	20	28	3	1,279
2030	156,516	1,270	16	42	20	30	3	1,381
2040	178,107	1,422	18	50	20	34	3	1,547
2030 Low	137,663	1,126	16	42	20	30	3	1,237
2030 High	168,959	1,358	16	46	20	30	3	1,473
2040 Low	154,662	1,248	18	50	20	34	3	1,373
2040 High	191,987	1,548	18	62	20	34	3	1,685
Summer Design Day								
Base	127,661	1,186	39	66	13	64	12	1,380
2025	156,558	1,278	43	71	13	64	12	1,481
2030	171,316	1,370	43	74	13	68	12	1,580
2040	194,786	1,542	45	80	13	74	12	1,766
2030 Low	145,707	1,168	43	74	13	68	12	1,378
2030 High	177,656	1,414	43	80	13	68	12	1,630
2040 Low	171,967	1,352	45	80	13	74	12	1,576
2040 High	205,000	1,652	45	92	13	74	12	1,888

NOTE: Passenger totals include revenue and non-revenue passengers.
SOURCE: Ricondo & Associates, Inc., 2019.

Table 2-13: Design Day Flight Schedule Peak Hour Metrics (Outbound)

		Aircraft Departures	
Year	Enplaned Passengers	Passenger/Charter Airlines	Total
Spring Design Day			
Base	6,397	68	68
2025	6,766	63	63
2030	7,615	63	64
2040	9,091	74	74
2030 Low	6,713	57	57
2030 High	8,694	71	72
2040 Low	7,797	60	69
2040 High	9,868	81	83
Summer Design Day			
Base	7,419	65	74
2025	7,911	60	70
2030	8,699	65	72
2040	9,801	83	88
2030 Low	8,273	65	68
2030 High	9,190	70	77
2040 Low	9,695	80	85
2040 High	10,160	86	91

NOTE: Passenger totals include revenue and non-revenue passengers for both scheduled and charter flights.
SOURCE: Ricondo & Associates, Inc., 2019.

Table 2-14: Selected Design Day Flight Schedule Peak Hour Metrics (Inbound)

		Aircraft Arrivals	
Year	Deplaned Passengers	Passenger/Charter Airlines	Total
Spring Design Day			
Base	6,848	68	72
2025	7,211	60	64
2030	8,044	67	71
2040	8,768	68	72
2030 Low	6,879	58	62
2030 High	9,243	68	71
2040 Low	8,090	61	63
2040 High	9,841	76	78
Summer Design Day			
Base	8,385	74	77
2025	7,674	64	68
2030	7,724	65	69
2040	10,453	79	88
2030 Low	7,531	62	66
2030 High	8,527	69	73
2040 Low	9,840	73	82
2040 High	10,453	79	88

NOTE: Passenger totals include revenue and non-revenue passengers for both scheduled and charter flights.
SOURCE: Ricondo & Associates, Inc., 2019.

Table 2-15: Selected Design Day Flight Schedule Peak Hour Metrics (Combined Peak)

		Aircraft Operations	
Year	Passengers	Passenger/Charter Airlines	Total
Spring Design Day			
Base	9,027	85	95
2025	10,655	94	104
2030	12,226	97	107
2040	14,234	111	113
2030 Low	10,874	89	91
2030 High	13,099	101	107
2040 Low	11,923	94	102
2040 High	15,170	125	129
Summer Design Day			
Base	9,855	99	111
2025	13,363	104	117
2030	12,681	105	118
2040	15,160	127	140
2030 Low	13,227	103	111
2030 High	14,247	111	124
2040 Low	13,626	108	117
2040 High	15,639	131	144

NOTE: Passenger totals include revenue and non-revenue passengers for both scheduled and charter flights.
SOURCE: Ricondo & Associates, Inc., 2019.

2.9 AVIATION ACTIVITY FORECAST REVIEW AND UPDATE

Considering the COVID-19 pandemic and its impact on the aviation industry overall and at MSP, three primary tasks were conducted in September and October 2021:

- a review and update of the original baseline forecast completed in 2020, including an estimate of the recovery from the COVID-19 impact on demand;
- the development of a more aggressive pandemic recovery scenario; and
- a revision of the baseline 2025, 2030, and 2040 DDFSs.

After updating activity metrics to reflect the most recent actual information, the review and update of the baseline forecast consisted of several steps:

- review of the baseline forecast's model for activity growth in the longer-term period of the forecast horizon to assess the reasonability and continued applicability of that approach for all activity segments (passenger, cargo, GA, and military);
- if reasonable and applicable, update of the inputs used for that model to revise the longer-term outlook of activity;
- analysis of shorter-term drivers related to the pandemic's effect on activity to model the duration and impact of those drivers on enplaned passengers at MSP;
- review and update of the fleet and load factor assumptions developed for the baseline forecast; and

- based on changes previously identified, update of the baseline forecast of aircraft operations for each activity segment.

The following subsections summarize the approach to these tasks. See **Section 2.10** for tables reflecting the revised forecasts.

2.9.1 Longer-Term Enplaned Passenger Forecast Model Validation

As previously described, the baseline enplaned passenger forecast was developed using a methodology that first estimated underlying demand in both O&D and connecting markets potentially served at MSP. Statistical relationships of those passenger types to socioeconomic factors, such as personal income and employment, were identified through regression analysis. These relationships, in the form of statistical equations, were coupled with projections of socioeconomic factors to forecast future potential passenger volumes. Additional factors, including the airline business decision (or ability) to serve the various segments of passenger demand and the influence of air service at other competing airports, were subsequently used to estimate the portion of underlying future demand that would be carried at MSP. In the forecast review and update, possible changes to these factors and their effects were explored.

Table 2-16 compares the local and national socioeconomic factors used to predict demand, as sourced for the original forecast, and more recently for the forecast revision. The outlook for most factors has improved (as indicated in green), while several remain unchanged from the prior forecast (as indicated in gray). The forecast of local and national population growth has been reduced, as has area net earnings and non-farm employment (per Woods & Poole Economics, Inc.).

Delta’s financial performance and the relative importance of MSP as part of the airline’s route network was reviewed, with the conclusion that the airline will continue to be a strong competitor relative to its peers, and that the airline will continue to use MSP as a critical element of its network to serve both O&D and connecting passengers. **Exhibit 2-34** illustrates the share of Delta’s scheduled domestic seat capacity offered at its hubs in 2019 (before the onset of the COVID-19 pandemic) and in 2021, during which MSP has maintained a similar share of capacity. Also of note is Salt Lake City International Airport (SLC), which has generated a higher share of Delta’s domestic seat capacity from its hubs due, in part, to that hub’s geographic location and its unique use by the airline during the pandemic to consolidate seat capacity there and conserve costs to provide connections to smaller West Coast markets.

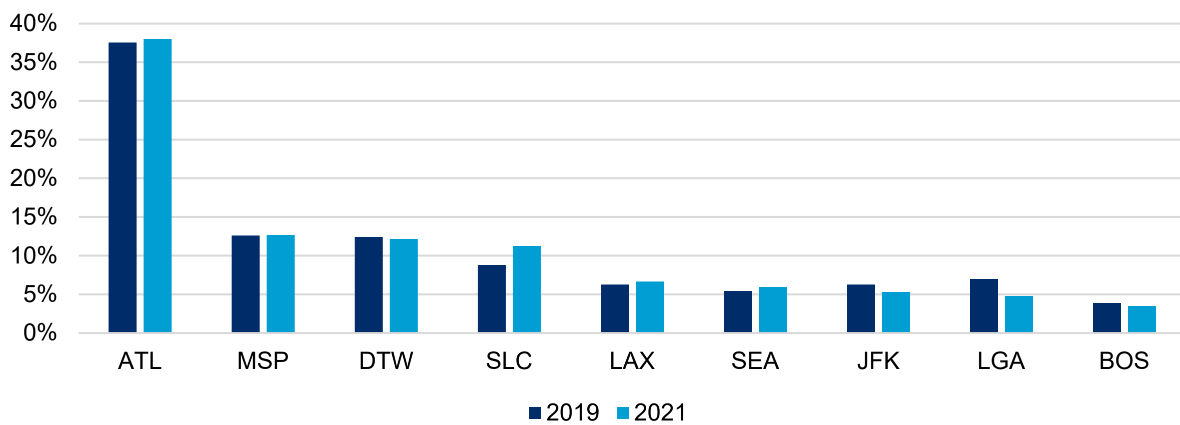
Exhibit 2-35 presents the domestic capacity for the industry at selected U.S. hubs that generally compete for similar east–west passenger traffic.

Table 2-16: Comparison of Socioeconomic Forecast Inputs

Factor	2017 Forecast CAGR (2018–2040)	2021 Forecast CAGR (2018–2040)
MSP Area[1]		
Non-Farm Earnings	1.8%	1.8%
Non-Farm Employment	1.4%	1.0%
Gross Regional Product	1.7%	1.8%
Net Earnings	1.9%	1.8%
Per-Capita Personal Income	0.9%	1.3%
Personal Income	1.9%	2.0%
Population	1.0%	0.7%
National[1]		
Non-Farm Earnings	1.7%	2.0%
Non-Farm Employment	1.2%	1.2%
Gross Domestic Product	1.7%	2.0%
Net Earnings	1.8%	2.0%
Per-Capita Personal Income	1.0%	1.6%
Personal Income	1.8%	2.2%
Population	0.9%	0.6%
Metropolitan Council (MSP Area)	**2017 Forecast CAGR (2020–2040)**	**2021 Forecast CAGR (2020–2040)**
Non-Farm Employment	0.6%	1.4%
Gross Regional Product	2.2%	3.1%
Personal Income	2.1%	2.2%
Population	0.8%	0.8%

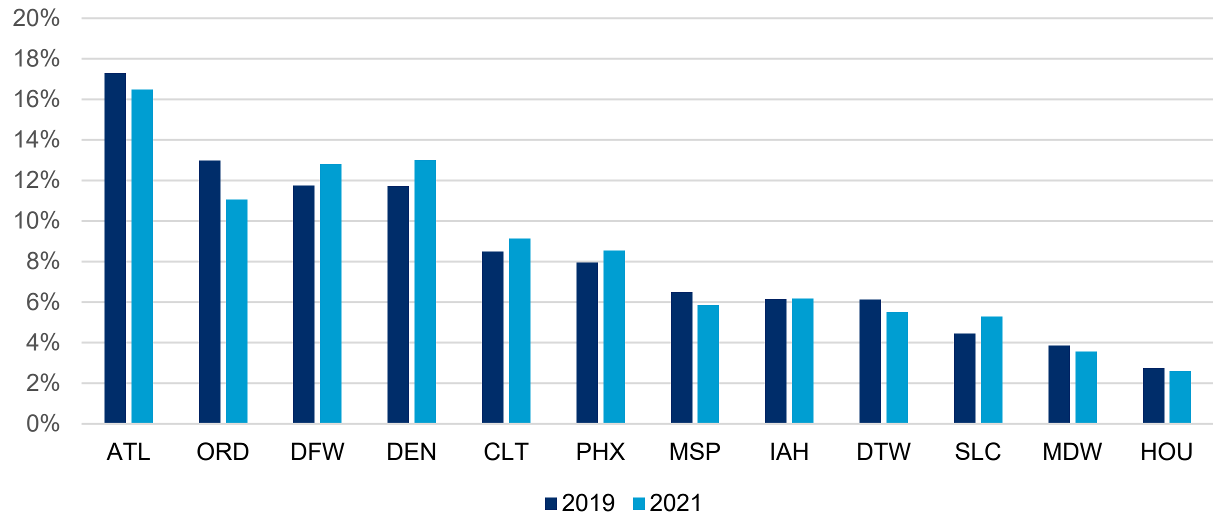
NOTES: CAGR – Compound Annual Growth Rate
When the baseline forecast was originally developed, 2017 was the most recent year of Metropolitan Council data.
1 Data from Woods & Poole Economics, Inc.
SOURCES: Metropolitan Council, 2021; Woods & Poole Economics, Inc., 2021.

Exhibit 2-34: Share of Domestic Seat Capacity at Delta Air Lines' Hubs in 2019 and 2021



NOTES: ATL – Hartsfield-Jackson Atlanta International Airport, DTW – Detroit Metropolitan Wayne County Airport, SLC- Salt Lake City International Airport, LAX – Los Angeles International Airport, SEA – Seattle-Tacoma International Airport, JFK – John F. Kennedy International Airport, LGA – LaGuardia Airport, BOS – Boston Logan International Airport.
SOURCE: Cirium, 2021.

Exhibit 2-35: Share of Domestic Seat Capacity Among Selected Hubs in 2019 and 2021



NOTES:ATL – Hartsfield-Jackson Atlanta International Airport; ORD – Chicago O'Hare International Airport, DFW – Dallas/Fort Worth International Airport, DEN – Denver International Airport, CLT – Charlotte Douglas International Airport, PHX – Phoenix Sky Harbor International Airport, IAH – Houston Intercontinental Airport, DTW – Detroit Metropolitan Wayne County Airport, SLC- Salt Lake City International Airport, MDW – Chicago Midway International Airport, HOU – William P. Hobby International Airport.
SOURCE: Cirium, 2021.

While the Airport's share has fallen slightly, that is largely due to the increased share of capacity at other hubs, namely Dallas Fort Worth International Airport (DFW), Denver International Airport (DEN), Charlotte Douglas International Airport (CLT), Phoenix Sky Harbor International Airport (PHX), and SLC, all of which experienced an increase in share during the pandemic due to their proximity to regions that have retained a relatively high amount of demand. Airlines have leveraged these airports to serve those regions more efficiently during the pandemic, and it was assumed that as pandemic-related influences subside, the share of capacity across U.S. hubs will normalize.

2.9.2 Modeling of Shorter-Term Passenger Recovery

The pandemic has disrupted the relationships between passenger volumes and drivers traditionally used to forecast demand, such as employment, personal income, and other socioeconomic factors. Passenger travel has more recently been influenced by factors such as travel restrictions, fear of illness, or work policies that have emerged since the onset of the pandemic.

As the effects of the pandemic subside, passenger demand is expected to be influenced again by traditional drivers. However, the return to that point will not be immediate, and the timing will likely be different based on factors such as regional economic recoveries, seat capacity allocation decisions by airlines, and local or national travel restrictions. The return to traditional drivers of growth will likely be uneven across markets and passenger types. As such, the path back to a point where demand is influenced by traditional factors, rather than pandemic-related concerns, was modeled using a methodology that considers both qualitative and quantitative factors.

The methodology considered the following:

- airline capacity and load factor recovery at MSP
- airline capacity recovery at airports served by MSP and in the industry overall
- economic recovery projected for the region and in regions served from MSP
- historical revenue produced by passengers in the individual markets served from MSP
- other forecasts developed for the Airport and the industry

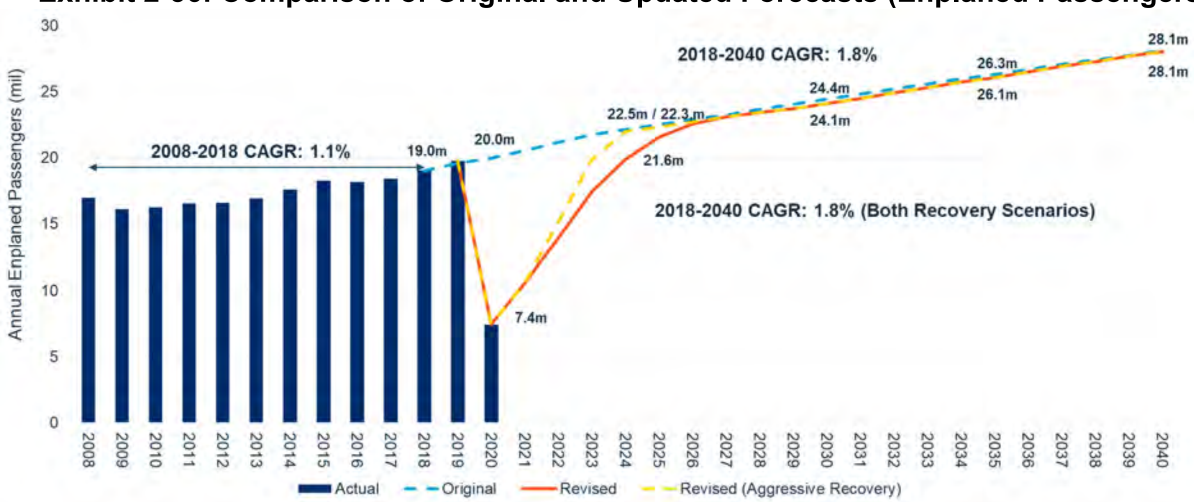
Using a combination of these factors, the return to traditional influences was estimated on a passenger-by-passenger basis according to the O&D of their travel. As modeled, pandemic-related influences continue to impact certain segments of passenger activity through 2026 (although growth continues during that period), after which traditional influences prevail throughout the remainder of the forecast period.

A more aggressive forecast of recovery to traditional drivers was also developed, which considered more favorable economic conditions and airline response. In the more aggressive scenario, pandemic-related influences were modeled to cease by the end of 2024.

2.9.3 Revised Enplaned Passenger Metrics

Exhibit 2-36 presents these updated enplaned passenger forecasts, shown as both revised and revised (aggressive recovery) alongside the original baseline forecast. Forecast annual enplaned passenger values revert to traditional drivers of activity, as previously described, and subsequently follow a similar path as the original baseline forecast through 2040, primarily as a result of the updated independent projections of socioeconomic drivers.

Exhibit 2-36: Comparison of Original and Updated Forecasts (Enplaned Passengers)



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports (actual); Ricondo & Associates, Inc., 2021 (forecast).

2.9.4 Passenger Aircraft Operations Forecast Revision

The fleet assumptions for the original baseline forecast were reviewed and updated for pandemic-influenced changes to inform an updated passenger aircraft operations forecast. Delta's systemwide fleet changes comprise most of those adjustments:

- Retirement of certain aircraft immediately in 2020:
  - o MD90
  - o B777-200
  - o B737-700 (not relevant to MSP)
  - o MD88 (not relevant to MSP)
- Retirement of 50-seat regional jets by 2023
- Retirement of certain aircraft by 2025:
  - o B717 (50% of fleet retired immediately in 2020)
  - o B767-300 (40% of fleet retired immediately in 2020)

In certain instances, retired aircraft were assumed to be replaced on a one-for-one basis with other aircraft in the revised future fleet:

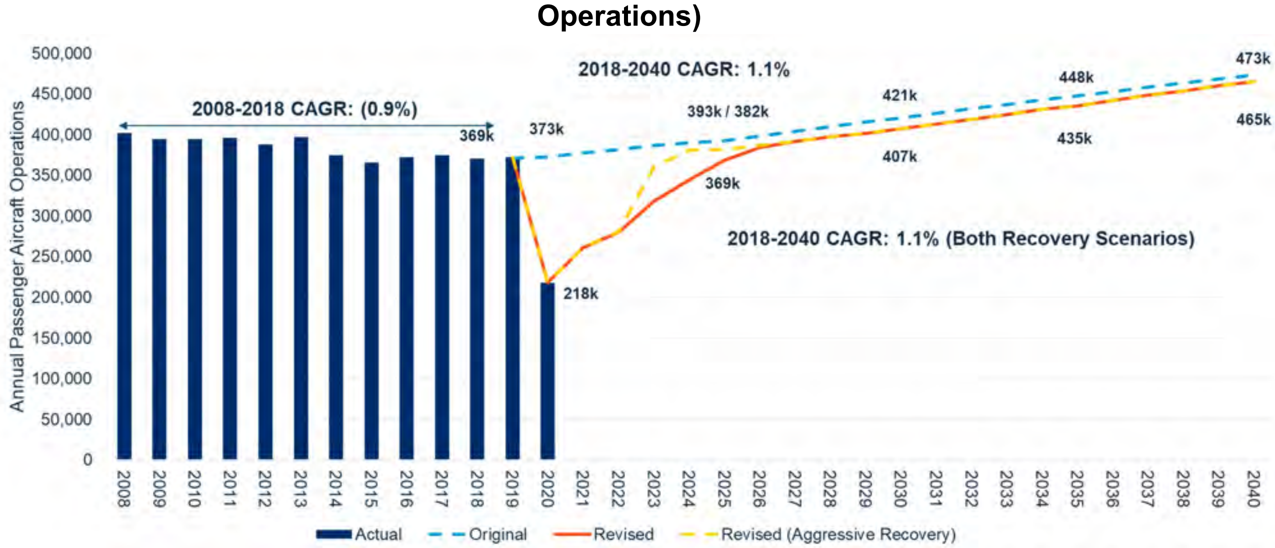
- MD90 aircraft replaced with A320-family aircraft
- B777-200 aircraft replaced with a combination of A330-300/900 and A350 aircraft
- B717 aircraft replaced with A220-family aircraft

In addition, certain aircraft were modeled to be replaced with other aircraft on a percentage basis:

- CRJ-200 aircraft replaced with CRJ900 aircraft on a 70% of operations basis
- B767-300 aircraft replaced with A330-900 aircraft on a 75% of operations basis

The revised fleet was modeled to accommodate the updated passenger forecast volumes, resulting in an updated passenger aircraft operations forecast, as reflected in **Exhibit 2-37** (shown for both recovery scenarios, and as compared to the original baseline forecast).

Exhibit 2-37: Comparison of Original and Updated Forecasts (Passenger Aircraft Operations)

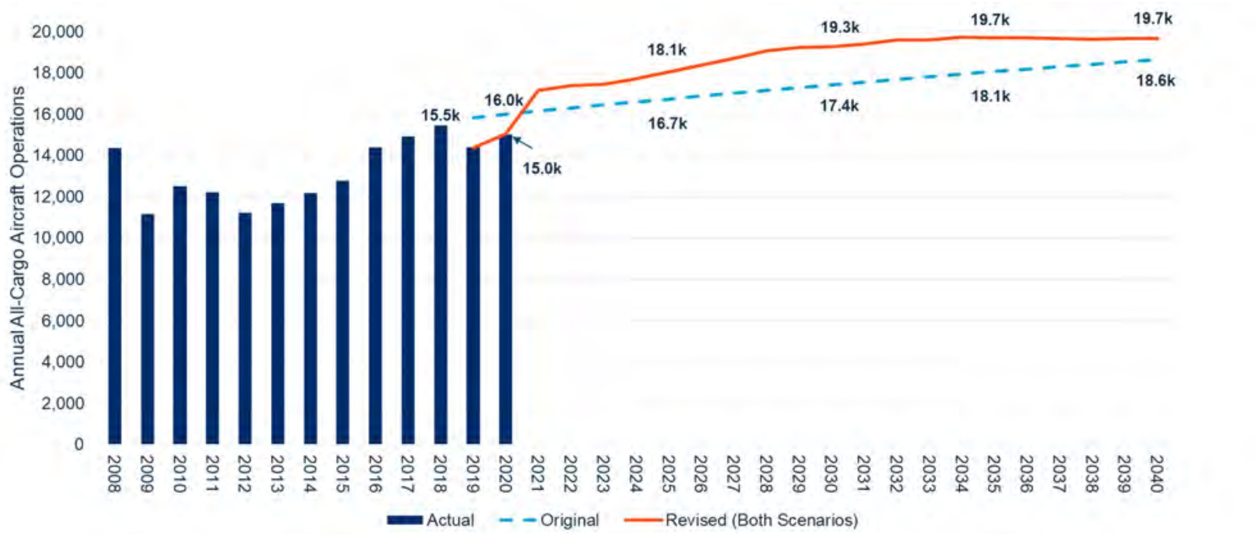


NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports (actual); Ricondo & Associates, Inc., 2021 (forecast).

2.9.5 Cargo Volume and All-Cargo Aircraft Operations Forecast Revision

The forecast of cargo volumes was reviewed for possible adjustments to both the passenger-related and all-cargo carrier components. Passenger carrier cargo volumes were adjusted according to the revised forecast of passenger operations, while the all-cargo carrier portion was revised to consider changes in the FAA's outlook of air cargo, as provided in the *Aerospace Forecast Fiscal Years 2021–2041*. The *Aerospace Forecast Fiscal Years 2018–2038* was used to inform the original baseline forecast values. A slightly higher industry-wide forecast of all-cargo carrier volume growth (translating to slightly higher all-cargo carrier cargo volumes at MSP) was coupled with minor increases to the forecast of average all-cargo aircraft capacity, resulting in a higher forecast of all-cargo operations. **Exhibit 2-38** compares the original baseline all-cargo carrier operations forecast with the revised forecast. Note: the all-cargo carrier forecast does not change in the aggressive recovery scenario.

Exhibit 2-38: Comparison of Original and Updated All-Cargo Operations Forecasts



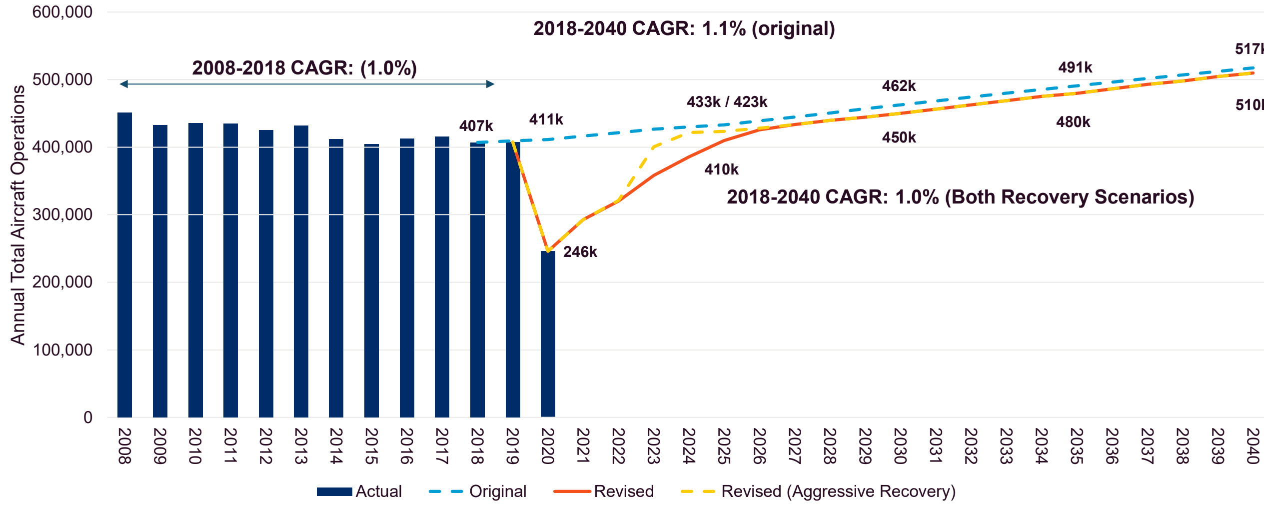
SOURCES: MAC Activity Reports (actual); Ricondo & Associates, Inc., 2021 (forecast).

2.9.6 General Aviation and Military Operations Forecast Revision

GA operations forecasts were reviewed and ultimately unchanged, given the FAA's similar, albeit slightly higher, growth guidance provided in its *Aerospace Forecast Fiscal Years 2021–2041* relative to its 2018 report. Military aircraft operations were revised slightly downward, as published in the 2020 TAF. As explained in the original report, military aircraft operations forecasts are taken directly from the TAF, as military aircraft operations are determined by the U.S. Department of Defense which does not publish guidance on future activity levels.

Exhibit 2-39 compares the total aircraft operations forecasts.

Exhibit 2-39: Comparison of Original and Updated Total Aircraft Operations Forecasts



NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports (actual); Ricondo & Associates, Inc., 2021 (forecast).

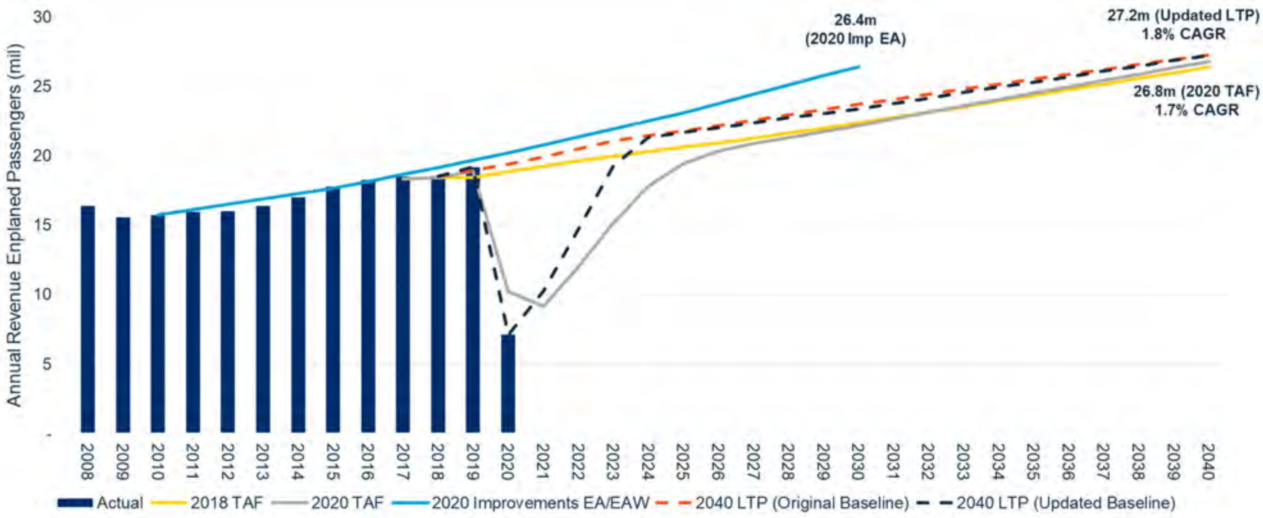
2.9.7 Design Day Flight Schedule Revision

The original baseline DDFSs for the spring and summer peaks were revised to reflect, as appropriate, changes in the annual forecast of the various segments of activity at MSP. As the enplaned passenger forecasts were similar in the outer years of the revised forecast compared to the original baseline forecast, changes to the passenger activity DDFS in 2030 and 2040 related mainly to changes in operations resulting from adjusted fleet plans. For 2025, the more aggressive recovery scenario was modeled in the DDFSs. That scenario reflected 2025 annual passenger volumes similar to the results in the original baseline forecast, and thus the updated 2025 DDFS also reflected changes mainly in the prevailing fleet. Other segments of capacity in the DDFSs were left largely unchanged, as it was assumed that the original baseline DDFS values remained reflective of those operations in the respective peak periods, with increases or decreases in off-peak periods. However, additional all-cargo operations were added to the spring DDFSs for all future years. Revised DDFS metrics for the spring and summer periods are included in the tables in **Section 2.10**.

2.9.8 Comparison to TAF Forecasts

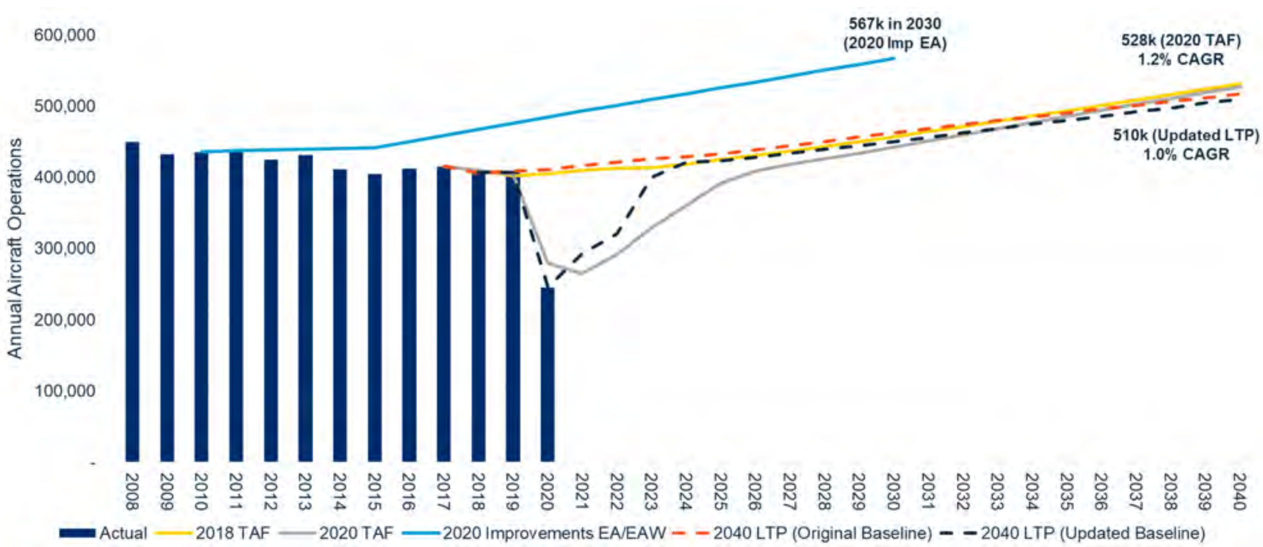
The results of the revised (aggressive recovery) 2040 LTP forecast were compared to the original 2040 LTP baseline forecast and the FAA's 2018 and 2022 TAFs for the Airport. **Exhibits 2-40** and **2-41** compare the revenue enplaned passengers and total aircraft operations forecasts. The updated 2040 LTP forecast anticipates 27.0 million revenue enplaned passengers in 2040, reflecting a CAGR of 1.8%. In comparison, the 2022 TAF anticipates 26.3 million revenue enplaned passengers in 2040, a CAGR of 1.6%. Revenue enplaned passengers are compared to be consistent with TAF reporting. Forecasts have also been adjusted to reflect federal fiscal year (FFY – the 12 months ending September) to be consistent with the TAF standard. Additional comparisons are presented in **Tables 2-17** and **2-18**, comparing the revised (aggressive recovery) forecast and the 2022 TAF both in federal fiscal year and revenue passenger terms.

Exhibit 2-40: Comparison of Selected Enplaned Passenger Forecasts



NOTES: EA – Environmental Assessment; EAW – Environmental Assessment Worksheet; CAGR – Compound Annual Growth Rate; LTP – Long-Tern Plan; TAF – Terminal Area Forecast
The Federal Aviation Administration's Terminal Area Forecasts reflect the federal fiscal year (October through September).
SOURCES: MAC Activity Reports (actual); Ricondo & Associates, Inc., 2021 (Long-Term Plan forecasts); U.S. Department of Transportation, Federal Aviation Administration, 2022 *Terminal Area Forecast*, 2023.

Exhibit 2-41: Comparison of Selected Aircraft Operations Forecasts



NOTES: EA – Environmental Assessment; EAW – Environmental Assessment Worksheet; CAGR – Compound Annual Growth Rate; LTP – Long-Tern Plan; TAF – Terminal Area Forecast
The Federal Aviation Administration's Terminal Area Forecasts reflect the federal fiscal year (October through September).
SOURCES: MAC Activity Reports (actual and 2020 Improvements EA/EAW forecasts); Ricondo & Associates, Inc., 2021 (Long-Term Plan forecasts); U.S. Department of Transportation, Federal Aviation Administration, *Terminal Area Forecast*, 2022.

2.10 REVISED BASELINE FORECAST AND DESIGN DAY FLIGHT SCHEDULE TABLES

Tables 2-17 through **2-31** present the revised historical and forecast data in relation to enplaned passengers, passenger activity, air cargo, and aircraft operations. Additionally, these tables present peak hour and daily metrics.

Regarding Planning Activity Levels (PALs), annual forecasts are often used to create planning timelines that correlate improvement projects with specific calendar years. Using PALs instead of forecast years removes timeframes from the analysis and focuses on implementing projects when the Airport reaches certain activity levels. For most planning purposes, the timing for capacity-related improvements should correlate to activity levels. In the original forecast, PALs were identified for the activity levels at years 2025, 2030, and 2040 (PALs 1, 2, and 3, respectively). Because the post-pandemic update to the forecast also included updates to the DDFSs developed for years 2025, 2030, and 2040, PALs 1, 2, and 3 have been re-established as the activity as forecast in those years. **Table 2-31** illustrates those levels.

Table 2-17: Historical and Forecast Enplaned Passengers – Revised

		Enplaned Passengers (mil)							
	Year	Total	O&D	Connecting	% O&D	Domestic	International	% Domestic
Actual	2008	17.0	8.5	8.5	49.9%	15.7	1.3	92%
	2009	16.1	8.3	7.8	51.4%	15.0	1.1	93%
	2010	16.3	8.4	7.9	51.4%	15.1	1.2	93%
	2011	16.5	8.6	7.9	52.1%	15.4	1.1	93%
	2012	16.6	8.6	8.0	51.7%	15.5	1.1	93%
	2013	16.9	8.8	8.2	51.7%	15.8	1.2	93%
	2014	17.6	9.3	8.3	53.0%	16.4	1.2	93%
	2015	18.3	9.8	8.5	53.8%	17.0	1.3	93%
	2016	18.7	10.5	8.2	56.2%	17.3	1.4	92%
	2017	19.0	11.0	8.0	58.1%	17.5	1.5	92%
	2018	19.0	11.5	7.5	60.4%	17.5	1.5	92%
	2019	19.8	12.1	7.7	60.9%	18.2	1.6	92%
	2020	7.4	4.7	2.8	62.8%	7.0	0.4	94%
Forecast	2021	10.6	6.6	4.0	62.2%	10.3	0.3	97%
	2022	13.9	8.7	5.3	62.2%	13.2	0.7	95%
	2023	17.4	10.8	6.6	62.2%	16.3	1.1	94%
	2024	19.9	12.1	7.8	60.8%	18.4	1.5	92%
	2025	21.6	13.1	8.5	60.7%	19.9	1.7	92%
	2026	22.6	13.7	8.9	60.6%	20.7	1.9	92%
	2027	23.1	14.0	9.1	60.6%	21.2	1.9	92%
	2028	23.4	14.2	9.3	60.5%	21.5	2.0	92%
	2029	23.7	14.3	9.4	60.4%	21.7	2.0	92%
	2030	24.1	14.6	9.6	60.4%	22.1	2.0	92%
	2031	24.5	14.8	9.7	60.3%	22.4	2.1	91%
	2032	24.9	15.0	9.9	60.2%	22.8	2.1	91%
	2033	25.3	15.2	10.1	60.1%	23.1	2.2	91%
	2034	25.7	15.4	10.3	60.0%	23.5	2.2	91%
	2035	26.1	15.6	10.4	59.9%	23.8	2.3	91%
	2036	26.5	15.8	10.6	59.8%	24.1	2.3	91%
	2037	26.9	16.1	10.8	59.7%	24.5	2.4	91%
	2038	27.3	16.2	11.0	59.6%	24.8	2.4	91%
	2039	27.7	16.5	11.2	59.5%	25.2	2.5	91%
	2040	28.1	16.7	11.4	59.4%	25.5	2.5	91%
CAGR								
2008–2018		1.1%	3.1%	-1.2%		1.1%	1.4%	
2018–2040		1.8%	1.7%	1.9%		1.7%	2.4%	

NOTES: O&D – Origin and Destination; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2021; U.S. Department of Transportation, T-100, 2021; Sabre, Market Information Data Tapes (MIDT), 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-18: Historical and Forecast Enplaned Passengers – Revised and Aggressive Recovery

		Enplaned Passengers (mil)						
	Year	Total	O&D	Connecting	% O&D	Domestic	International	% Domestic
Actual	2008	17.0	8.5	8.5	49.9%	15.7	1.3	92%
	2009	16.1	8.3	7.8	51.4%	15.0	1.1	93%
	2010	16.3	8.4	7.9	51.4%	15.1	1.2	93%
	2011	16.5	8.6	7.9	52.1%	15.4	1.1	93%
	2012	16.6	8.6	8.0	51.7%	15.5	1.1	93%
	2013	16.9	8.8	8.2	51.7%	15.8	1.2	93%
	2014	17.6	9.3	8.3	53.0%	16.4	1.2	93%
	2015	18.3	9.8	8.5	53.8%	17.0	1.3	93%
	2016	18.7	10.5	8.2	56.2%	17.3	1.4	92%
	2017	19.0	11.0	8.0	58.1%	17.5	1.5	92%
	2018	19.0	11.5	7.5	60.4%	17.5	1.5	92%
	2019	19.8	12.1	7.7	60.9%	18.2	1.6	92%
	2020	7.4	4.7	2.8	62.8%	7.0	0.4	94%
Forecast	2021	10.6	6.6	4.0	62.2%	10.3	0.3	97%
	2022	15.1	9.4	5.7	62.1%	14.2	0.9	94%
	2023	19.9	12.1	7.7	61.0%	18.5	1.4	93%
	2024	22.0	13.3	8.6	60.7%	20.3	1.7	92%
	2025	22.3	13.6	8.8	60.7%	20.6	1.8	92%
	2026	22.7	13.8	9.0	60.6%	20.8	1.9	92%
	2027	23.1	14.0	9.1	60.6%	21.2	1.9	92%
	2028	23.4	14.2	9.3	60.5%	21.5	2.0	92%
	2029	23.7	14.3	9.4	60.4%	21.7	2.0	92%
	2030	24.1	14.6	9.6	60.4%	22.1	2.0	92%
	2031	24.5	14.8	9.7	60.3%	22.4	2.1	91%
	2032	24.9	15.0	9.9	60.2%	22.8	2.1	91%
	2033	25.3	15.2	10.1	60.1%	23.1	2.2	91%
	2034	25.7	15.4	10.3	60.0%	23.5	2.2	91%
	2035	26.1	15.6	10.4	59.9%	23.8	2.3	91%
	2036	26.5	15.8	10.6	59.8%	24.1	2.3	91%
	2037	26.9	16.1	10.8	59.7%	24.5	2.4	91%
	2038	27.3	16.2	11.0	59.6%	24.8	2.4	91%
	2039	27.7	16.5	11.2	59.5%	25.2	2.5	91%
	2040	28.1	16.7	11.4	59.4%	25.5	2.5	91%
CAGR								
2008–2018		1.1%	3.1%	-1.2%		1.1%	1.4%	
2018–2040		1.8%	1.7%	1.9%		1.7%	2.4%	

NOTES: O&D – Origin and Destination; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, Airline Origin and Destination Survey (DB1B), 2021; U.S. Department of Transportation, T-100, 2021; Sabre, Market Information Data Tapes (MIDT), 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-19: (1 of 2) Historical and Forecast Passenger Activity Metrics (Average Seats as Flown) – Revised

		Domestic (Both Directions)					International (Both Directions)					Total (Both Directions)				
	Year	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF
Actual	2008	378	31.3	82.8	103.3	80.1%	24	2.6	108.3	134.4	80.6%	402	33.9	84.3	105.1	80.2%
	2009	372	29.9	80.5	102.2	78.7%	22	2.3	100.8	127.3	79.1%	395	32.2	81.6	103.6	78.8%
	2010	368	30.2	82.0	100.4	81.7%	27	2.4	89.1	111.8	79.7%	394	32.5	82.5	101.1	81.6%
	2011	370	30.8	83.3	100.3	83.1%	26	2.3	87.2	108.5	80.4%	396	33.1	83.5	100.8	82.9%
	2012	363	30.9	85.2	101.7	83.8%	25	2.2	89.3	106.6	83.8%	388	33.1	85.5	102.1	83.8%
	2013	372	31.5	84.7	102.5	82.7%	24	2.3	95.7	112.1	85.3%	397	33.9	85.4	103.1	82.8%
	2014	351	32.7	93.3	108.9	85.6%	24	2.4	101.0	119.4	84.6%	375	35.2	93.8	109.6	85.5%
	2015	341	33.9	99.5	114.9	86.6%	24	2.7	109.4	126.5	86.5%	365	36.6	100.1	115.6	86.6%
	2016	347	34.6	99.9	117.1	85.3%	25	2.8	111.5	132.3	84.3%	372	37.5	100.7	118.2	85.2%
	2017	351	35.0	99.8	118.0	84.6%	24	3.0	124.5	145.2	85.8%	375	38.0	101.3	119.7	84.7%
	2018	345	35.0	101.5	118.7	85.6%	24	3.0	124.7	149.1	83.6%	369	38.0	103.0	121.0	85.2%
	2019	347	36.4	104.9	122.1	85.9%	25	3.2	125.2	154.3	81.2%	372	39.6	106.3	124.3	85.5%
	2020	210	14.0	66.6	118.5	56.2%	8	0.9	107.3	147.5	72.7%	218	14.9	68.1	119.6	57.0%
Forecast	2021	255	20.5	80.6	123.6	65.2%	7	0.6	91.2	171.6	53.2%	261	21.1	80.9	124.8	64.8%
	2022	267	26.5	99.2	125.6	79.0%	14	1.4	101.6	163.3	62.2%	280	27.8	99.3	127.4	78.0%
	2023	301	32.7	108.6	127.7	85.1%	17	2.2	126.7	164.5	77.0%	318	34.9	109.6	129.7	84.5%
	2024	324	36.8	113.7	133.5	85.2%	21	3.0	141.2	164.5	85.8%	345	39.8	115.4	135.4	85.2%
	2025	343	39.7	115.8	135.2	85.6%	25	3.4	134.0	164.3	81.6%	369	43.1	117.1	137.2	85.3%
	2026	358	41.4	115.7	135.7	85.3%	26	3.7	141.9	164.8	86.0%	384	45.1	117.5	137.7	85.3%
	2027	365	42.3	116.1	136.1	85.3%	27	3.8	142.4	165.3	86.1%	391	46.2	117.9	138.1	85.4%
	2028	370	43.0	116.2	136.1	85.4%	27	3.9	143.4	166.3	86.2%	397	46.9	118.1	138.1	85.5%
	2029	374	43.5	116.3	136.0	85.5%	28	4.0	144.5	167.5	86.3%	401	47.5	118.2	138.2	85.6%
	2030	379	44.2	116.5	136.1	85.6%	28	4.1	145.7	168.7	86.4%	407	48.2	118.5	138.4	85.6%
	2031	384	44.8	116.6	136.2	85.6%	28	4.2	146.7	169.6	86.5%	413	49.0	118.7	138.5	85.7%
	2032	390	45.5	116.8	136.3	85.7%	29	4.3	147.6	170.5	86.5%	419	49.8	118.9	138.7	85.8%
	2033	395	46.3	117.0	136.4	85.8%	30	4.4	148.5	171.4	86.6%	425	50.6	119.2	138.8	85.9%
	2034	401	47.0	117.2	136.5	85.9%	30	4.5	149.4	172.4	86.7%	431	51.5	119.4	139.0	85.9%
	2035	405	47.5	117.4	136.6	85.9%	30	4.6	150.3	173.3	86.8%	435	52.1	119.7	139.2	86.0%

NOTES: CAGR – Compound Annual Growth Rate; LF – Load Factor
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-19: (2 of 2) Historical and Forecast Passenger Activity Metrics (Average Seats as Flown) – Revised

		Domestic (Both Directions)					International (Both Directions)					Total (Both Directions)				
	Year	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF
	2036	411	48.3	117.5	136.6	86.0%	31	4.7	151.2	174.1	86.8%	442	53.0	119.9	139	86.1%
	2037	417	49.1	117.6	136.7	86.1%	31	4.8	152.0	174.9	86.9%	448	53.8	120.1	139	86.1%
	2038	421	49.6	117.8	136.8	86.1%	32	4.9	152.8	175.7	87.0%	453	54.5	120.3	140	86.2%
	2039	428	50.4	118.0	136.8	86.2%	32	5.0	153.6	176.4	87.1%	460	55.4	120.5	140	86.3%
	2040	432	51.0	118.1	136.9	86.3%	33	5.1	154.4	177.2	87.1%	465	56.1	120.7	140	86.4%
CAGR																
2008–2018		-0.9%	1.1%	2.1%	1.4%		0.0%	1.4%	1.4%	1.0%		-0.9%	1.1%	2.0%	1.4%	
2018–2040		1.0%	1.7%	0.7%	0.7%		1.5%	2.4%	1.0%	0.8%		1.1%	1.8%	0.7%	0.7%	

NOTES: CAGR – Compound Annual Growth Rate; LF – Load Factor
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-20: (1 of 2) Historical and Forecast Passenger Activity Metrics (Average Seats as Flown) – Revised and Aggressive Recovery

		Domestic (Both Directions)					International (Both Directions)					Total (Both Directions)				
	Year	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF
Actual	2008	378.4	31.3	82.8	103.3	80.1%	24.0	2.6	108.3	134.4	80.6%	402.3	33.9	84.3	105.1	80.2%
	2009	372.2	29.9	80.5	102.2	78.7%	22.5	2.3	100.8	127.3	79.1%	394.6	32.2	81.6	103.6	78.8%
	2010	367.9	30.2	82.0	100.4	81.7%	26.5	2.4	89.1	111.8	79.7%	394.4	32.5	82.5	101.1	81.6%
	2011	369.8	30.8	83.3	100.3	83.1%	26.2	2.3	87.2	108.5	80.4%	396.0	33.1	83.5	100.8	82.9%
	2012	362.7	30.9	85.2	101.7	83.8%	25.0	2.2	89.3	106.6	83.8%	387.7	33.1	85.5	102.1	83.8%
	2013	372.2	31.5	84.7	102.5	82.7%	24.5	2.3	95.7	112.1	85.3%	396.7	33.9	85.4	103.1	82.8%
	2014	351.0	32.7	93.3	108.9	85.6%	24.1	2.4	101.0	119.4	84.6%	375.1	35.2	93.8	109.6	85.5%
	2015	341.0	33.9	99.5	114.9	86.6%	24.3	2.7	109.4	126.5	86.5%	365.3	36.6	100.1	115.6	86.6%
	2016	346.8	34.6	99.9	117.1	85.3%	25.5	2.8	111.5	132.3	84.3%	372.3	37.5	100.7	118.2	85.2%
	2017	351.0	35.0	99.8	118.0	84.6%	24.0	3.0	124.5	145.2	85.8%	375.0	38.0	101.3	119.7	84.7%
	2018	344.8	35.0	101.5	118.7	85.6%	24.0	3.0	124.7	149.1	83.6%	368.8	38.0	103.0	121.0	85.2%
	2019	347.0	36.4	104.9	122.1	85.9%	25.2	3.2	125.2	154.3	81.2%	372.1	39.6	106.3	124.3	85.5%
	2020	209.7	14.0	66.6	118.5	56.2%	8.3	0.9	107.3	147.5	72.7%	218.1	14.9	68.1	119.6	57.0%
Forecast	2021	254.5	20.5	80.6	123.6	65.2%	6.6	0.6	91.2	171.6	53.2%	261.1	21.1	80.9	124.8	64.8%
	2022	266.6	28.5	106.8	125.6	85.0%	14.4	1.8	125.8	163.3	77.0%	281.0	30.3	107.7	127.6	84.5%
	2023	340.1	37.0	108.6	127.7	85.1%	20.1	2.8	138.2	164.5	84.0%	360.3	39.7	110.3	129.8	85.0%
	2024	357.4	40.6	113.7	133.5	85.2%	23.4	3.3	141.2	164.5	85.8%	380.8	44.0	115.4	135.4	85.2%
	2025	357.1	41.2	115.3	135.2	85.2%	25.0	3.5	141.2	164.3	85.9%	382.1	44.7	117.0	137.1	85.3%
	2026	360.0	41.7	115.7	135.7	85.3%	26.5	3.8	141.9	164.8	86.0%	386.5	45.4	117.5	137.7	85.3%
	2027	364.7	42.3	116.1	136.1	85.3%	26.7	3.8	142.4	165.3	86.1%	391.4	46.2	117.9	138.1	85.4%
	2028	370.0	43.0	116.2	136.1	85.4%	27.2	3.9	143.4	166.3	86.2%	397.2	46.9	118.1	138.1	85.5%
	2029	373.9	43.5	116.3	136.0	85.5%	27.5	4.0	144.5	167.5	86.3%	401.4	47.5	118.2	138.2	85.6%
	2030	379.1	44.2	116.5	136.1	85.6%	28.0	4.1	145.7	168.7	86.4%	407.1	48.2	118.5	138.4	85.6%
	2031	384.4	44.8	116.6	136.2	85.6%	28.5	4.2	146.7	169.6	86.5%	412.9	49.0	118.7	138.5	85.7%
	2032	389.9	45.5	116.8	136.3	85.7%	29.0	4.3	147.6	170.5	86.5%	418.9	49.8	118.9	138.7	85.8%
	2033	395.4	46.3	117.0	136.4	85.8%	29.5	4.4	148.5	171.4	86.6%	424.9	50.6	119.2	138.8	85.9%
	2034	401.0	47.0	117.2	136.5	85.9%	30.0	4.5	149.4	172.4	86.7%	431.0	51.5	119.4	139.0	85.9%
	2035	405.1	47.5	117.4	136.6	85.9%	30.4	4.6	150.3	173.3	86.8%	435.5	52.1	119.7	139.2	86.0%

NOTES: CAGR – Compound Annual Growth Rate; LF – Load Factor
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-20: (2 of 2) Historical and Forecast Passenger Activity Metrics (Average Seats as Flown) – Revised and Aggressive Recovery

		Domestic (Both Directions)					International (Both Directions)					Total (Both Directions)				
	Year	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF	Ops (000)	Pax (mil)	Pax/Flt	Avg. Seats	LF
	2036	411.0	48.3	117.5	136.6	86.0%	30.9	4.7	151.2	174.1	86.8%	441.9	53.0	119.9	139.3	86.1%
	2037	417.0	49.1	117.6	136.7	86.1%	31.5	4.8	152.0	174.9	86.9%	448.5	53.8	120.1	139.4	86.1%
	2038	421.5	49.6	117.8	136.8	86.1%	31.9	4.9	152.8	175.7	87.0%	453.4	54.5	120.3	139.5	86.2%
	2039	427.5	50.4	118.0	136.8	86.2%	32.5	5.0	153.6	176.4	87.1%	460.0	55.4	120.5	139.6	86.3%
	2040	432.0	51.0	118.1	136.9	86.3%	32.9	5.1	154.4	177.2	87.1%	465.0	56.1	120.7	139.8	86.4%
CAGR																
2008–2018		-0.9%	1.1%	2.1%	1.4%		0.0%	1.4%	1.4%	1.0%		-0.9%	1.1%	2.0%	1.4%	
2018–2040		1.0%	1.7%	0.7%	0.7%		1.5%	2.4%	1.0%	0.8%		1.1%	1.8%	0.7%	0.7%	

NOTES: CAGR – Compound Annual Growth Rate; LF – Load Factor
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-21: Historical and Forecast Air Cargo Volumes and Operations – Revised

		Cargo Volume (000 Tons)				
	Year	Air Cargo	Passenger	Total	Air Cargo Operations (000)	Cargo Tons Per Air Cargo Operation
Actual	2008	205.5	51.6	257.1	14.4	14.3
	2009	168.4	40.7	209.1	11.1	15.1
	2010	182.8	50.8	233.6	12.5	14.6
	2011	177.7	52.3	230.0	12.2	14.6
	2012	162.9	56.1	219.0	11.2	14.5
	2013	158.7	63.2	221.9	11.7	13.6
	2014	157.1	66.8	223.9	12.2	12.9
	2015	152.8	66.9	219.7	12.8	12.0
	2016	167.7	60.4	228.1	14.4	11.6
	2017	175.9	77.1	252.9	14.9	11.8
	2018	188.8	75.0	263.8	15.5	12.2
	2019	198.5	53.6	252.1	14.4	13.8
	2020	198.2	25.9	224.1	15.0	13.2
Forecast	2021	227.3	54.3	281.6	17.2	13.2
	2022	231.1	59.0	290.1	17.4	13.3
	2023	232.6	67.4	300.1	17.4	13.3
	2024	237.1	76.4	313.5	17.7	13.4
	2025	242.5	82.8	325.3	18.1	13.4
	2026	247.6	86.6	334.1	18.4	13.5
	2027	253.2	88.5	341.7	18.7	13.5
	2028	259.0	89.9	348.9	19.1	13.6
	2029	262.0	90.9	352.8	19.2	13.6
	2030	263.4	92.3	355.7	19.3	13.7
	2031	266.4	93.7	360.1	19.4	13.7
	2032	269.8	95.2	364.9	19.6	13.8
	2033	272.9	96.7	369.5	19.6	13.9
	2034	277.3	98.2	375.4	19.7	14.1
	2035	279.8	99.3	379.1	19.7	14.2
	2036	282.9	100.9	383.7	19.7	14.4
	2037	285.7	102.5	388.2	19.7	14.5
	2038	288.0	103.7	391.7	19.6	14.7
	2039	291.8	105.3	397.0	19.7	14.8
	2040	295.3	106.5	401.8	19.7	15.0
CAGR						
2008–2018		-0.8%	3.8%	0.3%	0.7%	-1.6%
2018–2040		2.1%	1.6%	1.9%	1.1%	0.9%

NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-22: Historical and Forecast Air Cargo Volumes and Operations – Revised and Aggressive Recovery

	Year	Cargo Volume (000 Tons) Air Cargo	Passenger	Total	Air Cargo Operations (000)	Cargo Tons Per Air Cargo Operation
Actual	2008	205.5	51.6	257.1	14.4	14.3
	2009	168.4	40.7	209.1	11.1	15.1
	2010	182.8	50.8	233.6	12.5	14.6
	2011	177.7	52.3	230.0	12.2	14.6
	2012	162.9	56.1	219.0	11.2	14.5
	2013	158.7	63.2	221.9	11.7	13.6
	2014	157.1	66.8	223.9	12.2	12.9
	2015	152.8	66.9	219.7	12.8	12.0
	2016	167.7	60.4	228.1	14.4	11.6
	2017	175.9	77.1	252.9	14.9	11.8
	2018	188.8	75.0	263.8	15.5	12.2
	2019	198.5	53.6	252.1	14.4	13.8
	2020	198.2	25.9	224.1	15.0	13.2
Forecast	2021	227.3	54.3	281.6	17.2	13.2
	2022	231.1	59.2	290.3	17.4	13.3
	2023	232.6	76.4	309.1	17.4	13.3
	2024	237.1	84.4	321.5	17.7	13.4
	2025	242.5	85.8	328.3	18.1	13.4
	2026	247.6	87.1	334.7	18.4	13.5
	2027	253.2	88.5	341.7	18.7	13.5
	2028	259.0	89.9	348.9	19.1	13.6
	2029	262.0	90.9	352.8	19.2	13.6
	2030	263.4	92.3	355.7	19.3	13.7
	2031	266.4	93.7	360.1	19.4	13.7
	2032	269.8	95.2	364.9	19.6	13.8
	2033	272.9	96.7	369.5	19.6	13.9
	2034	277.3	98.2	375.4	19.7	14.1
	2035	279.8	99.3	379.1	19.7	14.2
	2036	282.9	100.9	383.7	19.7	14.4
	2037	285.7	102.5	388.2	19.7	14.5
	2038	288.0	103.7	391.7	19.6	14.7
	2039	291.8	105.3	397.0	19.7	14.8
	2040	295.3	106.5	401.8	19.7	15.0
CAGR						
2008–2018		-0.8%	3.8%	0.3%	0.7%	-1.6%
2018–2040		2.1%	1.6%	1.9%	1.1%	0.9%

NOTE: CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-23: Historical and Forecast Aircraft Operations – Revised

		Annual Aircraft Operations (000)							
		Passenger			Non Passenger				
	Year	Domestic	International	Total	Air Cargo	GA / Air Taxi	Military	Total	Overall Total
Actual	2008	378.4	24.0	402.3	14.4	31.9	3.0	49.2	451.6
	2009	372.2	22.5	394.6	11.1	24.2	2.7	38.0	432.6
	2010	367.9	26.5	394.4	12.5	25.9	2.8	41.2	435.6
	2011	369.8	26.2	396.0	12.2	23.9	2.9	39.1	435.1
	2012	362.7	25.0	387.7	11.2	23.5	2.4	37.2	424.9
	2013	372.2	24.5	396.7	11.7	20.6	2.5	34.9	431.6
	2014	351.0	24.1	375.1	12.2	22.1	2.4	36.7	411.8
	2015	341.0	24.3	365.3	12.8	23.4	2.8	39.0	404.4
	2016	346.8	25.5	372.3	14.4	23.3	2.9	40.6	412.9
	2017	351.0	24.0	375.0	14.9	23.7	2.0	40.7	415.7
	2018	344.8	24.0	368.8	15.5	20.1	2.6	38.1	406.9
	2019	347.0	25.2	372.1	14.4	18.7	2.2	35.3	407.5
	2020	209.7	8.3	218.1	15.0	10.5	2.2	27.8	245.9
Forecast	2021	254.5	6.6	261.1	17.2	12.2	2.2	31.6	292.7
	2022	266.6	13.6	280.2	17.4	20.6	2.2	40.2	320.4
	2023	300.6	17.3	317.9	17.4	20.7	2.2	40.4	358.3
	2024	323.6	21.2	344.8	17.7	20.8	2.2	40.8	385.6
	2025	343.1	25.4	368.5	18.1	20.9	2.2	41.2	409.8
	2026	357.6	26.3	383.9	18.4	21.1	2.2	41.7	425.6
	2027	364.7	26.7	391.4	18.7	21.2	2.2	42.2	433.6
	2028	370.0	27.2	397.2	19.1	21.3	2.2	42.6	439.8
	2029	373.9	27.5	401.4	19.2	21.4	2.2	42.9	444.3
	2030	379.1	28.0	407.1	19.3	21.6	2.2	43.1	450.1
	2031	384.4	28.5	412.9	19.4	21.7	2.2	43.4	456.3
	2032	389.9	29.0	418.9	19.6	21.8	2.2	43.7	462.5
	2033	395.4	29.5	424.9	19.6	22.0	2.2	43.8	468.7
	2034	401.0	30.0	431.0	19.7	22.1	2.2	44.1	475.1
	2035	405.1	30.4	435.5	19.7	22.2	2.2	44.2	479.6
	2036	411.0	30.9	441.9	19.7	22.4	2.2	44.3	486.2
	2037	417.0	31.5	448.5	19.7	22.5	2.2	44.4	492.9
	2038	421.5	31.9	453.4	19.6	22.6	2.2	44.5	497.9
	2039	427.5	32.5	460.0	19.7	22.8	2.2	44.7	504.7
	2040	432.0	32.9	465.0	19.7	22.9	2.2	44.8	509.8
CAGR									
2008–2018		-0.9%	0.0%	-0.9%	0.7%	-4.5%	-1.6%	-2.5%	-1.0%
2018–2040		1.0%	1.5%	1.1%	1.1%	0.6%	-0.6%	0.7%	1.0%

NOTES: GA – General Aviation; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2021; Department of Transportation, Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-24: Historical and Forecast Aircraft Operations – Revised and Aggressive Recovery

		Annual Aircraft Operations (000)							
		Passenger			Non Passenger				
	Year	Domestic	International	Total	Air Cargo	GA / Air Taxi	Military	Total	Overall Total
Actual	2008	378.4	24.0	402.3	14.4	31.9	3.0	49.2	451.6
	2009	372.2	22.5	394.6	11.1	24.2	2.7	38.0	432.6
	2010	367.9	26.5	394.4	12.5	25.9	2.8	41.2	435.6
	2011	369.8	26.2	396.0	12.2	23.9	2.9	39.1	435.1
	2012	362.7	25.0	387.7	11.2	23.5	2.4	37.2	424.9
	2013	372.2	24.5	396.7	11.7	20.6	2.5	34.9	431.6
	2014	351.0	24.1	375.1	12.2	22.1	2.4	36.7	411.8
	2015	341.0	24.3	365.3	12.8	23.4	2.8	39.0	404.4
	2016	346.8	25.5	372.3	14.4	23.3	2.9	40.6	412.9
	2017	351.0	24.0	375.0	14.9	23.7	2.0	40.7	415.7
	2018	344.8	24.0	368.8	15.5	20.1	2.6	38.1	406.9
	2019	347.0	25.2	372.1	14.4	18.7	2.2	35.3	407.5
	2020	209.7	8.3	218.1	15.0	10.5	2.2	27.8	245.9
Forecast	2021	254.5	6.6	261.1	17.2	12.2	2.2	31.6	292.7
	2022	266.6	14.4	281.0	17.4	20.6	2.2	40.2	321.2
	2023	340.1	20.1	360.3	17.4	20.7	2.2	40.4	400.6
	2024	357.4	23.4	380.8	17.7	20.8	2.2	40.8	421.6
	2025	357.1	25.0	382.1	18.1	20.9	2.2	41.2	423.3
	2026	360.0	26.5	386.5	18.4	21.1	2.2	41.7	428.2
	2027	364.7	26.7	391.4	18.7	21.2	2.2	42.2	433.6
	2028	370.0	27.2	397.2	19.1	21.3	2.2	42.6	439.8
	2029	373.9	27.5	401.4	19.2	21.4	2.2	42.9	444.3
	2030	379.1	28.0	407.1	19.3	21.6	2.2	43.1	450.1
	2031	384.4	28.5	412.9	19.4	21.7	2.2	43.4	456.3
	2032	389.9	29.0	418.9	19.6	21.8	2.2	43.7	462.5
	2033	395.4	29.5	424.9	19.6	22.0	2.2	43.8	468.7
	2034	401.0	30.0	431.0	19.7	22.1	2.2	44.1	475.1
	2035	405.1	30.4	435.5	19.7	22.2	2.2	44.2	479.6
	2036	411.0	30.9	441.9	19.7	22.4	2.2	44.3	486.2
	2037	417.0	31.5	448.5	19.7	22.5	2.2	44.4	492.9
	2038	421.5	31.9	453.4	19.6	22.6	2.2	44.5	497.9
	2039	427.5	32.5	460.0	19.7	22.8	2.2	44.7	504.7
	2040	432.0	32.9	465.0	19.7	22.9	2.2	44.8	509.8
CAGR									
2008–2018		-0.9%	0.0%	-0.9%	0.7%	-4.5%	-1.6%	-2.5%	-1.0%
2018–2040		1.0%	1.5%	1.1%	1.1%	0.6%	-0.6%	0.7%	1.0%

NOTES: GA – General Aviation; CAGR – Compound Annual Growth Rate
SOURCES: MAC Activity Reports; U.S. Department of Transportation, T-100, 2021; Federal Aviation Administration, Air Traffic Activity Data System (ATADS), 2021; Ricondo & Associates, Inc., 2021 (forecasts).

Table 2-25: Selected Design Day Flight Schedule Daily Metrics (Revised)

Spring Design Day								
2025	141,927	1,154	14	42	20	28	3	1,261
2040	178,505	1,406	18	54	20	34	3	1,535
Base	127,661	1,186	39	66	13	64	12	1,380
2030	171,821	1,350	43	74	13	68	12	1,560

NOTE: Passenger totals include revenue and non-revenue passengers.
SOURCE: Ricondo & Associates, Inc., 2021.

Table 2-26: Selected Design Day Flight Schedule Peak Hour Metrics (Outbound)

		Aircraft Departures	
Year	Enplaned Passengers	Passenger/Charter Airlines	Total
Spring Design Day			
Base	6,397	68	68
2025	6,821	63	63
2030	7,669	63	64
2040	9,067	73	74
Summer Design Day			
Base	7,419	65	74
2025	8,011	60	69
2030	8,791	65	71
2040	9,896	83	88

NOTE: Passenger totals include revenue and non-revenue passengers for both scheduled and charter flights.
SOURCE: Ricondo & Associates, Inc., 2021.

Table 2-27: Selected Design Day Flight Schedule Peak Hour Metrics (Inbound)

		Aircraft Arrivals	
Year	Deplaned Passengers	Passenger/Charter Airlines	Total
Spring Design Day			
2025	7,293	58	62
2040	8,815	68	72
Base	8,385	74	77
2030	7,707	65	69

NOTE: Passenger totals include revenue and non-revenue passengers for both scheduled and charter flights.
SOURCE: Ricondo & Associates, Inc., 2021.

Table 2-28: Selected Design Day Flight Schedule Peak Hour Metrics (Combined Peak)

		Aircraft Operations	
Year	Passengers	Passenger/ Charter Airlines	Total
Spring Design Day			
Base	9,027	85	95
2025	10,772	93	103
2030	12,115	96	103
2040	14,273	111	113
Summer Design Day			
Base	9,855	99	111
2025	13,443	102	114
2030	12,738	103	116
2040	15,283	124	137

NOTE: Passenger totals include revenue and non-revenue passengers for both scheduled and charter flights.
SOURCE: Ricondo & Associates, Inc., 2021.

Table 2-29: Summary of Forecast Results

	2018 Base Year	2025 PAL 1	2030 PAL 2	2040 PAL 3
Annual				
Passenger Aircraft Operations (000)	369	382	407	465
Total Aircraft Operations (000)	407	423	450	510
Total Passengers (mil)	38	44.7	48.2	56.1
Enplaned Passengers (mil)	19	22.3	24.1	28.1
Summer Design Day				
Daily Passenger Aircraft Operations	1,186	1,254	1,350	1,526
Peak Hour Passenger Aircraft Operations	99	102	103	124
Total Daily Passengers (000)	128	157	172	195
Total Peak Hour Passengers (000)	9.9	13.4	12.7	15.3
Spring Design Day				
Daily Passenger Aircraft Operations	1,113	1,154	1,256	1,406
Peak Hour Passenger Aircraft Operations	85	93	96	111
Total Daily Passengers (000)	119	142	157	179
Total Peak Hour Passengers (000)	9	10.8	12.1	14.3

NOTES: PAL – Planning Activity Level
The base year spring design day is in 2018.
Sources: MAC Activity Reports; U.S. Department of Transportation, 2021; Ricondo & Associates, Inc., 2021.

Chapter 3. Facility Requirements

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Chapter 3 Facility Requirements

This chapter describes the airfield, terminal, and landside facility requirements needed to accommodate the current and forecast demand at the Minneapolis-Saint. Paul International Airport (MSP) through the 2040 planning period. The landside section discusses the requirements for elements such as terminal area access and egress, curbside facilities, parking, rental car facilities, and the Ground Transportation Center (GTC). The terminal section highlights facility requirements through a gap analysis, comparing existing terminal facilities to future requirements. The airfield section reviews all requirements related to elements such as runways, taxiways, and airfield capacity.

3.1 LANDSIDE

This section documents the requirements for future terminal curbside facilities, parking, rental car facilities, and GTC. The future facility requirements were determined using a data-driven approach, incorporating historical MSP landside activity and forecast aviation activity. Landside requirements were determined using actual traffic and parking data collected in 2019. They are not based on the 2018 Design Day Flight Schedule (DDFS). Technical memoranda detailing the methodology and results for the landside requirements are included in **Appendix C.1**.

3.1.1 Roadway Access and Curbfront Requirements

3.1.1.1 Terminal Curbfront Access Roadways

The access roadway requirements were determined through methodologies defined in the Airport Cooperative Research Program (ACRP) Report 40, *Airport Curbside and Terminal Area Roadway Operations*. Roadway capacity for a given roadway segment considers the number of lanes and free-flow speed. The resulting Level-of-Service (LOS) is a function of the volume-to-capacity ratio and free-flow speed. LOS C is the target LOS threshold for planning new airport facilities; however, at large-hub airports, LOS D may be considered acceptable on existing roadways during peak periods to serve the forecast vehicular demand. **Table 3-1** presents the LOS provided by the access and egress lanes to the curbside facilities at each terminal. In response to feedback from stakeholders, this analysis assumed two lanes are provided to Terminal 1 (T1) departures and arrivals facilities.

Table 3-1: Curbside Access and Egress Roadway Performance (LOS)[1]

	T1 Departures (2 Lanes)	T1 Arrivals (2 Lanes)	T2 Arrivals/Departures (3 Lanes)
Base (2019)	D	C	B
PAL 1	D	C	B
PAL 3 (Spring)	E	C	C

NOTES:
PAL – Planning Activity Level
1 Curbside requirements for PAL 2 are intentionally not presented. It is best practice to design curbside facilities to meet requirements at the end of the planning horizon.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

3.1.1.2 Terminal Curbfront Roadways

The Advanced Land Transportation Performance Simulation (ALPS™) microsimulation model was used to better understand the future demand on the airport's terminal curbfront roadways. Like the access roadways, a target LOS C was used for the departures and arrivals curbside requirements, as recommended by ACRP Report 40. The data inputs, data processing, and planning assumptions that were made when developing the ALPS™ model are provided in the technical memorandum in **Appendix C.1**. The modeling assumed only private vehicles are permitted to pick up passengers at the arrivals curbfront. The modeling also assumed private vehicles, taxis, and Transportation Network Companies (TNCs) are permitted to drop off passengers at the departures curbfront.

Traffic volumes derived from the ALPS™ model were used as inputs for the ACRP Quick Analysis Tool for Airport Roadways (QATAR), a planning-level macroscopic analysis tool for estimating airport terminal curbfront LOS. This helped determine the departures and arrivals curbside requirements. The QATAR analysis assumed double-lane curbing is allowed at both terminals. The QATAR analysis also assumed a four-lane roadway cross section existed, which provides two lanes for through traffic. The T1 and Terminal 2 (T2) baseline departures and arrivals curbside requirements are presented in **Table 3-2**, **Table 3-3**, **Table 3-4**, and **Table 3-5**, respectively. Additional curbside requirements analysis results are provided in **Appendix C.1**.

Table 3-2: T1 Departures Curbside Requirements (Double-Lane Curbing / LOS C)[1]

	Peak Hour	Peak-Hour Curbing Volumes	Departures Curb (Departures Peak)	Surplus/(Deficit)
Base (2019)	4:45 A.M.	1,087'	840'	(10')
PAL 1	4:45 A.M.	1,069'	840'	(10')
PAL 3 (Summer)	6:45 A.M.	1,400'	1,130'	(300')

NOTES:
PAL – Planning Activity Level
1 Curbside requirements for PAL 2 are intentionally not presented. It is best practice to design curbside facilities to meet requirements at the end of the planning horizon.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Table 3-3: T1 Arrivals Curbside Requirements (Double-Lane Curbing / LOS C)[1,2]

	Peak Hour	Peak-Hour Curbing Volumes	Arrivals Curb (Arrivals Peak)	Surplus/(Deficit)
Base (2019)	6:30 P.M.	604'	840'	(140')
PAL 1	4:45 P.M.	581'	815'	(115')
PAL 3 (Summer)	4:30 P.M.	1,180'	1,130'	(430')

NOTES:
PAL – Planning Activity Level
1 Vehicular recirculation for the arrivals curbfront at T1 was assumed to be 20%.
2 Curbside requirements for PAL 2 are intentionally not presented. It is best practice to design curbside facilities to meet requirements at the end of the planning horizon.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Table 3-4: T2 Departures Curbside Requirements (Double-Lane Curbing / LOS C)[1]

	Peak Hour	Peak-Hour Curbing Volumes	Departures Curb (Departures Peak)	Surplus/(Deficit)
Base (2019)	4:45 A.M.	530’	490’	210’
PAL 1	4:30 A.M.	482’	440’	260’
PAL 3 (Spring)	4:30 A.M.	821’	690’	10’

NOTES:
PAL – Planning Activity Level
1 Curbside requirements for PAL 2 are intentionally not presented. It is best practice to design curbside facilities to meet requirements at the end of the planning horizon.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Table 3-5: T2 Arrivals Curbside Requirements (Double-Lane Curbing / LOS C)[1,2]

	Peak Hour	Peak-Hour Curbing Volumes	Arrivals Curb (Arrivals Peak)	Surplus/(Deficit)
Base (2019)	1:45 P.M.	273’	590’	(140’)
PAL 1	1:30 P.M.	392’	715’	(265’)
PAL 3 (Spring)	2:00 P.M.	757’	940’	(490’)

NOTES:
PAL – Planning Activity Level
1 Vehicular recirculation for the arrivals curbfront at T2 was assumed to be 40% (20% recirculate directly to the curbfront, and 20% recirculate to the cell phone lot).
2 Curbside requirements for PAL 2 are intentionally not presented. It is best practice to design curbside facilities to meet requirements at the end of the planning horizon.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

3.1.2 Parking Requirements

Airport public parking facilities accommodate both public parkers and a subset of employee parkers. Additional public parking supply is currently provided by off-airport private facilities. A baseline parking requirements analysis was performed, which assumed no change in passenger and employee behavior over the planning period. Changes in customer behavior over time could result in changing parking requirements at a given PAL. Potential changes to customer behavior and the resulting impacts to landside requirements were evaluated through PAL 1, as documented in **Appendix C.3**.

Exhibit 3-1 illustrates the general methodology used to determine the employee and public parking requirements.

Exhibit 3-1: Parking Requirements Methodology

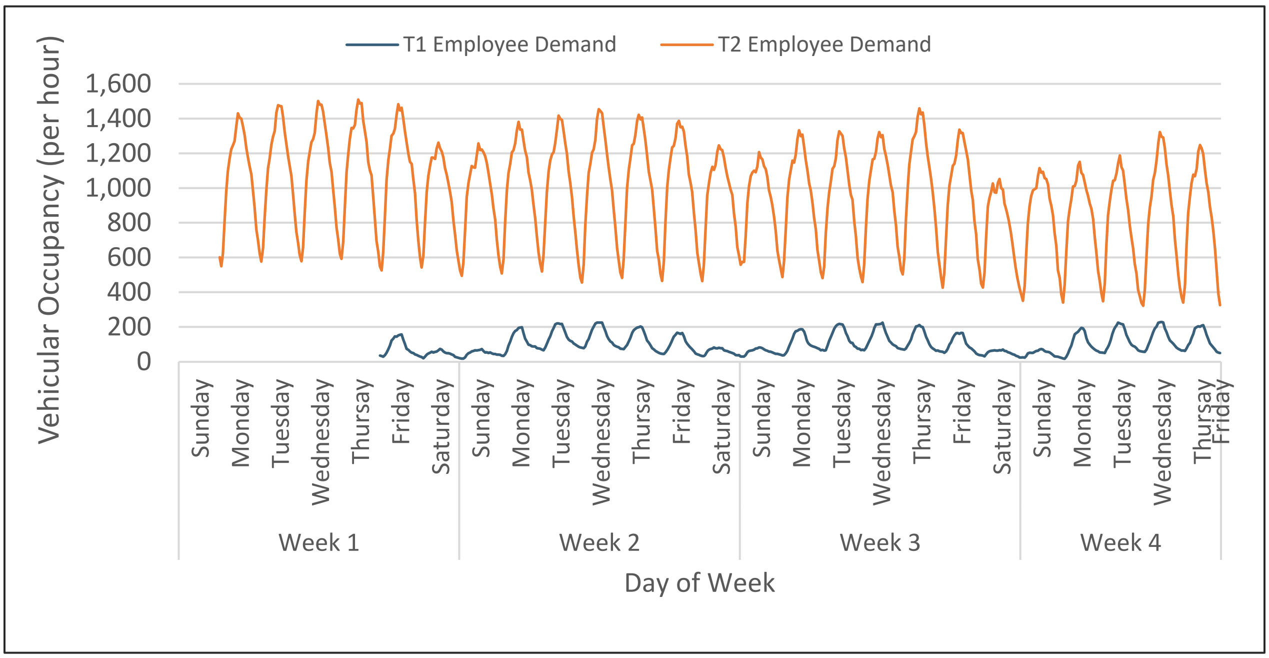
SOURCE: Kimley-Horn and Associates, Inc., 2022.

3.1.2.1 Employee Parking

Employee parking requirements were calculated for a subset of airline, tenant, and concessionaire employees. The analysis only included employees parking in public parking facilities managed by the Metropolitan Airports Commission (MAC) Parking Access and Revenue Control System (PARCS). An analysis estimating the amount of Delta employees parking outside MAC facilities is included for planning purposes, which is related to alternatives impacting existing Delta employee parking.

The employee parking requirements were based on parking transaction data from the airport's PARCS. Employee entry and exit transaction data were used to determine employee parking demand because discreet employee parking occupancy data were not available. **Exhibit 3-2** shows the peak occupancy at both T1 and T2, which was selected to determine the employee parking demand. To determine the existing employee parking stall requirement, a 10% service factor was applied to the demand to account for known inefficiencies in parking operations and peaking characteristics during shift changes.

Exhibit 3-2: Employee Parking Occupancy (March 2019)



NOTES:
T1 – Terminal 1; T2 – Terminal 2
SOURCE: Kimley-Horn and Associates, Inc., 2022.

The existing employee parking stall requirement grew at the same rate as annual passenger aircraft operations to determine future requirements, with requirements assumed to be consistent throughout the year. **Table 3-6** presents the resulting employee parking requirements.

Table 3-6: Existing and Future Employee Parking Requirements (Stalls)

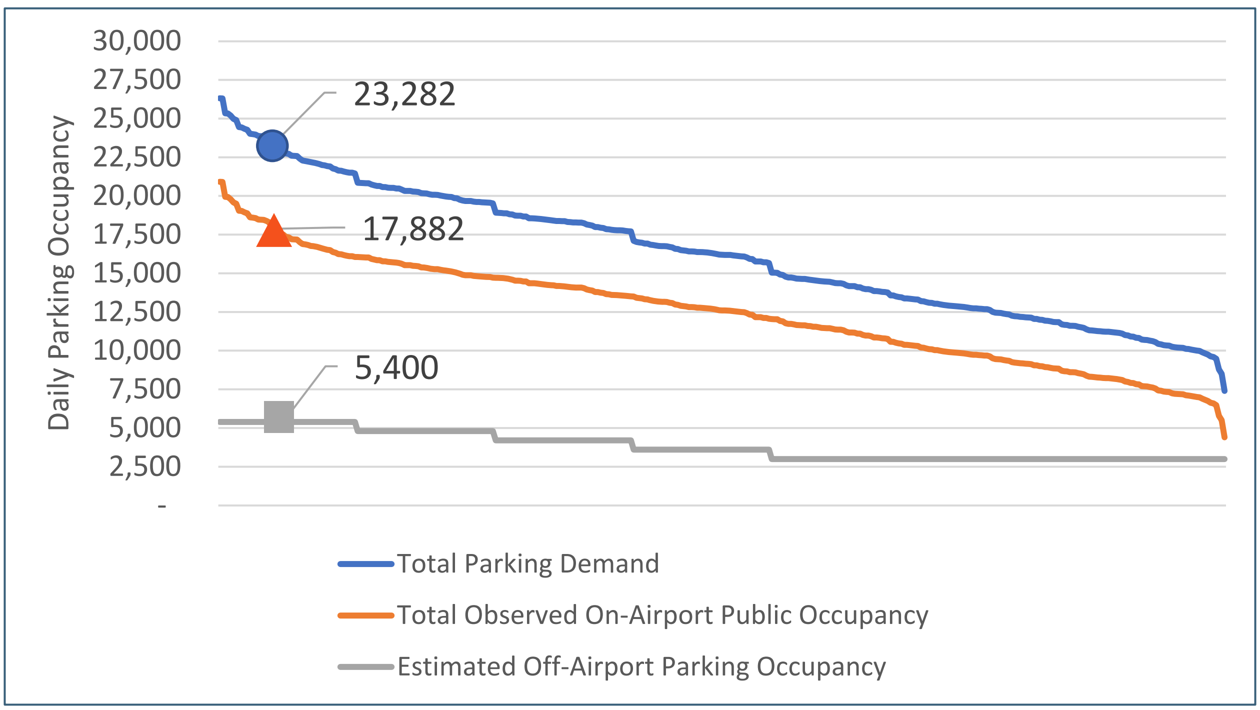
	Base Year (2019)	PAL 1	PAL 2	PAL 3
Employee Parking	1,900	1,950	2,080	2,380
Delta Off-Airport Employees [1,2]	1,660	1,700	1,810	**2,070**

NOTES:
PAL – Planning Activity Level
1 The requirement was estimated from observed traffic activity in March 2021 and employee parking occupancy on the Silver Ramp in January 2021. Future studies should verify the Delta employee parking requirement.
2 Growth was based on forecasted Delta flight operations.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

3.1.2.2 Public Parking

The on-Airport public parking requirements were determined using MAC-provided parking occupancy data. Off-airport parking requirements were estimated based on an assumed off-Airport parking supply and an assumed peak period occupancy. Based on the sorted data, as shown on **Exhibit 3-3**, the 20th busiest day was then identified as the public parking design day. The total demand includes both on-airport and off-airport parking. The 20th busiest day is the industry standard for planning airport public parking requirements.

Exhibit 3-3: Sorted Public Parking Occupancy (2019)



SOURCE: Kimley-Horn and Associates, Inc., 2022.

To determine the existing public parking stall requirement, a 5% service factor was applied to the design day demand to account for known parking operation inefficiencies. The future public parking requirements were calculated by increasing the existing requirement at the same rate as the annual Origin and Destination O&D enplaned passengers. The off-Airport parking requirements were assumed to grow at the same rate as on-Airport parking demand.

Table 3-7 summarizes the public parking requirements. Public parking stall requirements are presented for the entire Airport, rather than by each individual terminal. Terminal-specific parking requirements will be further explored in the alternatives analysis. Detailed results can be found in **Appendix C.3**.

Table 3-7: Existing and Future Public Parking Requirements (Stalls)

	Base Year (2019)	PAL 1	PAL 2	PAL 3
On-Airport	18,800	21,090	22,640	25,900
Off-Airport	5,700	6,370	6,840	7,820
Total	**24,500**	**27,460**	**29,480**	**33,720**

NOTE:
PAL – Planning Activity Level
SOURCE: Kimley-Horn and Associates, Inc., 2022.

3.1.2.3 Total Airport Parking Requirement

The total Airport parking requirement comprises the on-Airport public parking requirement, the off-Airport public parking requirement, and the employee parking requirement. The requirements presented do not identify the demand allocated for T1 parking, T2 parking, and off-Airport parking products. For estimates of terminal-specific requirements at PAL 1, refer to **Appendix C.3**. Without a preferred terminal alternative, it is not possible to accurately measure terminal-specific parking demand. As such, terminal-specific requirements will be assessed as part of the alternatives analysis and will be based on forecast flight activity at each terminal.

Proposed private developments south of the Airport are anticipated to reduce the off-Airport parking supply. It was assumed that off-Airport parking customers would use on-Airport parking when the off-Airport parking demand exceeds the available supply, thus increasing the on-Airport parking requirement. Various parking supply scenarios were analyzed to estimate the future surplus or deficit when compared with existing conditions. The following are the supply scenarios analyzed:

- *Supply Stage 1:* Existing – Stage 1 assumes all existing MAC parking facilities are open and no developments have impacted the supply of off-Airport operators. **Table 3-8** provides the estimated surplus/deficit for Stage 1.
- *Supply Stage 2:* Off-Airport development and Red/Blue Ramps Capital Improvement Program (CIP) – Stage 2 assumes off-Airport developments have reduced the private operator parking supply (1,000-stall loss). This stage also assumes the Red and Blue Ramps Levels 2 and 3 are converted to public parking (1,700-stall gain). **Table 3-9** provides the estimated surplus/deficit for Stage 2.
- *Supply Stage 3:* Green/Gold Ramps demolition – In addition to the impacts to the parking supply from Supply Stage 2, Stage 3 accounts for the loss of on-Airport parking with the demolition of the Valet Ramp and Green and Gold Ramps (7,950-stall loss). It also includes the reduction of off-Airport parking supply with the loss of the Park ‘N Go surface lot and the Park ‘N Fly parking ramp (2,100-stall loss). **Table 3-10** provides the estimated surplus/deficit for Stage 3.

Table 3-8: Stage 1 Parking Surplus/Deficit

	Base Year (2019)	PAL 1	PAL 2	PAL 3
Total Parking Requirement (Public and Employee) [1]	**26,400**	**29,410**	**31,560**	**36,100**
Total Parking Supply	33,220			
Surplus/(Deficit)	6,820	3,810	1,660	(2,880)

NOTES:
PAL – Planning Activity Level
1 Does not include the Delta employee parking requirement.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Table 3-9: Stage 2 Parking Surplus/Deficit

	Base Year (2019)	PAL 1	PAL 2	PAL 3
Total Parking Requirement (Public and Employee) [1]	**26,400**	**29,410**	**31,560**	**36,100**
Total Parking Supply	33,920			
Surplus/(Deficit)	N/A	4,510	2,360	(2,180)

NOTES:
PAL – Planning Activity Level; N/A – Not Applicable
1 Does not include the Delta employee parking requirement.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Table 3-10: Stage 3 Parking Surplus/Deficit

	Base Year (2019)	PAL 1	PAL 2	PAL 3
Total Parking Requirement (Public and Employee) [1]	**26,400**	**29,410**	**31,560**	**36,100**
Total Parking Supply	23,870			
Surplus/(Deficit)	N/A	(5,540)	(7,690)	(12,230)

NOTES:
PAL – Planning Activity Level; N/A – Not Applicable
1 Does not include the Delta employee parking requirement.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

3.1.2.4 Electric Vehicle Parking Considerations

The current electric vehicle (EV) fleet has driven an increasing demand for EV charging infrastructure. Guidance for Evs set by the federal government, the State of Minnesota, and vehicle manufacturers informed the future EV charger uses and potential infrastructure requirements. The number of EV charging stalls needed for public and employee parking at MSP was estimated using a methodology based on vehicle sales. **Table 3-11** presents the recommended number of EV charging stalls to accommodate on-Airport public and employee parking. The analysis assumes 25% of EVs parked at MSP require concurrent charging.

Table 3-11: Electric Vehicle Charging Stall Requirements

	On-Airport Parking Requirement [1]	Percent EV Fleet	EV Charging Stall Requirement
PAL 1	24,410	3.1%	**191**
PAL 2	28,660	12.3%	**884**
PAL 3	33,200	42.0%	**3,485**

NOTES:
PAL – Planning Activity Level; EV – Electric Vehicle
1 The parking requirement includes the on-Airport public parking requirement, excess off-Airport requirement, and employee parking. It does not include the Delta employee parking requirement or off-Airport provided parking.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Changes in driver habits, battery technology, charging technology, and available off-Airport charging options may alter the number of EVs needing access to an EV charger over the planning period, with considerations made for vehicles requiring different charging intensity based on the stay duration. A future study is recommended to explore the number of EV chargers at different levels (i.e., Level 1, Level 2, and direct-current [DC] fast charge) to provide a range of services that align with customer demand, while aligning electrical demand with the power grid. Refer to **Appendix C.3** for additional information on the electrification of vehicles.

3.1.3 Rental Car Facility Requirements

A survey from 2019 was used to gather rental car agency (RAC) data related to the number of return transactions per day, rental transactions per hour during an average day, and overall monthly activity. **Exhibit 3-4** illustrates the methodology used to determine rental car facility requirements.

Exhibit 3-4: Rental Car Facility Requirements Methodology

NOTE:
RAC – Rental Car Agency
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Peak-hour rental and return activity was used to determine RAC facility requirements to provide a high level of customer service. The total activity assumed a 5% terminal-specific passenger surge above the historic Airport split, because T1 and T2 operations peak at different hours during the day. The rental car facility requirements were determined using the peak-hour rentals and returns, industry-standard surge factors, industry-standard sizing factors, and industry-standard transaction times. A 1.25 surge factor was applied to customer service counter positions, fueling positions, and wash bays to account for uneven activity distribution within the peak hour. Peak-hour returns and rentals grew at the same rate as O&D enplaned passenger growth at each PAL. **Table 3-12** presents the rental car facility requirements. Refer to **Appendix C.2** for a more detailed description of the methodology used and **Appendix C.3** for terminal-specific requirements at PAL 1. Future terminal-specific requirements will be assessed as part of the alternatives analysis and will be based on forecast flight activity at each terminal.

Table 3-12: Existing and Future Rental Car Facility Requirements

Customer Service Counter Positions	52	61	66	75
Fueling Positions	92	102	109	125
QTA Storage (On-Site Vehicles)	1,160	1,310	1,400	1,610

NOTES:
PAL – Planning Activity Level; QTA – Quick Turnaround
SOURCE: Kimley-Horn and Associates, Inc., 2022.

The results suggest the Airport has sufficient customer service positions and ready/return stalls through the planning period, but will face deficits for fueling positions, wash bays, and Quick Turn Around (QTA) storage space, as presented in **Table 3-13**.

Table 3-13: Rental Car Facility Surplus/Deficit

		Surplus/(Deficit)			
Facility	**Existing Supply**	**Base Year**	**PAL 1**	**PAL 2**	**PAL 3**
Customer Service Counter Positions	77	22	16	9	2
Ready/Return Stalls	2,715	1,065	860	725	440
Fueling Positions	100	8	(2)	(9)	(25)
Wash Bays	20	(4)	(6)	(7)	(12)
QTA Storage (On-Site Vehicles)	1,260	100	(50)	(140)	(350)

NOTES:
PAL – Planning Activity Level; QTA – Quick Turnaround
SOURCE: Kimley-Horn and Associates, Inc., 2022.

3.1.3.1 Electric Vehicle Rental Car Considerations

RACs have stated a business desire to convert their fleets to EVs, including one large national brand planning to convert its entire fleet by 2025. Aggressive corporate goals may not immediately manifest in greater rates of EVs within the fleet, but the trend toward fleet electrification should not be diminished due to the significant electrical loads associated with maintaining an all-EV fleet. By 2040, 96% of the rental car fleet is anticipated to be electric.

The shift in the rental car fleet toward Evs could change the turnaround process, as vehicles require electric fueling rather than gasoline fueling. The demand for EV chargers will be dependent on the agency's operational model. Three operational scenarios are feasible:

- *Ready/Return Charging*: This scenario assumes all Evs are charged in the ready/return area using either Level 2 chargers or a variety of Level 2 and DC fast chargers.
- *QTA Charging:* A QTA electric-fueling operation would parallel the existing operation, using DC fast chargers for power.

- *Ready/Return and QTA Charging:* Vehicles would be charged for a fixed time of 15 minutes in the QTA area using a DC fast charger. Vehicles requiring additional charging will be charged in the ready/return area using a Level 2 charger.

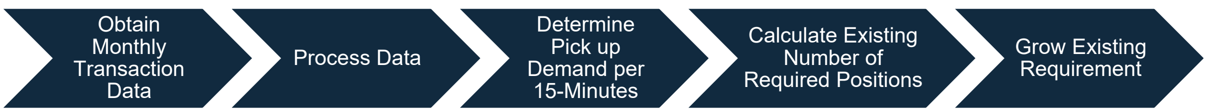
This study assumes EV charging in both the ready/return and QTA area based on preliminary input from RACs at peer airports. This assumption should be validated prior to new rental car facility development. Impacts to the number of electric and gasoline-fueling positions required for each RAC operational scenario are described in **Appendix C.3**.

3.1.4 Ground Transportation Center Requirements

The MAC provided the commercial ground transportation transaction data. The requirements analysis considered all commercial modes that currently operate at MSP. For the purposes of this report, on-demand ground transportation modes included TNCs, taxis, and limo services, whereas scheduled services accounted for the other commercial modes (shuttles and buses).

Exhibit 3-5 illustrates the general methodology used to determine the GTC requirements.

Exhibit 3-5: Ground Transportation Center Requirements Methodology



SOURCE: Kimley-Horn and Associates, Inc., 2022.

Monthly transaction data were aggregated and processed by the hour, day, and week. The hourly data was further distilled into 15-minute time periods. The 99th percentile, 15-minute activity level was used as the basis to determine the number of required vehicle positions. The number of required vehicle positions were determined using an average observed dwell time and a surge factor of 1.5 to account for sudden increases in activity. Refer to **Appendix C.2** for dwell times used for each commercial mode and detailed results.

The future on-demand commercial vehicle requirements were determined by growing the existing requirements by the peak-hour terminating passengers. Only terminating passengers were accounted for in the on-demand requirements because on-demand services typically only pick up passengers from the commercial curb.

The future scheduled service requirements were determined by growing the existing requirements by the peak-hour total flights. Scheduled services use the commercial curb for drop-off and pick-up, so both arriving and departing flights were considered in the peak hour.

Table 3-14 presents the existing and forecast baseline ground transportation requirements. By PAL 3, on-demand services will have a deficit of 7 positions and scheduled services will have a deficit of 10 positions. Several additional scenarios exploring the change in customer behavior through PAL 1 were analyzed, and detailed results can be found in **Appendix C.3**.

Table 3-14: Existing and Future Ground Transportation Facility Requirements

Ground Transportation Mode	Requirement (Number of Positions)	
	Base Year	**PAL 3**
Taxis	27	34
TNCs	45	56
Limousines	34	43
Shuttles	39	54
Buses	14	19
Total	**159**	**206**

NOTES:
PAL – Planning Activity Level; TNC – Transportation Network Company
1 Curbside requirements for PAL 2 are intentionally not presented. It is best practice to design curbside facilities to meet requirements at the end of the planning horizon.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

3.2 TERMINAL

This section describes the gap analysis used to determine the types and quantities of facilities that will be needed to maintain or achieve the facility LOS goals at successive PALs. The gap analysis assumed no operational changes to the current state of the terminals. The current state of the terminals, as described in Chapter 1, includes terminal capital improvements that have been approved by the MAC and are under design or construction. Deficiencies and/or surpluses identified by the gap analysis guided the development of alternative concepts; however, the gap analysis by itself does not constitute a facility program since it does not consider capital improvements or operational changes to mitigate identified facility gaps.

3.2.1 Aircraft Parking Positions

The DDFS associated with PAL 2 and PAL 3 were gated (aircraft assigned to an existing or new gate position) to determine the number of aircraft parking positions required to accommodate passenger airline operations at each PAL. This analysis was completed prior to the onset of the COVID-19 pandemic and therefore does not use the updated DDFS.

The principal difference between the original and updated DDFS was the earlier retirement of aircraft with less than 50 seats that served the smaller markets in the original DDFS, which were replaced by 70-seat and larger aircraft (CRJ-700/CRJ-900). Therefore, markets with 3 to 4 daily flights that were served using 50-seat aircraft in the original DDFS were most likely replaced by 2 to 3 daily flights using CRJ-700/CRJ-900 aircraft in the updated DDFS. This difference was negligible and did not warrant updating the analysis.

3.2.1.1 Gated Design Day Flight Schedules

Each flight listed in the DDFS was gated using the following rules:

- Gate buffer times were set at 10 minutes (20-minute separation) to allow for taxi in/out and push back for Delta operations, with 15 minutes (30-minute separation) for all other non-Delta operations.
- A minimum of 60 minutes for tow on/off (departures and arrivals), flights with ground times greater than 3 hours (potential tow operations), and generic off-gate towing standards.

- The gating priorities were ranked 1 through 5, with 1 being the highest priority as 1) airline assignments, 2) international arrivals, 3) widebody operations, 4) remaining operations, and 5) regional/commuter gate priority, by Concourse C, then Concourses B and A, respectively.

Airline terminal assignments (on August 7, 2018) were as follows:

- T1 (except Concourse E): Air Choice One, Air France, Boutique Air, Delta, and KLM Royal Dutch Airlines
- T1 – Concourse E: Aer Lingus, Air Canada, Alaska Airlines, American Airlines, Spirit Airlines, and United Airlines
- T2: Condor, Frontier Airlines, Icelandair, JetBlue Airways, Southwest Airlines, and Sun Country

3.2.1.2 Findings from the Gated Design Day Flight Schedules

Table 3-15 summarizes the distribution of passenger airline operations among the three available terminal assignments over successive PALs. Overall, the DDFS reflects a 31% increase in airline operations from 2018 to PAL 3, with T2 experiencing the largest increase (89%) in total operations. **Table 3-16** presents the changes within different aircraft types (groups) among the three available terminal assignments over successive PALs. Overall, the DDFS shows regional aircraft operations decreasing from 66% of overall aircraft operations in 2018 to 32% by PAL 3.

Table 3-17 presents the changes in the number of gates that will be required to support enplaning and deplaning passengers for the three available terminal assignments. Overall, the DDFS show the number of aircraft gates required to support flight arrivals and departures increasing from 120 in 2018 to 140 by PAL 3. **Table 3-18** presents the average number of turns that will occur at the existing gates. A turn is defined as a flight arrival *or* departure, whereas a flight operation is defined as the combination of a flight arrival *and* departure.

The total number of aircraft parking positions that will be required to support the number of aircraft on the ground consists of aircraft gates used for enplaning/deplaning passengers and hardstand positions used to park aircraft that are on the ground but are towed off aircraft gates. According to **Table 3-19**, 18 off-gate hardstands are required by PAL 2 and 32 are required by PAL 3.

Table 3-15: Design Day Flight Schedule Passenger Airline Operations

Terminal	2018 [1]	PAL 2	PAL 3
T1 (except Concourse E)	900	1,016	1,140
T1 Concourse E	163	170	194
T2	110	184	208
Total Passenger Airlines	1,173	1,370	1,542

NOTE: PAL – Planning Activity Level
SOURCE: Ricondo & Associates, Inc., 2022.

Table 3-16: Design Day Flight Schedule Passenger Airline Operations by Aircraft Group

Terminal	2018	PAL 2	PAL 3
	Regional		
T1 (except Concourse E)	412	332	328
T1 Concourse E	54	72	46
T2	-	-	-
	Narrowbody		
T1 (except Concourse E)	470	634	762
T1 Concourse E	109	98	148
T2	108	182	206
	Widebody		
T1 (except Concourse E)	18	50	50
T1 Concourse E	-	-	-
T2	2	2	2

NOTES:
PAL – Planning Activity Level
1 Frontier Airlines operated from Concourse E in August 2018.
SOURCE: Ricondo & Associates, Inc., 2022.

Table 3-17: Aircraft Gate Demand

Terminal	Existing Gate Count	PAL 2	PAL 3
T1 (except Concourse E)	88	96	104
T1 Concourse E	16	16	16
T2	16	17	20

NOTE:
PAL – Planning Activity Level
SOURCE: Ricondo & Associates, Inc., 2022.

Table 3-18: Average Turns on Existing Gates

Terminal	2018	PAL 2	PAL 3
T1 (except Concourse E)	5.1	5.4	5.7
T1 Concourse E	5.1	5.2	5.9
T2	3.9	5.7	6.1

NOTE:
PAL – Planning Activity Level
SOURCE: Ricondo & Associates, Inc., 2022.

Table 3-19: Off-Gate Tow On/Off Hardstands

Terminal	PAL 2	PAL 3
T1 (except Concourse E)	6	12
T1 Concourse E	9	15
T2	3	5

NOTE:
PAL – Planning Activity Level
SOURCE: Ricondo & Associates, Inc., 2022.

3.2.2 Passenger Terminal Facility Planning Parameters

Planning parameters represent criteria specific to MSP passengers, airlines, agencies, and other stakeholders that were used to conduct the gap analysis for passenger terminal facilities. The four categories of criteria were the following:

- LOS standards define acceptable wait times for passengers needing a particular service and the amount of space provided to passengers waiting in queue for service.

- Passenger attributes refer to passenger habits, which include travel party size, ground transportation method, number of bags checked, and show-up profiles.
- Baseline terminal facilities, as described in Chapter 1, summarize the inventory of terminal facilities and resources most pertinent to the gap analysis, including all terminal capital improvements that have been approved by the MAC.
- Operating parameters define the types of services and transaction times.

A detailed discussion of the passenger terminal facility planning parameters used to develop the 2040 LTP is contained in **Appendix A**. Sources used to define the planning parameters included airline industry manuals and guidelines, MSP-specific studies, on-Airport passenger surveys conducted in March and August of 2019, and MSP stakeholder workshops conducted in the spring of 2020.

3.2.2.1 Level of Service Standards

LOS standards were used to define the key performance objectives for (a) passenger transaction wait times (transactions such as checking in, checking bags, and clearing security) and (b) the amount of space provided to passengers waiting in queue. LOS standard goals generally conform to "optimum design standards," as recommended by the International Air Transport Association (IATA) in its *Airport Development Reference Manual*, 11th edition. Optimum design standards occur when facilities provide adequate space and reasonable delays, and the cost of maintenance and construction is equitable to facility utilization. The IATA LOS standard prescriptions were superseded by MAC-specific criteria or U.S. agency guidelines, where applicable. **Table 3-20** summarily lists the LOS standards used for the principal passenger terminal functional and waiting areas.

Table 3-20: Level of Service Standards

Function	Notes	Space (square feet per passenger)	Maximum Wait Time (minutes)
Check-in			
Self-Service Kiosk	Queue width 4.5–5.0 ft	14.0–19.4	<1
Bag-Drop	Queue width 4.5–5.0 ft	14.0–19.4	<3
Full-Service Economy	Queue width 4.5–5.0 ft	14.0–19.4	<10
Full-Service Premium	Queue width 4.5–5.0 ft	14.0–19.4	<5
Security Checkpoint Queue			
Standard Lane	Queue width 4.0 ft	10.8	<20
Expedited Screening Lane	Queue width 4.0 ft	10.8	<10
Holdrooms			
Seated	40% [1]	17.2	N/A
Standing	30%–40% [1]	11.9	N/A
Domestic Baggage Claim		16.2–18.3	20<
Federal Inspection Services			
International Baggage Claim		16.2–18.3	20<
Document Inspection	Queue width 4.5–5.0 ft	14.0–19.4 [2]	25<

NOTES:
N/A – Not Applicable
1 This accounts for 20% to 30% of passengers at nearby concessions.
2 This reflects the bag-first queue configuration.
SOURCES: International Air Transport Association, *Airport Development Reference Manual*, 11th edition, March 2019; Ricondo & Associates, Inc., 2022.

3.2.2.2 Passenger Attributes

Passenger attributes were described for the following airlines and airline groupings:

- Delta
- Sun Country
- Southwest
- Domestic Other Airlines (OALs): American, United, Spirit, Frontier, JetBlue, Alaska, Air Canada
- International OALs: Condor, Icelandair, Air France, KLM Royal Dutch Airlines, Aer Lingus

Attributes associated with passengers included the following:

- Travel party size – The number of passengers that share the same reservation code and conduct transactions as a group
- Well-wisher and meeter-greeter ratios – non-traveling friends and family who enter the terminal with departing passengers (well-wishers), or welcome arriving passengers (meeter-greeters)
- Passengers checking bags
- Show-up times at the Airport, prior to scheduled departure time

3.2.2.3 Operating Parameters

Operating parameters pertain to processing sequence and associated processing rates and rules for tenant use of facilities. Operating parameters also include minimum space configuration templates. Operating parameters and LOS standards are the principal considerations applied against demand to determine facility requirements.

For the gap analysis, the following operating parameters were used:

- Processing sequence for departing passengers, arriving domestic and arriving pre-cleared international passengers, and arriving international passengers
- Airline facilities, including –
  - Check-in locations
  - Check-in class eligibility
  - Check-in channels
  - Check-in transaction times
  - Outbound baggage makeup cart staging
  - Inbound baggage unloading
  - Airline crew size
- Transportation Security Administration (TSA)
  - Security Screening Checkpoint (SSCP) equipment types and screening rates
  - Checked Baggage Inspection Systems (CBIS) equipment and screening rates
- U.S. Customs and Border Protection (CBP)
  - Simplified Arrival

Airline terminal assignments are another important operating parameter. **Table 3-21** lists the airline terminal assignments as of spring 2020.

Table 3-21: Airline Terminal Assignments

T1	T2
Aer Lingus (EI)	Condor (DE)
Air Canada (AC)	Icelandair (FI)
Air Choice One (3E)	Frontier Airlines (F9)
Air France (AF)	JetBlue Airways (B6)
Alaska Airlines (AS)	Southwest Airlines (WN)
American Airlines (AA)	Sun Country Airlines (SY)
Boutique Air (4B)	
Delta Air Lines (DL)	
KLM Royal Dutch Airlines (KL)	
Spirit Airlines (NK)	
United Airlines (UA)	

NOTE:
The airline terminal assignments represent spring 2020.
SOURCE: Ricondo & Associates, Inc., 2022.

3.2.3 Passenger Terminal Facility Gap Analysis

The passenger terminal facility gap analysis provides an initial determination of the types and quantities of facilities that will be needed to maintain or achieve the MAC-provided LOS goals at successive PALs. The detailed gap analysis completed in June 2020 is included in **Appendix A**. Like the gap analysis for aircraft parking positions, the terminal facility gap analysis was completed prior to the onset of the COVID-19 pandemic, with the differences between the original DDFS and the updated DDFS not deemed significant enough to revise this analysis.

Terminal facility needs were primarily assessed by identifying peak-hour passenger demand (the hour in the day that has the greatest passenger activity) and flight scheduling patterns (how the airlines distribute flights), rather than annual activity (the total passengers the terminal processes for the year). Peak-hour passenger demand was derived from the DDFS discussed in Chapter 2. The DDFS provided information on a flight-by-flight basis for flight arrival and departure times, operating airline, terminal and gate location, aircraft type, points of origin and destination, seat capacity, load factor, and originating/terminating percentage.

The following subsections summarize the future terminal facility requirements from the passenger terminal facility gap analysis.

3.2.3.1 Check-in Facilities

Passenger demand for check-in facilities at T1 and T2 was modeled using computer simulation software that applied planning criteria, including show-up profiles and processing rates, to determine the number and types of check-in units that would be needed to maintain prescribed LOS standards for check-in. **Table 3-22**, **Table 3-23**, and **Table 1-24** list the required number of check-in positions for each terminal, airline, and airline partners. Summarily, the results from the gap analysis were as follows:

- T1: LOS is met at all PALs. The mix of check-in positions between bag-drop and agent counter may need to be redistributed.
- T2: Kiosk deficiencies exist at PAL 1 (assuming proprietary units).

Table 3-22: T1 Check-in Requirements – Delta and SkyTeam

Delta and SkyTeam Peak-Hour Originating Passengers (at show-up time)		Units	Inventory	PAL 1	PAL 2	PAL 3
		PAX	--	2,575	2,906	3,643
Peak-Hour Check-in Demand		PAX	--	688	687	842
Main Terminal	Kiosks	Units	48	27	35	35
	Sky Priority Agents	Positions	7	2	2	2
	Special Services Agents	Positions	14	5	5	5
	Bag-Drop Positions	Positions	14	13	15	20
	Total Bag-Drop/Agent	**Positions**	**35**	**20**	**22**	**27**
Curb	Kiosks	Units	5	9	12	13
	Agent Counters	Positions	10	4	5	6
Tram Level		Positions		12	7	9

NOTES:
Numbers in red denote deficiencies in an acceptable level of service.
PAL – Planning Activity Level; PAX – Passengers
SOURCE: Ricondo & Associates, Inc., June 2020.

Table 3-23: T1 Check-in Requirements – Other Airlines

T1 OTHER AIRLINES Peak-Hour Originating Passengers (at show-up time)		Units	Inventory	PAL 1	PAL 2	PAL 3
		PAX		1,156	1,248	1,337
Peak-Hour Check-in Demand		PAX	--	860	957	1,028
Kiosks	Air Canada	Units	4	3	4	4
	American Airlines	Units	20	13	13	18
	United Airlines	Units	16	10	10	11
	Common Use (AS, EI, NK, EAS)	Units	24	10	13	13
Bag-Drop Positions	American Airlines	Positions	6	4	4	6
	United Airlines	Positions	4	3	3	3
	Common Use (AS, EI, NK, EAS)	Positions	8	6	10	8
	Aer Lingus (Premium Only)	Positions	2	2	2	2
Agent Counter Positions	Air Canada	Positions	4	4	4	4
	Alaska Airlines (Premium Only)	Positions	2	2	2	2
	American Airlines	Positions	4	4	4	4
	Spirit Airlines	Positions	4	2	2	2
	United Airlines	Positions	6	4	4	4
	Unassigned Positions	Positions	2	--	--	--
Total Bag-Drop/Agent Positions		Positions	42	31	35	35

NOTES:
EAS – Essential Air Service (Air Choice One, Boutique Air); AS – Alaska Airlines; EI – Aer Lingus; NK – Spirit Airlines; PAL – Planning Activity Level; PAX – Passengers
SOURCE: Ricondo & Associates, Inc., June 2020.

Table 3-24: T2 Check-in Requirements

TERMINAL 2 – All Airlines Peak-Hour Originating Passengers (at show-up time)		Units	Inventory	PAL 1	PAL 2	PAL 3
		PAX	--	1,156	1,248	1,337
Peak-Hour Check-in Demand		PAX	--	860	957	1,028
Kiosks	Frontier Airlines	Units	3	10	10	10
	JetBlue Airways	Units	3	5	7	7
	Southwest Airlines	Units	10	14	14	17
Agent Counter Positions	Sun Country Airlines	Positions	28	15	17	20
	Condor	Positions	6	6	6	6
	Icelandair	Positions	6	5	5	5
	Frontier Airlines	Positions	6	4	4	4
	JetBlue Airways	Positions	6	4	4	4
	Southwest Airlines	Positions	14	9	9	11
Total Agent Positions		Positions	58	43	45	50

NOTES:
Agent Counters at T2 are common use and can fluctuate usage throughout the day.
PAL – Planning Activity Level; PAX – Passengers
SOURCE: Ricondo & Associates, Inc., June 2020.

3.2.3.2 Transportation Security Administration Passenger Security Screening Checkpoints

Computer simulation was used to evaluate the performance of the TSA SSCPs. Each PAL was simulated to determine the resulting security wait times and to estimate the number of passengers waiting in queue. Demand at the SSCPs was conditioned on passengers being able to complete their check-in transactions within the prescribed LOS wait times for check-in. The baseline condition assumed Automated Screening Lane (ASL) technology at the T1 SSCPs and non-ASL technology at the T2 SSCPs.

In addition to the summer DDFS (August), a spring DDFS (March) was evaluated using 2018 TSA throughput data. **Table 3-25** and **Table 3-26** list the required number of checkpoint lanes for each terminal. Summarily, the results from the gap analysis were as follows:

- T1: Under baseline conditions (ASL) and computed tomography X-ray [CTX]), the wait time goal of 10 minutes is exceeded by 1 to 2 minutes in PAL 3. With the addition of remote resolution, wait times are not exceeded and fewer passenger screening lanes are used.
- T1 Spring Sensitivity: Under baseline conditions (ASL and CTX), the T1 SSCPs cannot achieve the desired LOS, resulting in up to 30 minutes of wait time and overflowing queues. The addition of remote resolution will ensure wait time goals are met and queues are not exceeded.
- T2: Under baseline conditions (non-ASL), the wait time goal of 10 minutes is exceeded by 4 to 5 minutes in PAL 3. With the use of ASLs, wait time goals are met. Remote resolution would result in lower lane usage.
- T2 Spring Sensitivity: Under baseline conditions (non-ASL), the T2 SSCPs cannot achieve the desired LOS, resulting in over 30 minutes of wait time and overflowing queues. The addition of ASLs and CTX reduces the wait time and queue length, but it still does not meet the desired LOS. LOS is met with the addition of remote resolution.

Table 3-25: T1 Security Screening Checkpoint Requirements

Planning Activity Level	Peak-Hour Originating Passengers	Peak-Hour SSCP Demand (PAX)	SSCP	PAX Lanes Used	Expedited Passengers		Standard Passengers	
					Wait Time	Passengers in Queue	Wait Time	Passengers in Queue
ASL + CTX								
PAL 1	3,388	2,604	South	8	4:33	70	9:25	114
			North	8	4:38	51	9:40	122
PAL 2	3,558	2,752	South	8	5:04	73	9:45	127
			North	8	5:05	68	9:22	137
PAL 3	4,399	3,140	South	8	5:01	71	11:08	171
			North	8	5:03	91	11:14	136
ASL + CTX + Remote Resolution								
PAL 1	3,388	2,604	South	7	5:03	86	9:36	142
			North	7	5:09	60	9:38	138
PAL 2	3,558	2,752	South	7	4:49	85	9:50	124
			North	7	4:53	67	9:49	148
PAL 3	4,399	3,140	South	7	5:01	88	9:32	129
			North	7	5:04	93	9:43	159
Spring Break with ASL + CTX + Remote Resolution								
2018		4,301	South	7	5:01	88	10:45	145
			North	8	4:49	97	10:48	145

NOTES:
Numbers in red denote deficiencies in an acceptable level of service; Peak-Hour Originating Passengers: at scheduled departure time; Expedited Queue Capacity – South: 90 passengers; North: 108 passengers; Standard Queue Capacity – South: 190 passengers; North: 271 passengers
ASL – Automated Screening Lane; CTX – Computed Tomography X-ray; PAL – Planning Activity Level; PAX – Passengers; SSCP – Security Screening Checkpoint
SOURCE: Ricondo & Associates, Inc., May 2020.

Table 3-26: T2 Passenger Security Screening Checkpoint Requirements

Planning Activity Level	Peak-Hour Originating Passengers	Peak-Hour SSCP Demand (PAX)	PAX Lanes Used	Expedited Wait Time	Standard Wait Time	Passengers in Queue
Non-ASL						
PAL 1	1,156	1,107	7	4:50	9:09	136
PAL 2	1,248	1,158	7	4:41	9:14	141
PAL 3	1,337	1,282	7	4:30	14:23	201
ASL + CTX						
PAL 1	1,156	1,107	7	4:50	9:09	144
PAL 2	1,248	1,158	7	4:41	9:35	142
PAL 3	1,337	1,282	7	4:30	9:32	156
ASL + CTX + Remote Resolution						
PAL 1	1,156	1,107	5	4:44	9:39	128
PAL 2	1,248	1,158	5	5:01	9:15	129
PAL 3	1,337	1,282	5	4:55	8:01	144
Spring Break with ASL + CTX + Remote Resolution						
2018		1,734	6	4:10	8:33	183

NOTES:
Queue Capacity: 305 passengers; Numbers in red denote deficiencies in an acceptable level of service.
ASL – Automated Screening Lane; CTX – Computed Tomography X-ray; SSCP – Security Screening Checkpoint; PAL – Planning Activity Level; PAX – Passengers
SOURCE: Ricondo & Associates, Inc., May 2020.

3.2.3.3 Transportation Security Administration Checked Baggage Inspection System

The CBIS requirements were determined using the DDFS originating passenger demand and the average number of bags per passenger. Equipment requirements were not based on average baggage flows; rather, they were based on surged flows, obtained by applying a surge factor to a 10-minute bag demand derived from the DDFS (per TSA guidelines). **Table 3-27** lists the required number of checkpoint lanes for each terminal. The results from the gap analysis showed that by P AL 1, one additional screening device is needed at T2.

Table 3-27: Centralized Baggage Inspection Systems

	Terminal	Inventory	PAL 1	PAL 2	PAL 3
T1	10-Min Bag Demand	Capacity: 674	287	320	366
	Number of Devices	6	4	5	5
T2	10-Min Bag Demand	Capacity: 225	135	147	156
	Number of Devices	**2**	**3**	**3**	**3**

NOTES:
Numbers in red denote deficiencies in an acceptable level of service.
PAL – Planning Activity Level; T1 – Terminal 1; T2 – Terminal 2
SOURCE: Ricondo & Associates, Inc., June 2020.

3.2.3.4 Outbound Baggage Makeup Facilities

Requirements for outbound baggage makeup facilities principally pertain to the number and capacity of bag makeup devices (typically bag carousels, piers, or slides) that receive and accumulate checked bags prior to being loaded on to baggage carts or containers for delivery to outbound aircraft. **Table 3-28** lists the peak flights in makeup and the peak carts staged for each terminal.

Table 3-28: Outbound Baggage Makeup

		Capacity	PAL 1	PAL 2	PAL 3
T1	Peak Flights in Makeup		78	85	100
	Peak Carts Staged	189	159	167	203
T2	Peak Flights in Makeup		16	17	17
	Peak Carts Staged	**64**	**62**	**68**	**66**

NOTES:
Numbers in red denote deficiencies in an acceptable level of service.
PAL – Planning Activity Level; T1 – Terminal 1; T2 – Terminal 2
SOURCE: Ricondo & Associates, Inc., June 2020.

3.2.3.5 Holdrooms

Holdroom spatial requirements were calculated using the MAC standards for minimum and high LOS. The requirements listed by concourse in **Table 3-29** reflect the largest aircraft anticipated to serve each gate through PAL 3.

Table 3-29: Holdroom Requirements

Concourse	Inventory			Level of Service (PAL 3)	
	Gates	Avg. Holdroom Area (Sq Ft)	Total Holdroom Area (Sq. Ft.)	Minimum (Sq. Ft.)	High (Sq. Ft.)
A	11	738	8,121	13,585	13,926
B	9	992	8,929	11,594	11,871
C	26	1,800	46,806	40,274	43,682
D	6	2,011	12,067	11,106	12,047
E	16	1,805	28,883	33,906	36,874
F	16	2,188	35,011	38,071	41,512
G	20	2,018	40,359	47,464	51,543
T2	**14**	**4,698**	**65,777**	**41,539**	**45,207**

NOTES:
Passenger capacity is based on 15 square feet per passenger (seated/standing blend).
Numbers in red denote deficiencies in an acceptable level of service.
T2 – Terminal 2; Pax – Passenger
SOURCE: Ricondo & Associates, Inc., June 2020.

3.2.3.6 Domestic Baggage Claim

A computer simulation was used to evaluate the performance of the Airport's domestic baggage claims. Each PAL was simulated to determine the resulting number of passengers waiting at bag claim and the baggage accumulation. Passengers are typically the driver for domestic baggage claim requirements, as most passengers typically arrive at the carousels before the bags arrive. The analysis is predicated on last-bag delivery occurring within 20 minutes of flight arrival. Passengers are metered by the unloading rate of the aircraft and the walking distance from their gate to the claim hall. Table 3-30 lists the required number of domestic bag claim units for each terminal.

Table 3-30: Peak Domestic Baggage Claim Demand by Planning Activity Level

	Peak 10-Minute Demand	Inventory	PAL 1	PAL 2	PAL 3
T1	Flights at Claim	--	17	18	27
	Passengers at Claim	--	377	399	718
	Carousels in Use	11	11	11	11
T2	Flights at Claim	--	7	7	8
	Passengers at Claim	--	135	273	224
	Carousels in Use	**4**	**4**	**4**	**4**

NOTES:
PAL – Planning Activity Level
T1 – Terminal 1; T2 – Terminal 2
SOURCE: Ricondo & Associates, Inc., June 2020.

3.2.3.7 Customs and Border Protection – International Arrivals Facilities

Computer simulation was used to determine the international arrivals facilities and queue areas needed to achieve the LOS standards at each PAL. This included primary inspection, international baggage claim, and the re-check SSCP for international-to-domestic connecting passengers (T1 only). Demand at downstream processes was predicated on passengers being able to complete upstream processes within the prescribed LOS wait times and the last-bag delivery occurring within 20 minutes of flight arrival. The highest 30-minute demand at T1 occurs at PAL 2, which equates to four widebody aircraft in 20 minutes. While there are more international flight arrivals during spring (March/April) at the terminal, the highest peak demand occurs in summer. The summer international demand basis for T2 equates to one narrowbody and one widebody aircraft arriving within 20 minutes.

All simulations assume the CBP Simplified Arrival process, which uses biometric facial recognition technologies. The Simplified Arrival process eliminates the Automated Passport Control (APC) and exit control functions. For new international arrivals facilities, CBP could require facilities to conform to the "bag-first" configuration, as opposed to the current MSP configuration where passengers process through primary inspection prior to bag claim (officer first). Consequently, both the officer-first and bag-first configurations were simulated. **Table 3-31** and **Table 3-32** list the required primary inspection facilities for each terminal.

Table 3-31: T1 Primary Inspection Requirements

T1	Unit	Inventory	Officer First PAL2, PAL3	Bag First PAL2, PAL3
Peak 30-Min Passengers	Passengers	--	1,117	1,117
Global Entry APC Kiosks	Units	8	7	7
CBPO Positions – Global Entry	Booth/Podium	--	1	2
CBPO Positions – Mobile Passport Control	Booth/Podium	--	2	1
CBPO Positions – U.S. Citizens	Booth/Podium	--	11	10
CBPO Positions – Visitors	Booth/Podium	--	7	7
Total CBPO Positions	Booth/Podium	14	21	20
Passengers in Queue	Passengers	Officer First: 445	525	--
		Bag First: 296	--	383
Queue Area	**Square Feet**	**5,750**	**6,772**	**7,430**

NOTES:
Both PAL 2 and PAL have the same requirements
APC – Automated Passport Control; CBPO – Customs and Border Protection Officer
SOURCE: Ricondo & Associates, Inc., June 2020.

Table 3-32: T2 Primary Inspection Requirements

T2	Unit	Inventory	Officer First PAL2, PAL3	Bag First PLA2, PAL3
Peak 30-Min Passengers	Passengers	--	462	462
Global Entry APC Kiosks	Units	4	3	4
CBPO Positions – Global Entry	Booth/Podium	--	1	1
CBPO Positions – Mobile Passport Control	Booth/Podium	--	1	1
CBPO Positions – U.S. Citizens	Booth/Podium	--	4	4
CBPO Positions – Visitors	Booth/Podium	--	3	3
Total CBPO Positions	Booth/Podium	12	9	9
Passengers in Queue	Passengers	Officer First: 381	146	--
		Bag First: 254	--	150
Queue Area	**Square Feet**	**4,920**	**1,883**	**2,910**

NOTES:
Both PAL 2 and PAL have the same requirements
APC – Automated Passport Control; CBPO – Customs and Border Protection Officer
SOURCE: Ricondo & Associates, Inc., June 2020.

3.2.3.8 International Baggage Claim

Computer simulation was used to analyze the adequacy of the existing international baggage claim devices at each terminal. The results from the gap analysis were as follows:

- **Exhibit 3-6** shows the T1 international baggage claim facility can achieve LOS C in the officer-first and bag-first configurations when bags arrive within 20 minutes (both scenarios) and wait time goals are met at primary inspection (officer-first scenario).
- Because of the unique condition at T2 where domestic Bag Claim Devices (BCDs) A and B are partitioned off for international arrivals, domestic and international arrivals were simulated simultaneously to ensure there are no conflicts. The analysis for T2 used the spring schedule to analyze international bag claim since there are more international flights occurring in spring. **Exhibit 3-7** shows the T2 international baggage claim facility can achieve LOS C in the officer-first and bag-first configurations when bags arrive within 20 minutes (both scenarios) and wait time goals are met at primary inspection (officer-first scenario).

3.2.3.9 T1 Transportation Security Administration – Passenger Security Screening Checkpoint 7

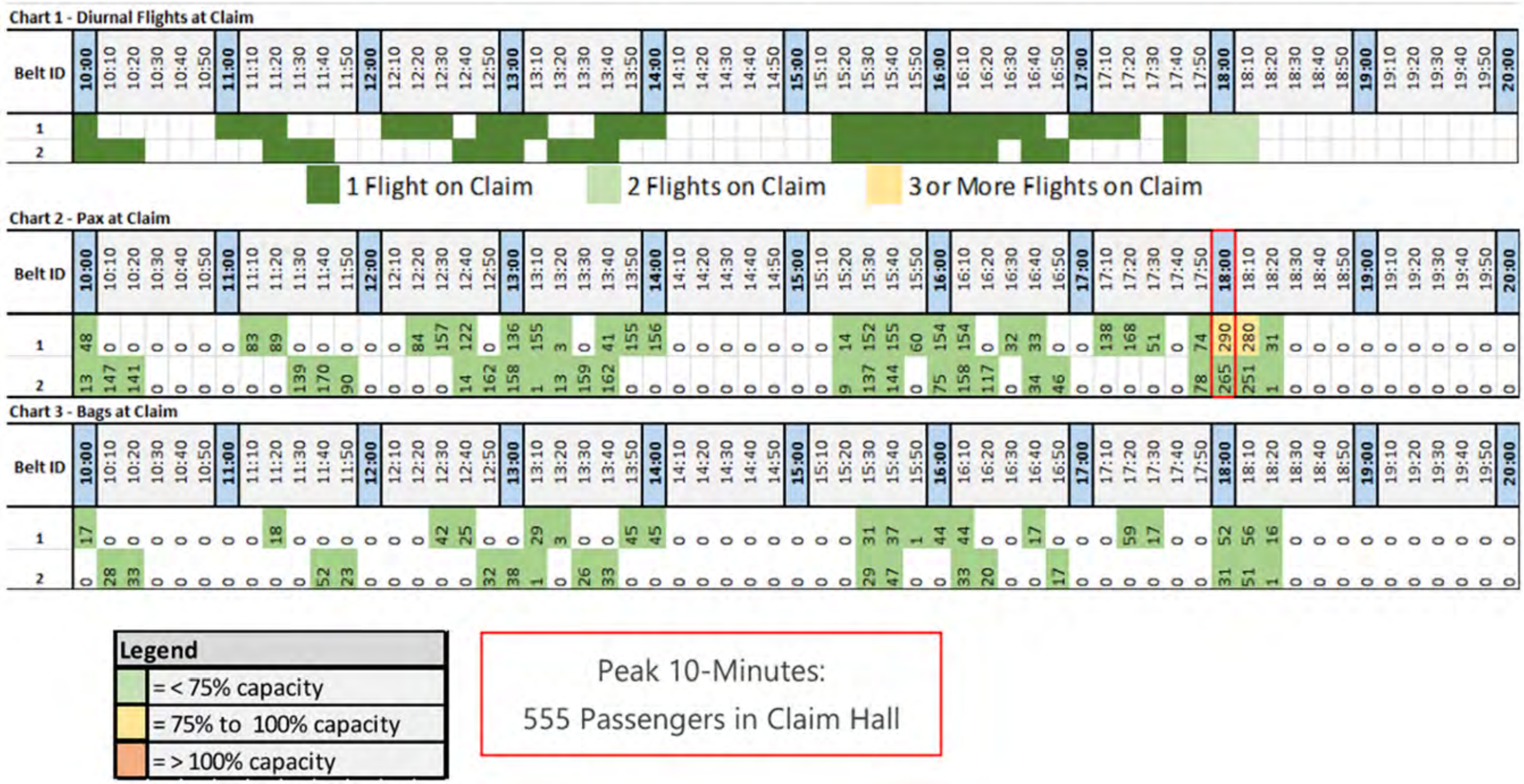
After completing the process at the international arrivals facility, passengers who are connecting to a domestic flight are rescreened at TSA SSCP 7. **Table 3-33** shows that SSCP 7 has a shortfall of up to three screening lanes to process international connecting passengers by PAL 2.

Table 3-33: T1 Passenger Security Screening Checkpoint 7 (International Arrivals)

Scenario	Peak 30 Minute Arriving International Passengers	Number of Screening Lanes	Wait Time (LOS: 10 Minutes)	Passengers in Queue
Base Simulation				
Non-ASL	1,117	3	49:47	381
Requirements Simulations				
Non-ASL	1,117	6	9:56	189
ASL + CTX	1,117	5	9:59	**190**

NOTES:
Queue Capacity: 80 passengers
Numbers in red denote deficiencies in an acceptable level of service.
Existing: 3 non-ASL screening lanes
ASL – Automated Screening Lane; CTX – Computed Tomography X-ray; LOS – Level of Service
SOURCE: Ricondo & Associates, Inc., June 2020.

Exhibit 3-6: T1 International Baggage Claim Performance (Bag First)



NOTE:
Pax – Passengers
SOURCE: Ricondo & Associates, Inc., June 2020.

Exhibit 3-7: T2 International/Domestic Baggage Claim Performance (Bag First)

Chart 1 - Diurnal Flights at Claim

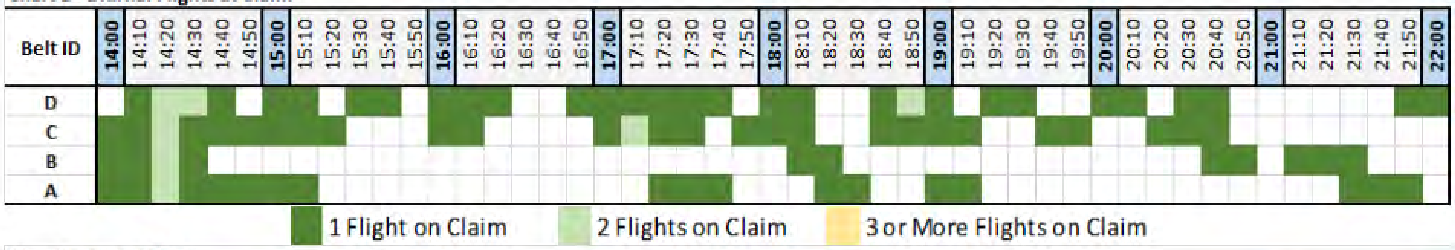


Chart 2 - Pax at Claim

Belt ID	14:00	14:10	14:20	14:30	14:40	14:50	15:00	15:10	15:20	15:30	15:40	15:50	16:00	16:10	16:20	16:30	16:40	16:50	17:00	17:10	17:20	17:30	17:40	17:50	18:00	18:10	18:20	18:30	18:40	18:50	19:00	19:10	19:20	19:30	19:40	19:50	20:00	20:10	20:20	20:30	20:40	20:50	21:00	21:10	21:20	21:30	21:40	21:50	22:00
D	35	15	35	45	39	38	17	43	0	17	41	15	0	41	41	0	0	12	43	29	38	0	33	34	20	49	0	0	13	33	46	28	14	37	0	0	20	41	3	0	36	33	0	0	0	0	0	0	37
C	39	16	22	59	37	34	32	38	37	0	0	0	19	40	0	0	0	0	0	50	51	41	0	0	40	36	0	0	0	38	38	36	36	0	0	40	40	0	0	40	39	0	0	0	0	0	0	0	0
B	40	20	35	44	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	94	0	0	0	0	0	0	0	0	0	0	0	0	0	15	46	4	0	33	42	0	0	0
A	38	31	43	37	36	0	46	56	0	0	0	0	0	0	0	0	0	0	0	0	0	49	61	0	0	0	25	65	36	0	17	54	7	0	0	0	0	0	0	0	0	0	0	0	0	0	38	44	0

Chart 3 - Bags at Claim

Belt ID	14:00	14:10	14:20	14:30	14:40	14:50	15:00	15:10	15:20	15:30	15:40	15:50	16:00	16:10	16:20	16:30	16:40	16:50	17:00	17:10	17:20	17:30	17:40	17:50	18:00	18:10	18:20	18:30	18:40	18:50	19:00	19:10	19:20	19:30	19:40	19:50	20:00	20:10	20:20	20:30	20:40	20:50	21:00	21:10	21:20	21:30	21:40	21:50	22:00
D	16	0	4	8	4	5	0	3	0	0	14	6	0	11	18	0	0	0	22	3	8	0	13	14	0	7	0	0	0	15	2	1	0	9	0	0	0	12	1	0	3	1	0	0	0	0	0	0	12
C	16	0	2	2	1	2	2	10	7	0	0	0	0	9	0	0	0	0	0	12	17	2	0	0	8	13	0	0	0	4	4	8	6	0	0	13	13	0	0	7	12	0	0	0	0	0	0	0	0
B	6	0	2	14	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	61	0	0	43	94	0	0	0	17	54	7	0	0	0	0	0	0	0	0	14	1	0	33	42	0	0	0
A	2	1	2	2	8	0	46	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	65	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	44	0

Legend
= < 75% capacity
= 75% to 100% capacity
= > 100% capacity

International Legend
= < 75% capacity
= 75% to 100% capacity
= > 100% capacity

Peak 10-Minutes:

119 International Passengers in Claim Hall

NOTE:
Pax – Passengers
SOURCE: Ricondo & Associates, Inc., June 2020.

3.3 AIRFIELD

This section describes the airside facility requirements needed at MSP to accommodate the current and forecasted demand through the 2040 LTP horizon. This section evaluates the required dimensional standards of various airside geometric elements against existing conditions, as noted in the inventory. Airfield capacity and incident/incursion histories are also discussed.

This analysis evaluated the following existing and future airside facility requirements:

- Airport Reference Code (ARC) / Critical Design Aircraft
- Runway Geometric Standards
  - Runway width
  - Runway Safety Area (RSA)
  - Runway Object-Free Area (ROFA)
  - Obstacle-Free Zone (OFZ)
  - Runway Protection Zone (RPZ)
  - Parallel runway separation
  - Runway to hold line separation
  - Runway to taxiway separation
- Taxiway Geometric Standards
  - Taxiway Design Group (TDG)
  - Taxiway width and shoulder width
  - Taxiway separation
  - Taxiway Safety Area (TSA)
  - Taxiway Edge Safety Margin (TESM)
  - Taxiway/Taxilane Object-Free Area (TOFA/TLOFA)
- Navigational Aid (NAVAID) Critical Areas
- Airfield Capacity
  - Runway length requirements
  - Takeoff length requirements
- Hot Spots, Incursion History, and Contributing Factors

3.3.1 Airport Reference Code (ARC) / Critical Design Aircraft

The Airport Reference Code (ARC) is an overall airport designation that relates airport design criteria to the operational and physical characteristics of the largest/most demanding aircraft type(s) that will operate at the airport. The ARC is made up of two components related to the critical design aircraft – which the FAA defines as the most demanding aircraft with greater than 500 annual operations.

The first component is related to the Aircraft Approach Category (AAC), represented by a letter A through E. The second component is the Airplane Design Group (ADG), represented by a roman numeral I through VI.

The existing critical design aircraft at MSP is the Airbus A330-900NEO, an ARC D-V aircraft. The future critical design aircraft has been identified as the Airbus A350-1000. The A350-1000 is the most demanding aircraft with forecast operations greater than 500 per year. This is based on the PAL 3 summer DDFS, which includes 24 operations for the A350-1000 in the design day. The

A350-1000 is an AAC D and ADG V aircraft, which aligns with the existing airfield's D-V designation. The A330-900NEO is TDG 5, while the A350-1000 is TDG 6. Consideration should be given to future taxiway/taxilane design to accommodate this change in TDG standard. **Table 3-34** summarizes the existing and future critical design aircraft specifications.

Table 3-34: Critical Design Aircraft Specifications

Aircraft	TDG	Wingspan	Tail Height
Airbus A330-900NEO	5	209.97 FT	**55.09 FT**
Airbus A350-1000	**6**	**212.42 FT**	**56.10 FT**

NOTE:
TDG – Taxiway Design Group
SOURCES: Manufacturer Data; U.S. Department of Transportation, FAA, Aircraft Characteristics Database, November 2022.

The AAC and ADG of an airport's critical design aircraft, when combined with a runway's approach visibility minimums, determines the Runway Design Code (RDC). The RDC establishes the minimum design standards for a particular runway and parallel taxiway, allowing safe operations for the critical design aircraft under specified weather conditions. The RDC is used for planning and design purposes and does not have any operational application. The Approach Reference Code (APRC) and Departure Reference Code (DPRC), as defined in **Chapter 1**, are operational designations for runways, specifically for runway-to-taxiway separations. A review of the APRC and DPRC standards was completed as a part of the LTP efforts. **Table 3-35** represents the existing and future RDC, APRC, and DPRC of each runway at MSP. Note the future change in critical design aircraft does not change any of these three standards. Since the APRC is dependent on a runway's lowest visibility minimums, different separation standards can apply depending on the runway configuration in use. **Section 3.3.2.9** reviews the runway-to-taxiway separations at MSP and discusses any substandard separations.

Table 3-35: Existing and Future RDC, APRC, and DPRC

Runway	RDC	APRC	DPRC
4	D-V	D/IV/2400 D/V/2400	D/IV, D/V
22	D-V	D/IV/4000 D/V/4000	D/IV, D/V
12L	D-V	D/IV/1200	D/IV, D/V
30R	D-V	D/IV/4000 D/V/4000	D/IV, D/V
12R	D-V	D/IV/1200	D/IV, D/V
30L	D-V	D/IV/1200	D/IV, D/V
17	D-V	D/IV/4000 D/V/4000	D/IV, D/V
35	D-V	D/IV/1200	D/IV, D/V

NOTES:
AAC – Aircraft Approach Category; ADG – Airplane Design Group; APRC – Approach Reference Code; DPRC – Departure Reference Code
SOURCE: HNTB Corporation, November 2022 (analysis).

3.3.2 Runway Geometric Standards

To maintain a safe airfield environment for aircraft to operate, the FAA has established safety and design standards for runways, taxiways, NAVAIDs, and adjacent land surrounding the runway system, as described in FAA Advisory Circular (AC) 150/5300-13B, *Airport Design*. This section describes the various design standards applicable to the Airport's airfield and areas of non-compliance with these standards (gaps). **Exhibit 3-10** graphically summarizes the deficiencies related to the airfield dimensional standards. **Section 3.3** and **Section 3.4** provide granular details regarding the required airfield standards and any deficiencies, with references to **Exhibit 3-10**, as applicable.

3.3.2.1 Runway Width

The required runway pavement width is dependent on the RDC and AAC-ADG combination for a given runway. All four runways at MSP will remain D-V runways with varying visibility minimums. Although visibility minimums are applicable to runway width in some cases, they do not apply to D-V runways. All D-V runways require 150-foot-wide runways, regardless of approach minimums. **Table 3-36** lists the required runway widths for each runway. All runways at MSP meet or exceed the required runway width for D-V.

Table 3-36: Runway Dimensions

Runway	4-22	12L-30R	12R-30L	17-35
Existing Width	150 FT	150 FT	200 FT	150 FT
Required Width	150 FT	150 FT	150 FT	150 FT
Deficiency	0	0	0	0

SOURCE: HNTB Corporation, November 2022 (analysis).

3.3.2.2 Declared Distances

As discussed in Section 1.4.2, declared distances effectively reduce the amount of runway available for takeoff, aborted takeoffs, and landings, so that adequate space exists for RSAs and ROFAs to mitigate unsuitable land use in the RPZ, or mitigate obstacles in the approach or departure path of an aircraft. **Table 3-37** presents the declared distances at MSP.

Table 3-37: Declared Distances

	Length	TORA	TODA	ASDA	LDA
Runway 4	11,006 FT	11,006 FT	11,006 FT	11,006 FT	9,456 FT
Runway 22	11,006 FT	11,006 FT	11,006 FT	11,006 FT	10,006 FT
Runway 12R	10,000 FT	10,000 FT	10,000 FT	10,000 FT	10,000 FT
Runway 30L	10,000 FT	10,000 FT	10,000 FT	10,000 FT	10,000 FT
Runway 12L	8,200 FT	8,200 FT	8,200 FT	7,620 FT	7,620 FT
Runway 30R	8,200 FT	8,200 FT	8,200 FT	8,200 FT	8,000 FT
Runway 17	8,000 FT	8,000 FT	8,000 FT	8,000 FT	8,000 FT
Runway 35	8,000 FT	8,000 FT	8,000 FT	8,000 FT	8,000 FT

NOTES:
TORA – Takeoff Run Available; TODA – Takeoff Distance Available; ASDA – Accelerate-Stop Distance Available; LDA – Landing Distance Available
SOURCE: HNTB Corporation, November 2022 (analysis).

3.3.2.3 Runway Safety Area

The RSA is a rectangular area surrounding the runway at the runway surface. Its purpose is to reduce the risk of damage to an aircraft in the event of an undershoot, overshoot, or excursion from the runway, as well as to provide adequate emergency vehicle access in such events. The RSA must be kept clear of objects, except for those identified as “fixed-by-function,” such as runway and taxiway lights and signage, Precision Approach Path Indicators (PAPIs), or Approach Lighting Systems (ALSs). A review of existing RSA conformity was completed for each runway at

MSP. The RSA beyond the Runway 12L departure end (i.e., prior to the Runway 30R threshold) measures 420 feet beyond the departure end instead of the standard 1,000 feet. The RSA is constrained on this end of the runway by the Minnesota State Highway 5 off-ramp to the terminal access road. The RSA beyond the Runway 12R departure end (i.e., prior to the Runway 30L threshold) measures 830 feet beyond the departure end instead of the standard 1,000 feet. The RSA is constrained on this end of the runway by Northwest Drive and Route 5. **Table 3-38** summarizes the RSA non-conformities at MSP.

Table 3-38: Runway Safety Area Non-Conformities

RSA (Runway and Location)	Length to Standard	Object/Rationale	Existing Mitigation
Runway 12L departure end	580 FT	MN-5 off-ramp to the terminal access road	Declared distances
Runway 12R departure end	190 FT	Northwest Drive and MN-5	EMAS
Runway 30R approach end	200 FT	MN-5 off-ramp to the terminal access road	Displaced threshold

NOTES:
RSA – Runway Safety Area; MN – Minnesota; EMAS – Engineered Material Arresting System
SOURCE: HNTB Corporation, November 2022 (analysis).

The Runway 12L departure end RSA non-conformity is mitigated through declared distances. The non-conformity for the 30R approach is mitigated by a displaced threshold of 200 feet. The Runway 12R departure end RSA non-conformity is currently mitigated by an engineered material arresting system (EMAS) bed located beyond the Runway 12R departure end. At MSP, there are no objects identified within the RSAs that are not fixed-by-function. Standard RSA dimensions, including the standard RSA dimensions related to the use of declared distances, are dependent on a runway's RDC. These dimensions are noted in **Table 3-39.**

Table 3-39: Standard Runway Safety Area Dimensions

	RDC	RSA Length Prior to Runway Threshold	RSA Length Beyond Runway End	Width	Existing RSA Length Beyond Stop End
Runway 4	D-V-2400	600 FT	1,000 FT	500 FT	1,000 FT
Runway 22	D-V-4000	600 FT	1,000 FT	500 FT	1,000 FT
Runway 12L	D-V-700	600 FT	1,000 FT	500 FT	420 FT [1]
Runway 30R	D-V-4000	600 FT	1,000 FT	500 FT	1,000 FT
Runway 12R	D-V-600	600 FT	1,000 FT	500 FT	830 FT [2]
Runway 30L	D-V-1000	600 FT	1,000 FT	500 FT	1,000 FT
Runway 17	D-V-5500	600 FT	1,000 FT	500 FT	1,000 FT
Runway 35	D-V-600	600 FT	1,000 FT	500 FT	1,000 FT

NOTES:
RDC – Runway Design Code; RSA – Runway Safety Area
1 Declared distances (accelerate-stop distance available) are used to achieve the standard RSA length.
2 An engineered material arresting system (EMAS) bed is installed approximately 630 feet from the Runway 30L threshold.
SOURCE: HNTB Corporation, November 2022 (analysis).

3.3.2.4 Runway Object-Free Area

The ROFA is a rectangular area surrounding the runway and centered on the surface of the runway. Its purpose is to enhance the safety of aircraft by providing wingtip protection in the event of an aircraft excursion. ROFA standards are to be clear of all objects protruding above the elevation of the nearest point of the RSA, except for objects required to be within the ROFA due to their function (fixed-by-function). This includes the ground within the ROFA, which must be adequately graded so the ground does not protrude the RSA elevation.

Table 3-40 shows where there are deficiencies in standard ROFAs at MSP.

Table 3-40: Runway Object-Free Area Deficiencies

Exhibit 3-10 Index Number	ROFA	Deficiency [1]	Object
1	RWY 4-22 at RWY 12	150 FT	Wind Cone
2	RWY 4-22 at TAXIWAY M2	145 FT	ASOS
3	RWY 4-22 at TAXIWAY C / C1	150 FT	Wind Cone
4	RWY 4-22 at TAXIWAY L	100 FT	Pole
5	RWY 12L-30R at TAXIWAY M	150 FT	Wind Cone
6	RWY 12L-30R at TAXIWAY M	3 FT	Glideslope Shelter
7	RWY 12L-30R at RWY 30R End	150 FT	Wind Cone
8	RWY 12R-30L at TAXIWAY A9	150 FT	Wind Cone
9	RWY 12R-30L at TAXIWAY W2	7 FT	Glideslope Shelter
10	RWY 12R-30L at TAXIWAY A2	150 FT	Wind Cone
11	RWY 17 Approach	50 FT (to ROFA end)	Glideslope Shelter and Antenna
12	RWY 17-35 at TAXIWAY K8	150 FT	Wind Cone
13	RWY 17-35 at TAXIWAY K8	150 FT	ASOS
14	RWY 17-35 (south of TAXIWAY L3)	150 FT	Wind Cone
15	RWY 17-35 (south of TAXIWAY L3)	1 FT	Glideslope Shelter
16	RWY 35 Approach	60 FT	VSR
17	RWY 35 Approach	70 FT – 100 FT	ALSF-2 and 17 Localizer Shelter
18	RWY 35 Approach	70 FT – 100 FT	Various Poles

NOTES:
Exhibit Index Number refers to number labels in Exhibit 3-10
ROFA – Runway Object-Free Area; ASOS – Automated Surface Observing System; VSR – Vehicle Service Road; ALSF-2 – High-Intensity Approach Lighting System with Sequenced Flashing Lights
1 Deficiency signifies the distance from the object to the edge of the ROFA.
SOURCE: HNTB Corporation, November 2022 (analysis).

Like RSAs, standard ROFA dimensions are dependent on the RDC. **Table 3-41** presents the standard ROFA dimensions of the Airport's runways, which are based on existing declared distances.

Table 3-41: Standard Runway Object-Free Area Dimensions

	RDC	ROFA Length Prior to Runway Threshold	ROFA Length Beyond Runway End	Width	Existing ROFA Length Beyond Stop End
Runway 4	D-V-2400	600 FT	1,000 FT	800 FT	1,000 FT
Runway 22	D-V-4000	600 FT	1,000 FT	800 FT	1,000 FT
Runway 12L	D-V-700	600 FT	1,000 FT	800 FT	420 FT [1]
Runway 30R	D-V-4000	600 FT	1,000 FT	800 FT	1,000 FT
Runway 12R	D-V-600	600 FT	1,000 FT	800 FT	830 FT [2]
Runway 30L	D-V-1000	600 FT	1,000 FT	800 FT	1,000 FT
Runway 17	D-V-5500	600 FT	1,000 FT	800 FT	1,000 FT
Runway 35	D-V-600	600 FT	1,000 FT	800 FT	1,000 FT

NOTES:
RDC – Runway Design Code; ROFA – Runway Object-Free Area
1 Declared distances (accelerates-stop distance available) are used to achieve the standard ROFA length.
2 An engineered material arresting system (EMAS) bed is installed approximately 630 feet from the runway threshold.
SOURCE: HNTB Corporation, November 2022 (analysis).

3.3.2.5 Obstacle-Free Zone

The OFZ includes volumes of airspace comprising the runway OFZ (ROFZ), precision OFZ (POFZ), inner-approach OFZ (IA-OFZ), and inner-transitional OFZ (IT-OFZ). These surfaces do not allow for any object penetration or stationary aircraft, except for frangible NAVAIDs that are fixed-by-function.

Runway Obstacle-Free Zone

Per FAA AC 150/5300-13B, *Airport Design*, the standard ROFZ width for large aircraft is 400 feet and extends 200 feet beyond each runway end. All runways at MSP accommodate large aircraft. There are no objects identified within the ROFZs that are not fixed-by-function. **Table 3-42** presents the ROFZ dimensions at MSP.

Table 3-42: Standard Runway Obstacle-Free Zone Dimensions for Runways with Operations by Large Aircraft

	ROFZ Width	ROFZ Length
Runway 4-22	400 FT	11,406 FT
Runway 12L-30R	400 FT	8,600 FT
Runway 12R-30L	400 FT	10,400 FT
Runway 17-35	400 FT	8,400 FT

NOTE:
ROFZ – Runway Obstacle-Free Zone
SOURCE: HNTB Corporation, November 2022 (analysis).

Runway Precision Obstacle-Free Zone

The POFZ is a volume of airspace above an area beginning at the threshold elevation, with a width of 800 feet and extending 200 feet beyond the runway end. The POFZ only applies to runways with a vertically guided approach with landing minimums less than 250 feet above ground level (AGL), or visibility less than 0.75 statute miles, which includes Runways 4, 12L, 12R, 30L, and 35. The POFZ is only in effect when an aircraft is on final approach within 2 miles of the threshold. There are no objects identified at MSP within the POFZs that are not fixed-by-function.

Inner-Approach Obstacle-Free Zone

The IA-OFZ is only applicable to runways with an ALS, which includes all runways at MSP except Runway 17. The IA-OFZ begins 200 feet prior to the runway threshold at the same elevation, extending 200 feet beyond the last fixture in the ALS before rising at a slope of 50 to 1. No structures were identified that penetrate the sloped IA-OFZ surfaces. The runway hold bar locations were analyzed to ensure no portion of aircraft holding at a runway would penetrate the IA-OFZ, including the tail of the critical design aircraft (A330-900NEO with 55-foot tail height). There are no holding locations at MSP where parked aircraft tails penetrate the IA-OFZ.

Inner-Transitional Obstacle-Free Zone

The IT-OFZ is only applicable to runways with approach visibility minimums lower than 0.75 statute miles. The IT-OFZ extends perpendicular to the runway centerline from the edge of the ROFZ, starting at a formula-based elevation above the runway centerline elevation, dependent on critical design aircraft characteristics and sloping upward at a ratio of 6 to 1 until reaching the Code of Federal Regulations (CFR) Part 77 horizontal surface, which is 150 feet above the established Airport elevation. As with the IA-OFZ, no structures or aircraft positioned at runway hold bar locations were identified to penetrate the IT-OFZ surfaces. The 55-foot tail height and 210-foot wingspan of the A330-900NEO was used for this analysis.

3.3.2.6 Runway Protection Zone

The RPZ is a trapezoidal area at ground elevation prior to a runway landing threshold and beyond a runway departure end, centered on the runway centerline. In contrast to the RSA and ROFA, the purpose of the RPZ is to protect people and property on the ground at the runway ends in the event of an aircraft overshoot or undershoot.

There are two components of the RPZ: the approach RPZ and the departure RPZ. **Table 3-43** shows the approach and departure RPZ dimensions at MSP.

Table 3-43: Standard Runway Protection Zone Dimensions

	Length	Inner Width	Outer Width
Runway 4 Approach	2,500 FT	1,000 FT	1,750 FT
Runway 22 Approach	1,700 FT	1,000 FT	1,510 FT
Runway 12L Approach	2,500 FT	1,000 FT	1,750 FT
Runway 30R Approach	1,700 FT	1,000 FT	1,510 FT
Runway 12R Approach	2,500 FT	1,000 FT	1,750 FT
Runway 30L Approach	2,500 FT	1,000 FT	1,750 FT
Runway 17 Approach	1,700 FT	500 FT	1,010 FT
Runway 35 Approach	2,500 FT	1,000 FT	1,750 FT
Runway 4 Departure	1,700 FT	500 FT	1,010 FT
Runway 22 Departure	1,700 FT	500 FT	1,010 FT
Runway 12L Departure	1,700 FT	500 FT	1,010 FT
Runway 30R Departure	1,700 FT	500 FT	1,010 FT
Runway 12R Departure	1,700 FT	500 FT	1,010 FT
Runway 30L Departure	1,700 FT	500 FT	1,010 FT
Runway 17 Departure	1,700 FT	500 FT	1,010 FT
Runway 35 Departure	1,700 FT	500 FT	1,010 FT

SOURCE: HNTB Corporation, November 2022 (analysis).

The approach RPZ begins at a point 200 feet from the runway threshold. The departure RPZ begins 200 feet beyond the runway, unless declared distances are used. If the end of the takeoff run available (TORA) is not in the same location as the runway end, the departure RPZ begins 200 feet beyond the end of the TORA. The TORA of all runways at MSP equals the runway lengths; therefore, all departure RPZs begin 200 feet beyond the end of the runways.

The FAA memorandum *Interim Guidance on Land Uses Within a Runway Protection Zone* (September 27, 2012), found in Appendix I of FAA AC 150/5300-13B, *Airport Design* (March 31, 2022), establishes guidance for airport sponsors on introducing new incompatible land uses and activities within the RPZ:

- Buildings and structures
- Recreational land use
- Transportation facilities (i.e., railroads, public roads, vehicular parking)
- Fuel storage facilities
- Hazardous material storage
- Wastewater treatment facilities
- Above-ground utility installation (including any type of solar panel installations)

Based on this list of non-compatible uses, the RPZs at MSP were evaluated for potential incompatible land uses; the results are shown in **Table 3-44**.

Table 3-44: Runway Protection Zone Incompatible Land Uses

Exhibit 3-10 Index Number	RPZ	Incompatible Land Uses
36	RWY 4 Approach RPZ	Fuel Station, Portion of Sun Country Airlines Apron
37	RWY 22 Approach RPZ	Army Reserve Parking/Apron, Military Highway, Private Parcels
38	RWY 12L Approach RPZ	Route 62, E 58th St.; Bossen Field Park, S 31st St.
39	RWY 30R Approach RPZ	Minnesota State Highway 5, Snelling Lake
	RWY 12R Approach RPZ	None
40	RWY 30L Approach RPZ	Minnesota State Highway 5, Minnesota River, State Park Building
	RWY 17 Approach RPZ	None
41	RWY 35 Approach RPZ	Airport Lane, Interstate 494, 24th Ave., American Blvd., Portion of Fairfield Inn Parcel, Airport Lane
42	RWY 4 Departure RPZ	Army Reserve Parking Lots
	RWY 22 Departure RPZ	None
43	RWY 12L Departure RPZ	Minnesota State Highway 5, Snelling Lake
44	RWY 12R Departure RPZ	Minnesota State Highway 5, Snelling Lake Road
	RWY 30L Departure RPZ	None
45	RWY 17 Departure RPZ	Interstate 494, Airport Lane
46	RWY 4 Approach RPZ	Airport Fuel Station, Portion of Sun Country Airlines Apron

NOTES:
Exhibit Index Number refers to number labels in Exhibit 3-10
RPZ – Runway Protection Zone
SOURCE: HNTB Corporation, November 2022 (analysis).

Although the non-compatible land uses are within the RPZs, no mitigation is proposed as part of the LTP. The non-compatible land uses may remain unless new, non-aeronautical developments are proposed within the RPZ, runway minimums change, or there is a change to runway end points.

3.3.2.7 Parallel Runway Separation

Multiple runways that have parallel separation can greatly increase airfield capacity compared to single runway layouts. Depending on the type of aircraft operations (visual flight rules [VFR] versus instrument flight rules [IFR]) and the lateral separation between parallel runways, varying degrees of aircraft separation and dependencies can be achieved and greatly increase airfield capacity, particularly in instrument meteorological conditions at large airports with air carrier hub operations.

The standard for parallel runway separation for runways accommodating dual simultaneous straight-in instrument approaches is 3,200 feet. However, for parallel separations less than 3,600 feet, such as at MSP, additional ATC requirements need to be considered, including dependencies of the simultaneous approaches, radar separations, radar capabilities, and aircraft equipment. For these reasons, simultaneous approaches are not conducted at MSP. For IFR departures or mixed operations, the standard separation is at least 2,500 feet. At MSP, the lateral distance between parallel runways is 3,380 feet, which exceeds the standards for arrivals and departures. No deficiencies were noted at the airport.

3.3.2.8 Hold Lines

Hold lines prevent aircraft from entering protected areas of a runway or navigational surface and are also used to control aircraft traffic at taxiway intersections. There are three patterns of hold lines: Pattern A, Pattern B, and Pattern C.

Pattern A

Pattern A hold lines are characterized by two solid lines adjacent to two dashed lines. Pattern A hold lines are commonly referred to as runway hold lines and are used to instruct aircraft to stop prior to entering or crossing a runway while taxiing on a taxiway or intersecting runway, or in land and hold short operations (LAHSO), which are used to instruct an aircraft to stop prior to crossing an intersecting runway or taxiway after landing (such as on Runway 30L at Taxiway A8 / W8 and on Runway 22 at Taxiway S). Pattern A locations for LAHSO are dependent on local air traffic procedures and the design criteria of the intersecting runway or taxiway. Pattern A locations for all other use are based on the critical design aircraft and adjustments based on the elevation of the Airport above sea level.

Runways 4, 12L, 12R, 30L, and 35 have an RDC of D-V with visibility minimums lower than 3/4 mile. The standard Pattern A hold position for these runways is 288 feet from the runway centerline, which is determined by a minimum of 280 feet from the runway centerline plus 1 additional foot for every 100 feet of the Airport's elevation above sea level. Runways 22, 30R, and 17 have an RDC of D-V with visibility minimums not lower than 3/4 mile. The standard Pattern A hold position for these runways is 258 feet from the runway centerline, which is determined by a minimum of 250 feet from the runway centerline plus 1 additional foot for every 100 feet of the Airport's elevation above sea level.

Table 3-45 summarizes the Airport's existing Pattern A runway hold line separation deficiencies.

Table 3-45: Pattern A Runway Hold Line Separation

Exhibit 3-10 Index Number	Runway	Associated Taxiway/Runway	Standard Separation[1]	Separation Deficiency
19	RWY 4-22	P (west)	288 FT	7 FT
19		A (west)		5 FT
19		H (east)		2 FT
19		RWY 12R		5 FT
21	RWY 12R-30L	M (south)	288 FT	2 FT
21		RWY 4		2 FT
21		RWY 22		2 FT
21		A4		1 FT
20	RWY 12L-30R	G (north)	288 FT	7 FT
20		P4 (east)		1 FT

NOTE:
Exhibit Index Number refers to number labels in Exhibit 3-10
1 The standard separation increased to account for airport elevation per the FAA, AC 150/5300 13B, Table G-11, Footnote 8.
SOURCE: HNTB Corporation, November 2022 (analysis).

The LTP does not propose immediate mitigation to address Pattern A deficiencies. The locations of the runway hold lines represent an existing condition with no known aircraft conflicts or incursions resulting from their locations. The next time the applicable taxiway is reconstructed, the locations of the runway hold lines should be reviewed and adjustments should be made.

Pattern B

Pattern B hold lines are characterized by two transverse solid markings with short solid lines connecting the two transverse lines, creating a ladder effect. Pattern B hold lines are used to instruct aircraft to stop and hold short before entering a protected area of the Instrument Landing System (ILS) or the POFZ. **Table 3-46** lists the locations of the Pattern B markings. No deficiencies of Pattern B hold line locations were identified.

Table 3-46: Pattern B Hold Line Locations

Location	Feature
Taxiway W / Taxiway W9 / Taxiway W10 / Taxiway Y	Runway 12R Glideslope
Taxiway W / Taxiway W2	Runway 30L Glideslope
Taxiway R / USAF Apron	Runway 12L Glideslope

NOTE:
USAF – U.S. Air Force
SOURCE: HNTB Corporation, November 2022 (analysis).

Pattern C

Pattern C markings are characterized by transverse dashed lines and are commonly referred to as intermediate hold lines. Pattern C markings are used at taxiway/taxiway intersections or other locations as needed for operational purposes on taxiways to hold aircraft while taxiing. **Table 3-47** lists the locations of Pattern C markings at MSP. Locations near taxiway/taxiway intersections were reviewed while considering the designations of the intersecting taxiways. Deficiencies are noted in the table.

Table 3-47: Pattern C Hold Line Analysis

Taxiway	Location	Deficiency
Taxiway L	North of Taxiway N	0
Taxiway L	South of Taxiway L9	0
Taxiway K	South of Taxiway Y	0[1]
Taxiway S	East of Taxiway K	0
Taxiway Y	West of Taxiway T	22 FT
Taxiway Y	South of Taxiway W	0
Taxiway W	East of Taxiway Y	50 FT[2]
Taxiway C	East of Taxiway C1	25 FT
Taxiway M	East of Taxiway M2	0
Taxiway C	South of Taxiway W	0
Taxiway M	South of Taxiway W	0
Taxiway W	West of Taxiway C	0
Taxiway W	West of Taxiway W7	0
Taxiway W	West of Taxiway W6	0
Taxiway W	West of Taxiway W3	0
Taxiway A	East of Taxiway A4	0
Taxiway A	West of Taxiway A4	0
Taxiway B (2)	North of Taxiway A	0
Taxiway A	East of Taxiway A7	0
Taxiway A	West of Taxiway A7	0
Taxiway B	West of Tunnel	0
Taxiway A	West of Taxiway M	0
Taxiway D	North of Taxiway B	0
Taxiway M	North of Taxiway B	0
Taxiway D	North of Taxiway C6	0
Taxiway M	North of Taxiway C6	26 FT
Taxiway P	West of Taxiway G	0
Taxiway P	West of Taxiway P4	0
Taxiway Q	West of Concourse Taxilane	0
Taxiway P	East of Taxiway P3	0

NOTES:
ADG – Airplane Design Group
1 This was reviewed per the western de-ice position that accommodates a B757-300W (ADG IV).
2 This was reviewed per the ADG V taxiing on Taxiway Y. The spacing is 31 feet deficient for ADV IV.
SOURCE: HNTB Corporation, November 2022 (analysis).

The LTP does not propose immediate mitigation to address the Pattern C deficiencies, as they represent an existing condition with no known aircraft conflicts resulting from the location of the hold lines. The next time the applicable taxiway is reconstructed, the locations of the intermediate hold lines should be reviewed, and adjustments should be made.

Movement Area Boundary Line

The movement area boundary line is characterized by a single solid line adjacent to a dashed line. The movement area boundary line is used to delineate portions of the airfield that are under control by the Airport Traffic Control Tower (ATCT). Movement area boundary lines are present along apron areas adjacent to taxiways, surrounding deice pads, and on Taxiways C and S north of the Humphrey Remote Apron, identified as Apron G in Chapter 1. Along aprons and deice pads, the movement area boundary line coincides with the TOFA of the adjacent taxiway. There are no deficiencies noted regarding the locations of movement area boundary lines at MSP.

3.3.2.9 Runway-to-Taxiway Separation

Runway-to-taxiway separation is the distance between a runway centerline and the centerline of a parallel taxiway. Standard separations are set to ensure simultaneous runway and taxiway traffic can operate safely with negligible risk of wingtip clipping.

As introduced in **Section 3.1.1**, standard runway-to-taxiway separations are dependent on a runway's RDC and APRC. The APRC is dependent on the visibility minimums of the runway and sets separation standards as it relates to operating conditions without restrictions. This means that different separation standards can apply based on the type of aircraft on approach and the weather conditions at the time of the approach. **Table 3-48** presents the required runway-to-taxiway separations at MSP.

Table 3-48: Runway-to-Taxiway Separation

Runway	AAC-ADG	APRC	DPRC	Parallel Taxiway	Visibility Minimums	Standard	Deficiency
4	D-V	D/IV/2400 D/V/2400	D/IV, D/V	Taxiway C Taxiway M	Lower than 3/4 mile but not lower than 1/2 mile	400 FT	0 FT
22	D-V	D/IV/4000 D/V/4000	D/IV, D/V	Taxiway C Taxiway M	Lower than 1 mile but not lower than 3/4 mile	400 FT	0 FT
12L	D-V	D/IV/1200	D/IV, D/V	Taxiway P Taxiway R	Lower than 1/4 mile	500 FT	100 FT[1]
30R	D-V	D/IV/4000 D/V/4000	D/IV, D/V	Taxiway P Taxiway R	Lower than 1 mile but not lower than 3/4 mile	400 FT	0 FT
12R	D-V	D/IV/1200	D/IV, D/V	Taxiway A Taxiway W	Lower than 1/4 mile	500 FT	100 FT[1]
30L	D-V	D/IV/1200	D/IV, D/V	Taxiway A Taxiway W	Lower than 1/4 mile	500 FT	100 FT[1]
17	D-V	D/IV/4000 D/V/4000	D/IV, D/V	Taxiway K Taxiway L	Not lower than 1 mile	400 FT	0 FT
35	D-V	D/IV/1200	D/IV, D/V	Taxiway K Taxiway L	Lower than 3/4 mile	500 FT	100 FT[1]

NOTES:
AAC – Aircraft Approach Category; ADG – Airplane Design Group; APRC – Approach Reference Code; DPRC – Departure Reference Code
1 The runway-to-taxiway separation meets the standards except when it is less than Category I visibility minimums with ADG V aircraft on the approach.
SOURCE: HNTB Corporation, November 2022 (analysis).

All runways at MSP have parallel taxiways with centerlines that are at least 400 feet from the runway centerlines, which meets basic FAA AC 150/5300-13B separation criteria based on the RDC. With respect to APRC, as noted in **Table 3-48**, during conditions of visibility lower than 0.5 miles while a D-V aircraft is on approach to the specified runway, the runway-to-taxiway separation is deficient by 100 feet. When those two criteria are in effect, operational restrictions are placed on taxiways by the local ATCT. The LTP does not propose to increase any runway-to-taxiway separations since the existing deficiencies are operationally mitigated when necessary.

3.3.3 Runway Length Requirements

An airport's runway(s) should be long enough to accommodate arrivals and departures for the critical design aircraft. Runway length requirements for MSP were analyzed according to the guidance contained in FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. The AC describes three methods for determining runway length requirements based on the weight of aircraft expected to use the runway. The three categories are as follows:

- Aircraft with a maximum takeoff weight (MTOW) of 12,500 pounds or less
- Aircraft within an MTOW greater than 12,500 pounds up to and including 60,000 pounds
- Regional jets and aircraft with an MTOW greater than 60,000 pounds

MSP routinely has high volumes of operations by aircraft with an MTOW greater than 60,000 pounds. Therefore, the third methodology was used for determining the required runway length at MSP.

The fleet mix used for the TESM analysis described in **Section 3.4.5** was used in reviewing runway length requirements, which represents the 10 most demanding aircraft expected to operate at MSP. All aircraft in the selected fleet mix have an MTOW greater than 60,000 pounds. Per Chapter 4 of FAA AC 150/5300-13B, the approach identified for aircraft with an MTOW greater than 60,000 pounds requires reviewing the aircraft manufacturers' aircraft performance manuals to determine the optimal runway length requirements based on how the aircraft operates at the Airport. **Table 3-49** shows the fleet mix analyzed.

Table 3-49: Runway Length Fleet Mix

Aircraft	MTOW[1]
A350-900	590,839 LBS
MD-11	602,500 LBS
B747-400ER	910,000 LBS
B747-800	978,000 LBS
B787-10	560,000 LBS
B777F	766,800 LBS
A330-900	533,519 LBS
B767-300	350,000 LBS
B757-300	270,000 LBS
B737-900	174,200 LBS

NOTES:
MTOW – Maximum Takeoff Weight; LBS – Pounds
1 MTOW varies by the specific aircraft configuration and type of engines. The MTOWs shown are from aircraft performance manuals; they represent the MTOW used in the runway length analysis calculations.
SOURCE: HNTB Corporation, November 2022 (analysis).

Runway length requirements are dependent on several variables, including aircraft type and flap settings, MTOW, runway elevation, runway gradient, and weather conditions (surface condition, air temperature, and wind). **Table 3-50** and **Table 3-51** present the general Airport and runway characteristics affecting runway length requirements.

Table 3-50: Airport Meteorological Characteristics

Characteristic	Value
Elevation (Feet)	841.8
Mean Maximum Temperature Hottest Month (℉)	85 (July)

SOURCE: HNTB Corporation, November 2022 (analysis).

Table 3-51: Runway Gradient Characteristics

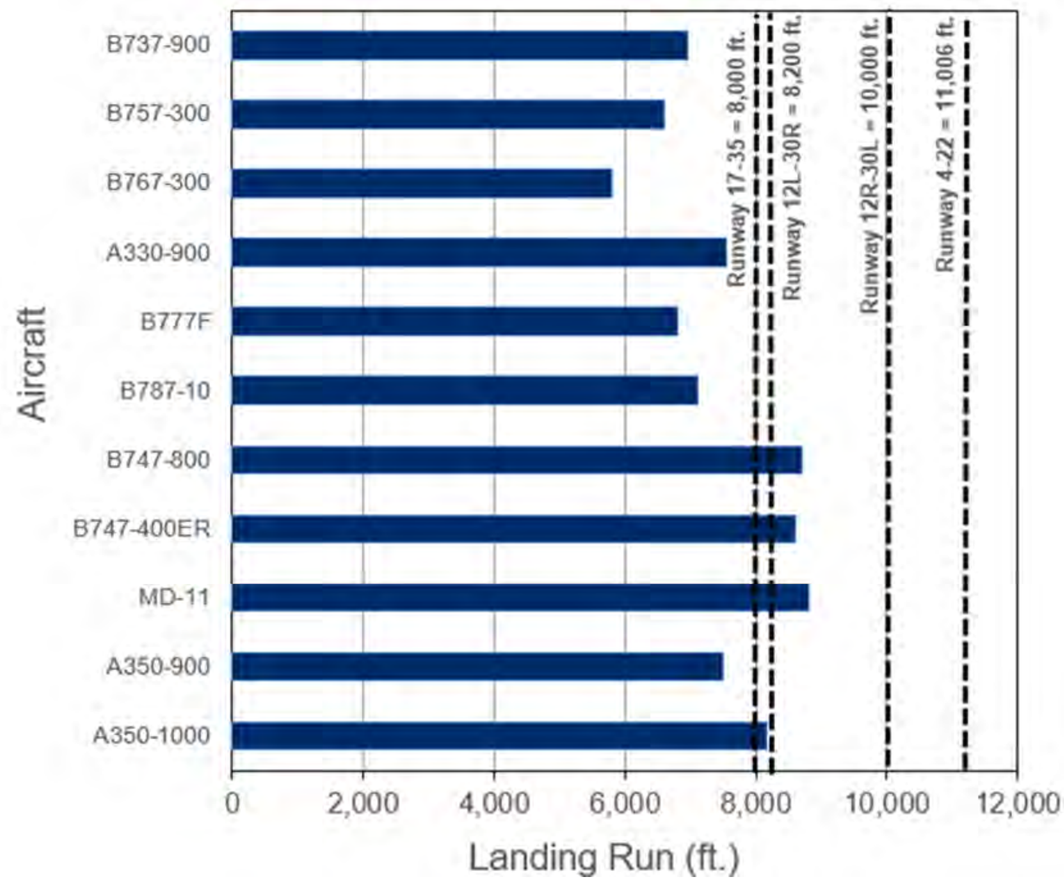
	4-22	12L-30R	12R-30L	17-35
Length (Feet)	11,006	8,200	10,000	8,000
Runway End Elevations (Feet)	833.5 / 830.3	838.6 / 819.5	841.8 / 814.4	840.4 / 833.3
Runway Effective Gradient	0.03%	0.23%	0.27%	0.09%
Grade Difference Between Runway Ends (Feet)	3	19	27	7

SOURCE: HNTB Corporation, November 2022 (analysis).

3.3.3.1 Landing Length Requirements

Exhibit 3-8 shows the landing length requirements of the fleet mix. The required landing lengths were obtained from the manufacturers' aircraft performance manuals and based on the maximum design landing weight and highest flap settings. When available, the "wet runway" condition was used to determine the landing length required. If no "wet runway" condition was included or published in a particular aircraft performance manual, then the base length obtained was increased by 15%, per guidance in AC 150/5300-13B.

Exhibit 3-8: Runway Length Requirements - Arrivals



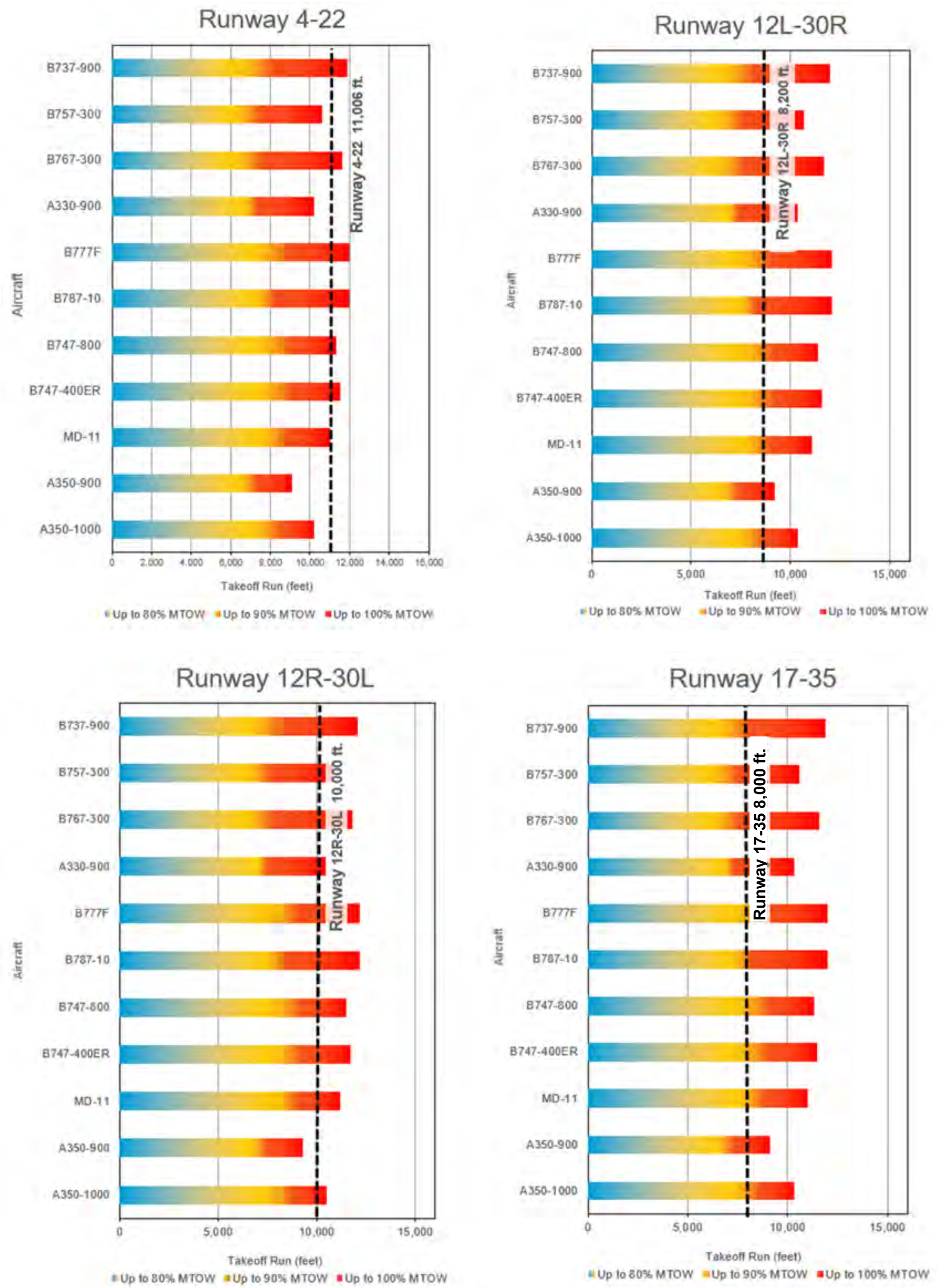
SOURCE: HNTB Corporation, November 2022 (analysis).

Based on the findings shown on **Exhibit 3-8**, MSP has sufficient runway length available to accommodate the landing length requirements of the selected fleet mix at maximum design landing weight. The two shortest runways at MSP, Runway 17-35 and Runway 12L-30L, fall short of the maximum requirements for the 747-400, 747-800, MD-11, and A350-1000. However, it should be noted that (a) other runways at MSP provide the requisite landing length for these aircraft, and (b) this analysis represented a maximum design condition; in normal circumstances, aircraft do not typically land at maximum design landing weights.

3.3.3.2 Takeoff Runway Length Requirements

Exhibit 3-9 shows the takeoff runway length requirements for the selected fleet mix with the existing lengths of Runway 4-22 (11,006 feet), Runway 12L-30R (8,200 feet), Runway 12L-30R (10,000 feet), and Runway 17-35 (8,000 feet) superimposed on the chart for reference. Each aircraft's takeoff runway length requirements are shown based on the following values: up to 80% MTOW (green), up to 90% MTOW (yellow), and up to 100% MTOW (red). This analysis indicates that the existing runway lengths at MSP require most of the critical design fleet mix to reduce fuel or payload to reduce the allowable takeoff weight from MTOW, based on the existing runway lengths.

Exhibit 3-9: Runway Length Requirements - Departures



NOTE:
MTOW – Maximum Takeoff Weight
SOURCE: HNTB Corporation, November 2022 (analysis).

It is important to note that this analysis was completed as a planning-level exercise and does not conclude that a longer runway is needed to accommodate the fleet mix, i.e., the most demanding aircraft with greater than 500 operations per year at MSP, or that the existing runway length limits the size of aircraft operating at the Airport. As previously noted, aircraft may need to adjust their takeoff weight to depart a particular runway. Prior to each flight, the flight crew and/or airline dispatch is responsible to determine the actual payload and acceptable runway length for the flight based on the aircraft operating characteristics, airline operating procedures, weather conditions at the Airport, distance of the flight, available takeoff and landing runway lengths, and a myriad of other factors. Based on forecast operations and the critical design aircraft through the 2040 LTP horizon, additional runway length at MSP is not required.

3.3.4 Taxiway/Taxilane Geometric Standards

The following subsections describe the requirements related to taxiway and taxilane design standards. The requirements are also compared against existing conditions to identify deficiencies and/or shortfalls.

3.3.4.1 Taxiway Design Group

TDG is a principle that groups aircraft based on landing gear dimensions. The TDG relates the dimensions of the cockpit to main gear and the width of the main landing gear of aircraft, which are primary design factors for taxiway and taxilane width and fillet standards. Based on this principle, different areas of an airport may have taxiways or taxilanes with different TDG classifications, depending on the location of various aircraft operations and aircraft sizes. Most taxiways at MSP are TDG 5, with a few taxiways classified as either TDG 3 or TDG 4. **Table 3-52** describes the taxiways at MSP.

The future critical design aircraft, the A350-1000, is a TDG 6 aircraft. Implications to various taxiway components associated with this change are discussed in the following sections.

3.3.4.2 Taxiway/Taxilane Width and Shoulder Width

Required taxiway width and shoulder width is a function of TDG. The existing taxiway system at MSP was reviewed for the width of each taxiway and associated shoulder and compared to the required standard width. **Table 3-52** shows the results of this review. Based on the results, there are no deficiencies in taxiway width and shoulder width at MSP.

The future up gauge in critical design aircraft from TDG 5 to TDG 6 will not affect the analysis of the taxiway width and shoulder width. The standard taxiway and shoulder widths for TDG 6 aircraft are the same as for TDG 5 aircraft. TDG 6 aircraft are expected to operate on the same taxiways currently designated as TDG 5 taxiways. TDG 6 aircraft are expected to operate primarily on taxiways supporting Runway 12R-30L and Runway 4-22. However, modifications may be required at taxiway-taxiway or taxiway-runway intersections in these areas for necessary fillet improvements. These improvements are recommended at the time of pavement reconstruction.

Table 3-52: (1 of 5) Taxiway/Taxilane Width

Taxiway	Type	Existing Width	Existing Shoulder Width	TDG	Standard Width	Standard Shoulder Width	Deficiency (Width/Shoulder)
A	Full Parallel	75 FT	35 FT	5	75 FT	30 FT	None/None
A1	RWY Entrance / Crossover	100 FT	35 FT	5	75 FT	30 FT	None/None
A2	RWY Entrance / Crossover	100 FT	35 FT	5	75 FT	30 FT	None/None
A3	High-Speed Exit / Crossover	100 FT	35 FT	5	75 FT	30 FT	None/None
A4	High-Speed Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
A5	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
A7	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
A8	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
A9	RWY Entrance / Crossover	100 FT	35 FT	5	75 FT	30 FT	None/None
A10	RWY Entrance / Crossover	100 FT	35 FT	5	75 FT	30 FT	None/None
B	Partial Parallel	75 FT	35 FT	5	75 FT	30 FT	None/None
B8	Crossover	88 FT	30 FT	5	75 FT	30 FT	None/None
C	Full Parallel	75 FT	34 FT	5	75 FT	30 FT	None/None
C1	Crossover	100 FT	30 FT	5	75 FT	30 FT	None/None
C2	Crossover / Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
C5	Crossover	100 FT	35 FT	5	75 FT	30 FT	None/None
C6	Crossover / Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
C9	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
C10	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
D	Partial Parallel	75 FT	30 – 35 FT	5	75 FT	30 FT	None/None
F	Future Partial Parallel	75 FT[1]	30 FT[1]	5	75 FT	30 FT	None/None

NOTES:
TDG – Taxiway Design Group
1 The assumed standard dimensions will be designed and constructed based on the preliminary edge of pavement provided by TKDA.
2 The taxilane will be removed as part of the LTP's preferred concept.
3 Formal shoulders are not striped; however, the total pavement width exceeds the total required width of the taxilane width, plus shoulders, for the applicable TDG standards noted for the taxilanes.
4 Runway 4-22 is periodically used as a taxiway and has taxiway edge lights installed for these occurrences. The LTP does not propose any changes to the occasional use of Runway 4-22 as a taxiway.
SOURCE: HNTB Corporation, November 2022 (analysis).

Table 3-52: (2 of 5) Taxiway/Taxilane Width

Taxiway	Type	Existing Width	Existing Shoulder Width	TDG	Standard Width	Standard Shoulder Width	Deficiency (Width/Shoulder)
F1	Future RWY Entrance	75 FT[1]	30 FT[1]	5	75 FT	30 FT	None/None
F2	Future RWY Entrance	75 FT[1]	30 FT[1]	5	75 FT	30 FT	None/None
F3	Future Crossover	75 FT[1]	30 FT[1]	5	75 FT	30 FT	None/None
F4	Future Crossover	75 FT[1]	30 FT[1]	5	75 FT	30 FT	None/None
G	Midfield Connector / Exit	75 FT	35 FT	5	75 FT	30 FT	None/None
G1	Crossover	75 FT	50 FT	5	75 FT	30 FT	None/None
G2	Crossover	75 FT	35 FT	5	75 FT	30 FT	None/None
H	Midfield Connector / Exit	75 FT	35 FT	5	75 FT	30 FT	None/None
J	Midfield Connector	50 FT	25 FT	5	75 FT	30 FT	None/None
K	Full Parallel	75 FT	35 FT	5	75 FT	30 FT	None/None
K1	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
K2	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
K3	Exit	100 FT	34 FT	5	75 FT	30 FT	None/None
K6	High-Speed Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
K8	High-Speed Exit / Crossover	75 – 100 FT	35 – 36 FT	5	75 FT	30 FT	None/None
K10	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
L	Full Parallel	75 FT	35 FT	5	75 FT	30 FT	None/None
L3	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
L5	Apron	75 FT	35 FT	5	75 FT	30 FT	None/None
L5	Apron Taxilane	75 FT	35 FT	5	75 FT	30 FT	None/None
L6	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
L6	Apron Taxilane	100 FT	35 FT	5	75 FT	30 FT	None/None
L7	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None

NOTES:
TDG – Taxiway Design Group
1 The assumed standard dimensions will be designed and constructed based on the preliminary edge of pavement provided by TKDA.
2 The taxilane will be removed as part of the LTP-preferred concept.
3 Formal shoulders are not striped; however, the total pavement width exceeds the total required width of the taxilane width, plus shoulders, for the applicable TDG standards noted for the taxilanes.
4 Runway 4-22 is periodically used as a taxiway and has taxiway edge lights installed for these occurrences. The LTP does not propose any changes to the occasional use of Runway 4-22 as a taxiway.
SOURCE: HNTB Corporation, November 2022 (analysis).

Table 3-52: (3 of 5) Taxiway/Taxilane Width

Taxiway	Type	Existing Width	Existing Shoulder Width	TDG	Standard Width	Standard Shoulder Width	Deficiency (Width/Shoulder)
L9	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
L10	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
M	Partial Parallel / Exit	75 FT	35 FT	5	75 FT	30 FT	None/None
M2	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
M6	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
N	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
P	Full Parallel	75 FT	35 FT	5	75 FT	30 FT	None/None
P1	RWY Entrance	100 FT	34 FT	5	75 FT	30 FT	None/None
P2	RWY Entrance	100 FT	34 FT	5	75 FT	30 FT	None/None
P3	High-Speed Exit	75 FT	34 FT	5	75 FT	30 FT	None/None
P4	High-Speed Exit	75 FT	35 FT	5	75 FT	30 FT	None/None
P8	High-Speed Exit	75 FT	34 FT	5	75 FT	30 FT	None/None
P9	RWY Entrance	100 FT	34 FT	5	75 FT	30 FT	None/None
P10	RWY Entrance	100 FT	34 FT	5	75 FT	30 FT	None/None
Q	Partial Parallel Taxilane	50 FT	34 FT	3	50	20 FT	None/None
		55 FT	34 FT	4	50	20 FT	None/None
		100 FT	34 FT	5	50	30 FT	None/None
		75 FT	34 FT	4	50	20 FT	None/None
		75 FT	34 FT	4	50	20 FT	None/None
R	Partial Parallel / Midfield Connector	75 FT	30 – 34 FT	5	75 FT	30 FT	None/None
R3	Crossover	75 FT	33 FT	5	75 FT	30 FT	None/None
R4	Crossover	60 FT	30 FT	5	75 FT	30 FT	None/None
R5	Crossover	75 FT	30 FT	5	75 FT	30 FT	None/None
R6	Crossover	80 FT	30 FT	5	75 FT	30 FT	None/None
R7	Crossover	82 FT	30 FT	5	75 FT	30 FT	None/None
R8	Crossover	125 FT	9 FT	5	75 FT	30 FT	None/None

NOTES:
TDG – Taxiway Design Group
1 The assumed standard dimensions will be designed and constructed based on the preliminary edge of pavement provided by TKDA.
2 The taxilane will be removed as part of the LTP-preferred concept.
3 Formal shoulders are not striped; however, the total pavement width exceeds the total required width of the taxilane width, plus shoulders, for the applicable TDG standards noted for the taxilanes.
4 Runway 4-22 is periodically used as a taxiway and has taxiway edge lights installed for these occurrences. The LTP does not propose any changes to the occasional use of Runway 4-22 as a taxiway.
SOURCE: HNTB Corporation, November 2022 (analysis).

Table 3-52: (4 of 5) Taxiway/Taxilane Width

Taxiway	Type	Existing Width	Existing Shoulder Width	TDG	Standard Width	Standard Shoulder Width	Deficiency (Width/Shoulder)
R9	RWY Entrance	100 FT	34 FT	5	75 FT	30 FT	None/None
R10	RWY Entrance	100 FT	34 FT	5	75 FT	30 FT	None/None
S	Midfield Connector / RWY Entrance / Crossover	75 FT	35 FT	5	75 FT	30 FT	None/None
S1	Apron Taxilane	100 FT	30 FT / 35 FT	5	75 FT	30 FT	None / None
S2	Apron Access Taxilane	75 FT	0 FT	5	75 FT	30 FT	None / 30 FT[2]
S3	Apron Taxilane	100 FT	30 FT	3	50 FT	20 FT	None / None
S4	Apron Taxilane	100 FT	30 FT	4	50 FT	20 FT	None / None
T	Midfield Connector / Exit / Crossover	75 FT	35 FT	4	50 FT	20 FT	None/None
		100 FT	35 FT	5	75 FT	30 FT	None/None
W	Full Parallel	75 FT	35 FT	5	75 FT	30 FT	None/None
W1	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
W2	RWY Entrance	100 FT	34 FT	5	75 FT	30 FT	None/None
W3	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
W5	Exit / Crossover	100 FT	35 FT	5	75 FT	30 FT	None/None
		75 FT	35 FT	4	50 FT	20 FT	None/None
W5	Apron Access Taxilane	75 FT	35 FT	4	50 FT	20 FT	None/None
W6	Crossover	50 FT	20 FT	4	50 FT	20 FT	None/None
W6	Apron Access Taxilane	50 FT	20 FT	3	50 FT	20 FT	None/None
W7	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None
W8	Exit	100 FT	35 FT	5	75 FT	30 FT	None/None

NOTES:
TDG – Taxiway Design Group
1 The assumed standard dimensions will be designed and constructed based on the preliminary edge of pavement provided by TKDA.
2 The taxilane will be removed as part of the LTP-preferred concept.
3 Formal shoulders are not striped; however, the total pavement width exceeds the total required width of the taxilane width, plus shoulders, for the applicable TDG standards noted for the taxilanes.
4 Runway 4-22 is periodically used as a taxiway and has taxiway edge lights installed for these occurrences. The LTP does not propose any changes to the occasional use of Runway 4-22 as a taxiway.
SOURCE: HNTB Corporation, November 2022 (analysis).

Table 3-52: (5 of 5) Taxiway/Taxilane Width

Taxiway	Type	Existing Width	Existing Shoulder Width	TDG	Standard Width	Standard Shoulder Width	Deficiency (Width/Shoulder)
W9	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
W10	RWY Entrance	100 FT	35 FT	5	75 FT	30 FT	None/None
Y	High-Speed Exit / Midfield Connector	75 – 100 FT	35 FT	5	75 FT	30 FT	None/None
Z	Crossover	75 FT	35 FT	5	75 FT	30 FT	None/None
Conc. A/B	Apron Taxilane	35 FT	0 FT[3]	2	35 FT	15 FT	None/None[3]
Conc. E/F	Apron Taxilane	160 – 180 FT	0 FT[3]	3-Apr	50 FT	20 FT	None/None[3]
RWY 4-22	Runway[4]	150 FT	35 FT	6	75 FT	30 FT	None / None

NOTES:
TDG – Taxiway Design Group
1 The assumed standard dimensions will be designed and constructed based on the preliminary edge of pavement provided by TKDA.
2 The taxilane will be removed as part of the LTP-preferred concept.
3 Formal shoulders are not striped; however, the total pavement width exceeds the total required width of the taxilane width, plus shoulders, for the applicable TDG standards noted for the taxilanes.
4 Runway 4-22 is periodically used as a taxiway and has taxiway edge lights installed for these occurrences. The LTP does not propose any changes to the occasional use of Runway 4-22 as a taxiway.
SOURCE: HNTB Corporation, November 2022 (analysis).

3.3.4.3 Taxiway-to-Taxiway Separation

Taxiway-to-taxiway separation is the distance between a taxiway centerline and the centerline of a parallel taxiway. Standard separations are set to ensure simultaneous parallel taxiing traffic can operate safely with adequate wingtip clearance. Standard taxiway-to-taxiway separations are based on the ADG for which the parallel taxiways have been designed. The standard separation is calculated as one-half of each taxiway's taxiway safety area width, plus the standard taxiway wingtip clearance for the larger ADG.

The standard taxiway-to-taxiway separation for parallel ADG V taxiway combinations at MSP is 249 feet. Based on a review of the ADG V parallel taxiway separation, deficiencies were identified at MSP, as listed in **Table 3-53**.

Table 3-53: Taxiway-to-Taxiway Separation

Parallel Taxiway Combination	Segment	Standard Separation	Existing Separation	Deficiency	Notes
Taxiway A – Taxiway B	A1 – A3	249 FT	237 FT	12'	Existing MOS in place (1999-AGL-1450-AGL), restricting Taxiway B to aircraft with wingspans less than 135 feet
Taxiway A – Taxiway B[1]	A3 – A4	249 FT	240 FT	9'	Existing MOS in place (MSP-2019-06734), restricting Taxiway B to ADG IV aircraft
Taxiway A – Taxiway B[2]	A4 – A7	249 FT	55 FT	194'	Aircraft currently restricted to using either Taxiway A or Taxiway B at this location
Taxiway A – Taxiway B[3]	A7 – D	249 FT	240 FT	9'	Existing MOS in place (MSP-2019-06734), restricting Taxiway B to ADG IV aircraft
Taxiway P – Taxiway Q	P1 – P3	249 FT	154 FT	95'	Existing MOS in place (2005-AGL-458-NRA) closes Taxiway Q if an aircraft larger than a B757-300WL is on Taxiway P
Taxiway P – Taxiway Q	P3 – D	249 FT	172 FT	77'	Existing MOSs in place (2015-AGL-8465-NRA through 2015-AGL-8467-NRA), restricting Taxiway Q to aircraft with wingspans less than 135 feet; permitting simultaneous taxiing of aircraft up to the B757-300WL; or permitting larger ADG IV aircraft on Taxiway P while restricting Taxiway Q to a CRJ-900 or smaller
Taxiway H – Taxiway J	M – Q	249 FT	210 FT	39'	Existing MOS in place (MSP-2018-04754), restricting Taxiway J to aircraft with wingspans less than 85.3 feet
Taxiway S – Humphrey Remote Apron	–	249 FT	235 FT	14'	Simultaneous taxiing operations currently restricted to aircraft no larger than the B777-200LR on Taxiway S, with the B767-300ER on the Humphrey Remote Apron taxilane

NOTES:
MOS – Modification of Standards; ADG – Airplane Design Group; VSR – Vehicle Service Road
1 The terminal concepts impact or remove this de-ice pad to varying degrees. Depending on the preferred terminal concept, the restriction can be removed if the deice pad is removed.
2 Concept improvement to extend the VSR tunnel and realign Taxiway B, which would enable this restriction to be revised. Taxiway B is restricted to ADG IV and B757 or smaller aircraft with ADG V on Taxiway A.
3 Concourse F and the adjacent VSR are proposed to be realigned in the current terminal concepts. The restriction can be removed in the current concepts; however, Taxiway B to the southeast is restricted to ADG IV.
SOURCE: HNTB Corporation, November 2022 (analysis).

Except as noted in the table, the LTP does not propose mitigation to remove the substandard taxiway-to-taxiway separations. It is anticipated that the existing Modification of Standards (MOS) will remain in place through the LTP horizon, since the Airport is geographically constrained and mitigating the substandard would require physically moving or removing sections of the taxiway, which would cause greater operational impacts than the restrictions currently in place. There are no known issues or concerns with the current operational restrictions in place for these taxiways.

3.3.4.4 Taxiway/Taxilane Safety Area

The taxiway safety area, which also applies to taxilanes, is an area symmetrical to the taxiway or taxilane centerline. Its purpose is to support the safe passage of aircraft and emergency vehicle equipment. Standard taxiway safety area widths are given by the wingspan of the largest aircraft belonging to the ADG for which the taxiway has been designed. The taxiway safety area must be kept clear of all objects, except for objects required to be within the surface due to their function.

The taxiway safety area also must be adequately graded to remove hazardous surface variations and prevent the accumulation of surface water.

The following dimensional standards apply for the taxiway safety area by ADG:

- Taxiways designed for ADG V aircraft have a standard taxiway safety area width of 214 feet (107.0 feet on either side of the taxiway centerline).
- Taxiways designed for ADG IV aircraft have a standard taxiway safety area width of 171 feet (85.5 feet on either side of the taxiway centerline).
- Taxiways designed for ADG III aircraft have a standard taxiway safety area width of 118 feet (59.0 feet on either side of the taxiway centerline).

Based on a review of the taxiway safety areas at MSP, there are two deficient areas, as noted in **Table 3-54**.

Table 3-54: Taxiway Safety Area Deficiencies

Exhibit 3-10 Index Number	Taxiway Safety Area	Deficiency	ADG	Object[1]
22	Taxiway W (W6 – W7)	14'	V	VSR Tunnel Portal

NOTES:
Exhibit Index Number refers to number labels in Exhibit 3-10
ADG – Airplane Design Group; VSR – Vehicle Service Road
1 Miscellaneous surveyed objects were not included in the inventory. It is assumed these are at-grade structures that do not penetrate the taxiway safety area.
SOURCE: HNTB Corporation, November 2022 (analysis).

The LTP does not propose any mitigation to this substandard condition; however, the MAC is seeking opportunities for mitigation in the future. During design development of the T2 north expansion and the deice pad / Remain Overnight (RON) area, there may also be an opportunity to remedy the substandard condition.

3.3.4.5 Taxiway Edge Safety Margin

The TESM is the distance between the outer edge of the landing gear of an aircraft with its nose on the centerline and the edge of the taxiway pavement. Its purpose is to protect from possible aircraft wander while taxiing, ensuring an aircraft's gear remains on taxiway-strength pavement. The TDG of a given taxiway sets the dimensional standards for the TESM. Taxiway fillets and straight segments should be designed so that all aircraft types using it do not exceed the TESM.

Taxiway fillets are designed for cockpit-over-centerline steering, meaning a pilot maneuvers a taxiing aircraft to keep the centerline beneath the cockpit during turning maneuvers. Prior to 2011, it was acceptable to design taxiway intersections for either cockpit-over-centerline steering or judgmental oversteer. Judgmental oversteer is a technique where pilots intentionally steer the cockpit outside the marked centerlines on turns. Change 17 to FAA AC 150/5300-13, issued in September 2011, removed judgmental oversteer as a design method for taxiway intersections due to the increased risk of aircraft excursions from the pavement and slower taxi speeds exhibited during the maneuver. Judgmental oversteer remains as an operational maneuver, but it is not acceptable as a design parameter. The TESM analysis conducted for the LTP used cockpit-over-centerline steering as a measurement, which is still the standard in FAA AC 150/5300-13B for taxiway intersection design.

Standard TESMs are dependent on an aircraft's TDG classification:

- For aircraft belonging to **TDG 5 or 6**, the standard TESM is 14.0 feet.
- For aircraft belonging to **TDG 3 or 4**, the standard TESM is 10.0 feet.
- For aircraft belonging to **TDG 2A or 2B**, the standard TESM is 7.5 feet.
- For aircraft belonging to **TDG 1A or 1B**, the standard TESM is 5.0 feet.

For a TESM analysis of the MSP airfield, 10 aircraft types were selected. These aircraft represented the most demanding aircraft in the present and projected fleet mix operating at MSP with regular use, including the legacy and future critical design aircraft. **Table 3-55** lists the TESM fleet mix.

The number of annual operations per aircraft was taken from the *MSP LTP Noise Contour Draft Technical Memorandum* (Noise Tech Memo), completed in February 2023. The 2040 baseline number of annual operations is listed in the table.

Table 3-55: Taxiway Edge Safety Margin Fleet Mix

Aircraft	2040 Annual Operations
Airbus A330-900 (A339)	4,015
Airbus A350-900 (A359)	365
Boeing 747-400 (B744)	<180[1]
Boeing 747-8 (B748)	365
Boeing 757-300 (B753)	11,680
Boeing 767-300 (B763)	4,015
Boeing 777 Freighter (B77F)	730
Boeing 787-10 (B78X)	<180[2]
McDonnel Douglas MD-11 (MD11)	1,460

NOTES:
1 The assumed number is based on the phasing out of the B747-400. It was included in the analysis due to its designation as the legacy critical design aircraft.
2 This represents less than 1 operation per day, per the Long-Term Plan Noise Contour Draft Technical Memorandum.
SOURCE: HNTB Corporation, November 2022 (analysis).

TESM compliance was checked for the 10 aircraft at all taxi maneuvers on the MSP airfield. **Table 3-56** summarizes the TESM analysis.

Table 3-56: Taxiway Edge Safety Margin Analysis

Criteria	Aircraft Type									
	A339	A359	A35K	B744	B748	B753	B763	B77F	B78X	MD11
ADG	V	V	V	V	VI	IV	IV	V	V	IV
TDG	5	5	6	5	5	4	5	6	6	6
CMG[1]	97.26 FT	99.27 FT	111.78 FT	91.67 FT	89.67 FT	85.33 FT	82.17 FT	94.88 FT	103.84 FT	101.74 FT
MGW[1]	41.37 FT	42.22 FT	42.13 FT	41.33 FT	41.75 FT	28.00 FT	35.75 FT	36.00 FT	39.04 FT	41.24 FT
Turning Maneuvers Examined	562	562	562	562	562	562	562	562	562	562
Feasible Turns[2]	518	519	505	521	520	546	547	520	518	544
Feasible Turns Violating TESM	484 (93.4%)	491 (94.6%)	484 (95.8%)	442 (84.8%)	489 (94.0%)	226 (41.4%)	374 (68.4%)	486 (93.5%)	487 (94.0%)	513 (94.3%)
Feasible Turns Violating TESM by >14 Feet[3]	238 (45.9%)	272 (52.4%)	370 (73.3%)	132 (25.3%)	264 (50.8%)	N/A	69 (12.6%)	224 (43.1%)	285 (55.0%)	302 (55.5%)
Feasible Turns Violating TESM by >10 Feet[3]	N/A	N/A	N/A	N/A	N/A	41 (7.5%)	N/A	N/A	N/A	N/A

NOTES:
ADG – Airplane Design Group; TDG – Taxiway Design Group; CMG – Cockpit to Main Gear; MGW – Main Gear Width (Outer to Outer); TESM – Taxiway Edge Safety Margin; N/A – Not Applicable
1 Dimensions were obtained from the FAA's AC Database, when available (some dimensions were "unverified") or AviPLAN software.
2 "Feasible turns" indicates that a centerline for the maneuver exists, that the centerline radius is adequate for the aircraft to perform a cockpit-over-centerline maneuver without oversteering, and that the pavement width on both the origin and destination segments is greater than or equal to the standard for the aircraft's TDG.
3 The standard TESMs for TDG 5/6 and 4 are 14 feet and 10 feet, respectively. A TESM violation greater than the standard TESM implies the aircraft landing gear must travel onto the shoulder to perform the maneuver, even assuming a perfect cockpit-over-centerline maneuver. This represents a safety concern, as taxiway shoulder pavement is designed to a lower strength than taxiway pavement.
SOURCE: HNTB Corporation, November 2022 (analysis).

The LTP does not propose targeted improvements to the taxiway geometry to address TESM deficiencies. While the existing taxiway edge geometry does not provide for the current TESM width based on the analysis, the existing intersections were designed to standard at the time of their construction. During the LTP process, airfield maintenance staff were contacted to inquire if taxiway edge lights were commonly repaired or replaced due to aircraft strikes, which could be a result of aircraft traversing outside the taxiway width due to substandard TESM width. The lack of taxiway edge light repairs would indicate that pilots of the larger aircraft analyzed use historical knowledge/experience and judgmental oversteer while navigating the taxiway system to remain within the taxiway limits. As taxiway pavements are rehabilitated, particularly those expected to serve TDG 6 aircraft, such as Taxiways A, B, W, and C, the edge geometry should be revised to meet current taxiway fillet geometry and TESM standards. The MAC will also continue to monitor aircraft movements and identify whether taxiway intersections should be prioritized for geometry changes based on the needs of the aircraft operating at the Airport.

3.3.4.6 Taxiway/Taxilane Object-Free Area

The TOFA and the TLOFA are areas symmetrical about the taxiway centerline and are wider than the taxiway safety area. Their purpose is to provide vertical and horizontal wingtip clearance for taxiing aircraft. Standard TOFA/TLOFA widths are determined by the wingspan plus the minimum taxiway/taxilane wingtip clearance of the largest aircraft belonging to the ADG for which the taxiway/taxilane has been designed. The TOFA/TLOFA must be kept clear of all objects, except for objects required to be within the TOFA/TLOFA due to their function. The TOFA/TLOFA also must be appropriately graded to provide drainage of water away from the taxiway safety area.

The following dimensional standards for the taxiway/taxilane apply by ADG:

- Taxiways/taxilanes designed for ADG V aircraft have a standard TOFA/TLOFA width of 285/270 feet (142.5/135.0 feet on either side of the taxiway/taxilane centerline).
- Taxiways/taxilanes designed for ADG IV aircraft have a standard TOFA/TLOFA width of 243/224 feet (121.5/112.0 feet on either side of the taxiway/taxilane centerline).
- Taxiways/taxilanes designed for ADG III aircraft have a standard TOFA/TLOFA width of 171/158 feet (85.5/79.0 feet on either side of the taxiway/taxilane centerline).

Based on a review of TOFAs and TLOFAs, deficiencies to standards in TOFAs were found at MSP, as shown in **Table 3-57**. There are no deficiencies in TLOFAs.

Table 3-57: Taxiway Object-Free Area Deficiencies

Exhibit 3-10 Index Number	TOFA Location	Deficiency	Description
23	Taxiway L3 near Runway 17-35	17.5 feet	A PAPI utility structure lies within the Taxiway L3 TOFA near the intersection with Runway 17-35.

NOTES:
Exhibit Index Number refers to number labels in Exhibit 3-10
TOFA – Taxiway Object-Free Area; PAPI – Precision Approach Path Indicator
SOURCE: HNTB Corporation, November 2022 (analysis).

A MOS is recommended to be pursued by the MAC for mitigation of the deficient object within the TOFA.

3.3.4.7 Navigational Aid Critical Areas

A NAVAID critical area is an area of ground near a NAVAID facility clear of obstructions. Its purpose is to prevent interference with the NAVAID signal. This section reviews the required standards and any existing gaps associated with the LOC critical area, GS critical area, and the Very High Frequency Omni-Directional Range (VOR) / Distance Measuring Equipment (DME).

Glideslope Critical Area

MSP has five critical areas associated with its five Glideslope (GS) antennas serving Runways 12L, 30R, 12R, 30L, and 35. These critical areas are on one side of the runway near the threshold and extend outward from the side of the runway pavement. The precise dimensions of the critical area depend on the type of equipment installed. **Table 3-58** lists the GS critical area deficiencies.

Table 3-58: Glideslope Critical Area Deficiencies

Exhibit 3-10 Index Number	Runway	Deficiency
24	12R	VSR penetration; current mitigation is signs on the VSR outside the critical area
25	30R	1 – Wind cone inside critical area 2 – Gravel road inside critical area
26	35	Wind cone inside critical area

NOTES:
Exhibit Index Number refers to number labels in Exhibit 3-10
VSR – Vehicle Service Road
SOURCE: HNTB Corporation, November 2022 (analysis).

The two wind cones should be re-sited and relocated outside the GS critical areas. Additional or new signage should be installed on the gravel road to warn vehicle operators that they are entering the GS critical area.

Localizer Critical Area

The dimensions and shape of a NAVAID critical area vary depending on the type of NAVAID. MSP has eight critical areas associated with its eight LOCs serving each runway approach. These critical areas are centered on the runway centerline, extend 50 feet behind the LOC and partway down the runway (with the length depending on the type of equipment installed), and are either 400 feet wide (Runways 4, 22, 30R, and 17) or 500 feet wide (Runways 12L, 12R, 30L, and 35). **Table 3-59** highlights the deficiencies found in the LOC critical areas.

Table 3-59: Localizer Critical Area Deficiencies

Exhibit 3-10 Index Number	Runway	Deficiency
27	12R	A pole is inside the Runway 12R localizer critical area.
28	12R	A gravel road is inside the Runway 12R localizer critical area. The road is the service road for the localizer, running behind the facility.
29	30R	Two poles are inside the Runway 30R localizer critical area.
30	12L	A gravel road is inside the Runway 12L localizer critical area. The road is the service road for the localizer, running behind the facility.
31	17	A pole is inside the critical area.

NOTE: Exhibit Index Number refers to number labels in Exhibit 3-10
SOURCE: HNTB Corporation, November 2022 (analysis).

The LTP does not propose any targeted mitigation for the identified objects within the LOC critical areas. The LOCs are continuously monitored and routinely checked, and the identified objects have not caused known interferences detrimental to the performance of the LOCs.

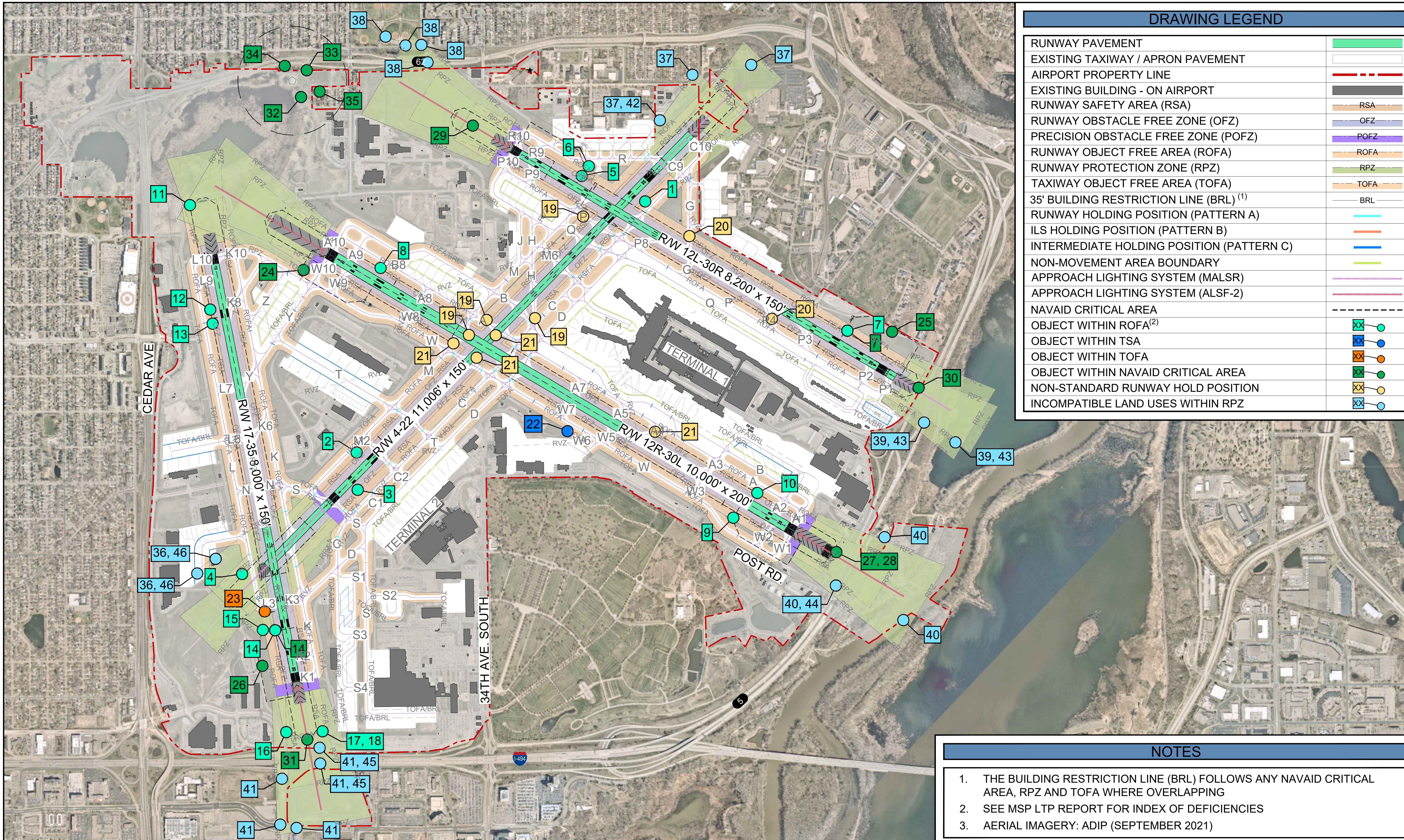
Very High Frequency Omni-Directional Range (VOR) / Distance Measuring Equipment (DME) Critical Area

There is also a critical area associated with the MSP VOR/DME facility. Generally, this critical area is defined by a 1,000-foot radius from the facility, but there are additional restrictions on permitted land uses, types of structures, and heights of objects near the MSP VOR/DME.

- Individual trees and groups of trees are within the VOR/DME critical area (identified on **Exhibit 3-10** as Items 32 and 33). All vegetation within this critical area should be managed or trimmed, as appropriate, to comply with FAA Order 6820.10, VOR, VOR/DME, and VORTAC Siting Criteria.
- There are off-Airport light poles, off-Airport freeway signage, fences, and off-Airport buildings or houses within the VOR/DME critical area (identified on **Exhibit 3-10** as Items 34 and 35). All such structures should be confirmed to be made of materials compliant with the guidance in FAA Order 6820.10 and should not exceed the pertinent height limitations.

The LTP does not propose any targeted mitigation for the objects within the VOR/DME critical area. The VOR/DME is continuously monitored and checked, and the identified objects have not caused known interferences detrimental to the VOR/DME performance.

The MSP VOR is on the FAA's list for decommissioning. The MSP VOR was included in Phase 2 of the VOR MON Program Discontinuance list, which was published in the *Federal Register* in July 2016. Phase 2 of the VOR discontinuance schedule covered fiscal year (FY) 2021 through FY 2025.



DRAWING LEGEND

RUNWAY PAVEMENT	
EXISTING TAXIWAY / APRON PAVEMENT	
AIRPORT PROPERTY LINE	
EXISTING BUILDING - ON AIRPORT	
RUNWAY SAFETY AREA (RSA)	RSA
RUNWAY OBSTACLE FREE ZONE (OFZ)	OFZ
PRECISION OBSTACLE FREE ZONE (POFZ)	POFZ
RUNWAY OBJECT FREE AREA (ROFA)	ROFA
RUNWAY PROTECTION ZONE (RPZ)	RPZ
TAXIWAY OBJECT FREE AREA (TOFA)	TOFA
35' BUILDING RESTRICTION LINE (BRL) (1)	BRL
RUNWAY HOLDING POSITION (PATTERN A)	
ILS HOLDING POSITION (PATTERN B)	
INTERMEDIATE HOLDING POSITION (PATTERN C)	
NON-MOVEMENT AREA BOUNDARY	
APPROACH LIGHTING SYSTEM (MALSR)	
APPROACH LIGHTING SYSTEM (ALSF-2)	
NAVAID CRITICAL AREA	
OBJECT WITHIN ROFA (2)	XX
OBJECT WITHIN TSA	XX
OBJECT WITHIN TOFA	XX
OBJECT WITHIN NAVAID CRITICAL AREA	XX
NON-STANDARD RUNWAY HOLD POSITION	XX
INCOMPATIBLE LAND USES WITHIN RPZ	XX

NOTES

1. THE BUILDING RESTRICTION LINE (BRL) FOLLOWS ANY NAVAID CRITICAL AREA, RPZ AND TOFA WHERE OVERLAPPING
2. SEE MSP LTP REPORT FOR INDEX OF DEFICIENCIES
3. AERIAL IMAGERY: ADIP (SEPTEMBER 2021)

MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT

2040 LONG-TERM PLAN

FEBRUARY 2023

EXHIBIT 3-10

AIRFIELD STANDARDS REVIEW

3.3.5 Airfield Capacity

For long-term planning purposes at large airports with multiple operating configurations and high levels of traffic, the FAA recommends use of sophisticated simulation modeling analysis to ascertain airport capacity to more accurately assess capacity compared to annual service volume (ASV) calculations and spreadsheet-based models that do not fully capture the intricacies of a large-hub operation.

3.3.5.1 Baseline Simulation Model Development

In September 2020, a comprehensive airfield capacity study (capacity study) was finalized under separate task authorization, in which the MAC completed a fast-time airfield simulation model using AirTOP. The objectives of this study included developing predictions of how much of the existing MSP airfield capacity is needed to accommodate existing and forecast demand levels as well as estimate associated levels of delay. For this analysis, summer DDFS were developed based on aviation activity forecasts completed for the MSP 2040 LTP. Four DDFS were developed, including 2018 and future PAL 3. **Table 3-60** lists the corresponding aircraft operations associated with each PAL.

Table 3-60: Forecast Annual Aircraft Operations by Planning Activity Level

Activity Level	Total Annual Operations
2018	407,394
PAL 1 (2025)	462,000
PAL 2 (2030)	517,000
PAL 3 (2040)	555,000

NOTE:
PAL – Planning Activity Level
SOURCE: Ricondo and Associates, MSP 2040 LTP Revised Forecast, 2022

3.3.5.2 Average Annual Day and Average Day Peak Month

To facilitate dialogue among multiple groups of stakeholders, this capacity study evaluated capacity based on demand on an average annual day (AAD), which is typical for environmental-focused studies, and demand on an average day peak month (ADPM) basis, which is typical for capacity studies. Both metrics present variations in the determination of ASV and delay. Recognizing these variations, ADPM and AAD capacity curves were developed to visualize and determine ASV; these curves are shown on **Exhibit 3-11**.

Exhibit 3-11: Annual Service Volume Ranges

NOTES:
PAL – Planning Activity Level; DDFS – Design Day Flight Schedule; ADPM – Average Day Peak Month; AAD – Average Annual Day; ASV – Annual Service Volume
SOURCES: HNTB Corporation, 2020 (analysis); MSP Long-Term Plan Airfield Capacity Study, December 2020.

The resulting recommended ASV range was 527,000 to 656,000 operations with current technologies and ATC procedure assumptions in place. An ASV range is provided since the LOS desired needs to factor into the amount of delay that will be considered tolerable. AAD and ADPM analyses have differing delay recovery times. Based on this capacity study's findings, there was no demonstrated need for additional runways or a replacement Airport within and beyond the 20-year planning period. The capacity study concluded that, as part of the LTP, incremental improvements to improve efficiency and reduce delays will be explored through modest improvements to airfield geometry, technology, and policy.

3.3.6 Runway Incursion Mitigation and Hot Spots

The following subsections describe the existing hot spots on the airfield, as well as the incident history from 2011 to 2021. In addition, specific characteristics in the airfield geometry have been identified that may contribute to the risk of surface incidents and/or runway incursions.

3.3.6.1 Federal Aviation Administration Hot Spots

A hot spot is typically identified as a complex or confusing taxiway-runway or taxiway-taxiway intersection, which has an increased risk or history of or potential risk for runway incursions and incidents, which can be due to airport layout or geometry, traffic flow, or airport marking signage and lighting, which requires heightened attention by pilots and drivers. These hot spots are identified and defined by the Runway Safety Action Team that analyzes the airport's history of runway incursions and incidents. MSP has three official hot spots. **Exhibit 3-12** shows the currently published hot spots at MSP. **Table 3-61** describes each hot spot.

Table 3-61: Federal Aviation Administration Hot Spots Description

Hot Spot	Location	Description
HS 1	Runway 4-22 / Runway 12R-30L intersection	Taxiway A, Taxiway B, Taxiway C, Taxiway D, Taxiway H, Runway 4-22, and Runway 12R-30L – complex geometry
HS 2	Runway 4-22 / Runway 12L-30R intersection	Complex geometry at the intersection of Taxiway C, Taxiway P8, Taxiway D, Taxiway P, Taxiway Q, and the Runway 4-22 and Runway 12L-30R intersection – rqr caution for runway crossings in this area
HS 3	12R / W10 intersection	Taxiway/runway geometry and traffic flow

NOTE:
HS – Hot Spot
SOURCE: U.S. Department of Transportation, FAA, November 2022.

3.3.6.2 Runway Incursions and Surface Incident History

The FAA defines surface incidents and runway incursions as follows:

- **Surface Incident** – Any event where unauthorized or unapproved movement occurs within the airport movement area, or an occurrence in the movement area associated with the operation of an aircraft that affects or could affect the safety of flight. A surface incident can occur anywhere on the airport's surface, including the runway.
- **Runway Incursion** – Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft.

As shown in **Table 3-62**, the FAA has adopted four categories of runway incursions, with category "A" being the most severe classification.

Table 3-62: Federal Aviation Administration Runway Incursion Severity Categories

Severity Classification	Description
A	A serious incident in which a collision was narrowly avoided
B	An incident in which separation decreases and there is a significant potential for collision, which may result in a time-critical corrective/evasive response to avoid a collision
C	An incident characterized by ample time and/or distance to avoid a collision
D	An incident that meets the definition of a runway incursion, such as incorrect presence of a single vehicle/person/aircraft on the protected area of a surface designated for the landing and takeoff of aircraft but with no immediate safety consequences

SOURCE: U.S. Department of Transportation, FAA, November 2022.

Types of incidents that are used to identify the primary cause of an incident include the following:

- **Operational Incidents (OI)** – Action of an ATCT that results in the following: less-than-required minimum separation between two or more aircraft or between an aircraft and obstacles, (vehicles, equipment, personnel on runways) or clearing an aircraft to take off or land on a closed runway. The majority of aircraft incidents at MSP were related to operational incidents, specifically loss of aircraft separation.
- **Pilot Deviations (PD)** – Action of a pilot that violates any CFR. Example: a pilot crosses a runway without a clearance while enroute to an airport gate.

- **Vehicle/Pedestrian Deviations (V/PD)** – Pedestrians or vehicles entering any portion of the airport movement areas (runways/taxiways) without authorization from ATC.

Table 3-63 and **Table 3-64** summarize the incursions and surface incidents that occurred over a 10-year period from 2011 to 2021.

Table 3-63: Incursion and Incident Summary – 2011 through 2021

Year	Airspace Conflict	A	B	C	D	SI	Total
2011	0	0	0	3	3	2	**8**
2012	0	0	0	12	0	1	**13**
2013	0	0	1	6	5	0	**12**
2014	0	0	0	4	0	1	**5**
2015	0	0	0	11	0	1	**12**
2016	0	0	0	27	4	1	**32**
2017	2	0	0	25	5	0	**32**
2018	0	0	0	7	7	0	**14**
2019	1	0	0	2	5	0	**8**
2020	0	0	0	4	5	0	**9**
2021	0	0	0	1	1	0	**2**
Total	**3**	**0**	**1**	**102**	**35**	**6**	**147**

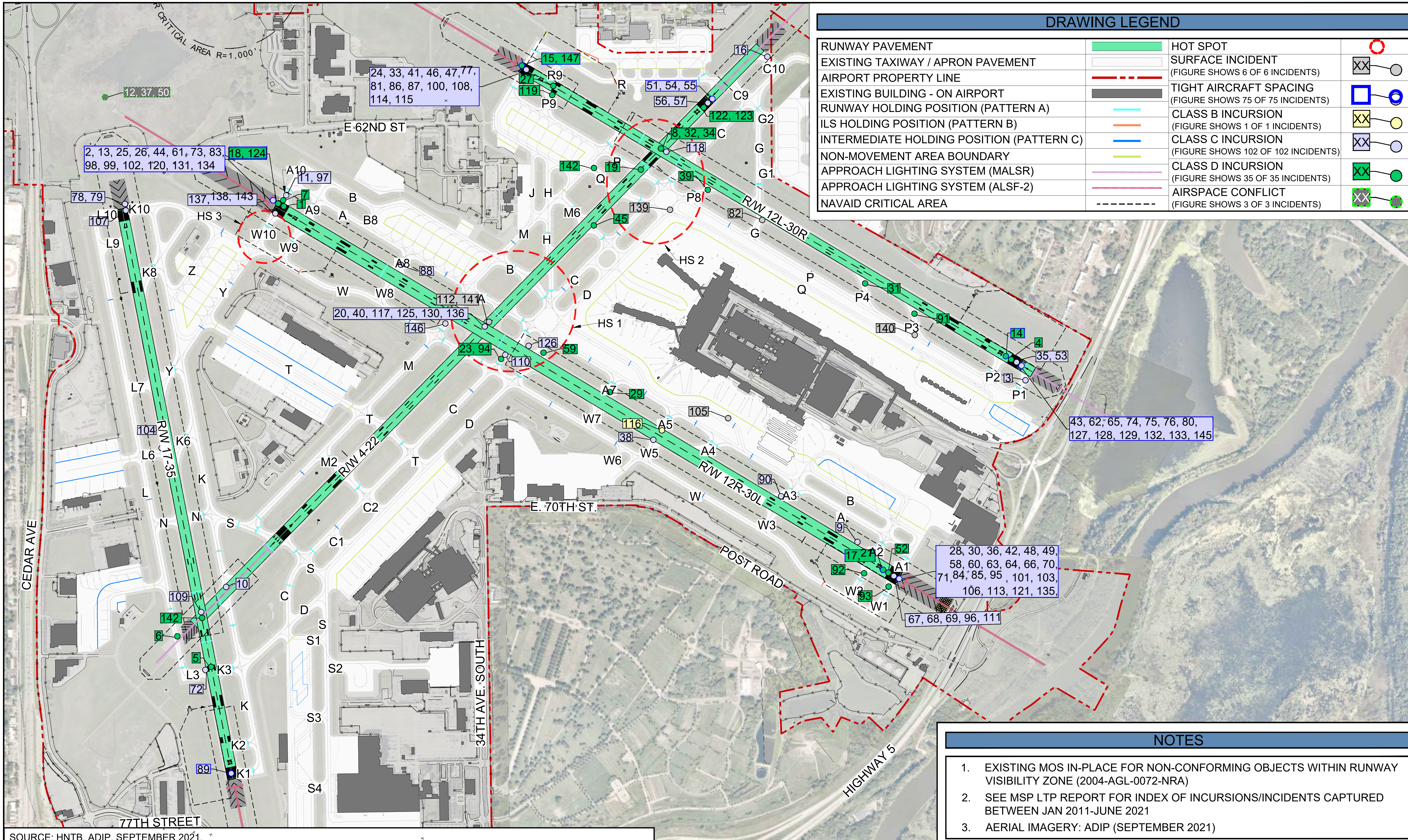
NOTES:
SI – Surface Incident
SOURCES: U.S. Department of Transportation, FAA, Runway Incursion Database, 2022; HNTB Corporation, November 2022 (analysis).

Table 3-64: Incident Type – 2011 through 2021

Year	OI	PD	V/PD	Total
2011	3	2	3	**8**
2012	9	4	0	**13**
2013	3	5	4	**12**
2014	4	1	0	**5**
2015	9	2	1	**12**
2016	22	4	6	**32**
2017	22	8	2	**32**
2018	8	5	1	**14**
2019	4	3	1	**8**
2020	0	3	6	**9**
2021	1	1	0	**2**
Total	**85**	**38**	**24**	**147**

NOTES:
OI – Operational Incident; PD – Pilot Deviation; VPD – Vehicle/Pedestrian Deviation
SOURCES: U.S. Department of Transportation, FAA, Runway Incursion Database, 2022; HNTB Corporation, November 2022 (analysis).

Exhibit 3-12 graphically depicts the incursions and incidents.



MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT

2040 LONG-TERM PLAN

OCTOBER 2022

EXHIBIT3–12

INCURSION/INCIDENT SEVERITY MAP

3.3.6.3 Geometric Contributing Factors

FAA AC 150/5300-13B, *Airport Design*, consolidates many recent research findings related to airfield safety, and this information is supplemented by other FAA documentation. Previously, several airfield safety enhancement bulletins had been published in FAA Orders and Engineering Briefs, and many of these remain relevant, as does documentation associated with the FAA national runway incursion program office. The research correlates existing design geometries with incursion history, as well as the future potential for an incursion to take place. The FAA determined there are specific characteristics in airfield geometry that can contribute to the potential for both surface incidents and runway incursions.

In addition to the FAA hot spots, additional airfield geometries do not meet current FAA AC 150/5300-13B guidelines, which result in the potential for incursions. These non-standard geometries are inclusive of those identified by the FAA RIM Data Management Tool, which includes a high-level analysis of non-standard geometries at MSP. **Exhibit 3-13** graphically depicts the geometric contributing factors.

- **High-Energy Runway Crossings** – Aircraft should not have runway crossing points in the middle-third of the runway to provide enhanced pilot situational awareness. At MSP, 12 high-energy runway crossings are at the following locations:
  - Runway 4-22 at Taxiways T, W, A, B, H
  - Runway 12L-30R at Taxiway G
  - Runway 12R-20L at Taxiways C, D, A7/W7, A5/W5
  - Runway 17-35 at Taxiways L6/K6, N

The LTP does not propose targeted mitigation to remove any of the high-energy runway crossings. Removal of these taxiways would have significant impacts to the Airport's capacity. Over half of the incursions reviewed had an operational incident noted as the primary cause. The number of incursions has also dramatically dropped in the last several years, potentially resulting from revised ATC procedures. A review of the pilot deviation–coded incidents indicates these types of incursions occur throughout the airfield and are not isolated to the high-energy crossings. Therefore, the airfield geometry, specifically relating to high-energy crossings, does not elevate the risk of a runway incursion at these locations.

- **Direct Access** – Pilots could mistakenly cross a runway directly from an apron area without being cleared. At MSP, 18 locations have direct runway access from an apron or ramp area, as summarized in **Table 3-65**.

Table 3-65: Direct Access Summary

Taxiway	Apron	Runway	Mitigation
A1	Delta Maintenance	30L	Deice Pad Reconfiguration
A2	Delta Maintenance	12R-30L	None[1]
A3	30L Deice Pad	12R-30L	None[1]
A4	Concourse G	12R-30L	None[1]
A7	Concourse F/G	12R-30L	None[1]
A8	12R Deice Pad	12R-30L	None[2]
W6	General Aviation Ramp	12R-30L	None[3]
C2	T2 Apron	4-22	None[4]
C6	Concourse E/F	4-22	None[5]
S	T2 Apron	4	None[4]
T	T2 Apron	4-22	None[4]
L6	Cargo Apron	17-35	None[4]
H	12L Deice Pad	4-22	None[2]
P1	30R Deice Pad	12L-30R	None[2]
P2	Concourse A	12L-30R	None[1]
P9	12L Deice Pad	12L-30R	None[2]
G	Concourse D	12L-30R	None[1]
Q	12L Deice Pad	4-22	None[4]

NOTES:
1 At these locations, taxiing aircraft need to cross a parallel taxiway before reaching the runway environment, and they need to cross an area delineated by taxiway edge markings, both of which should increase pilot situational awareness.
2 There is only one deice position that has direct access to the runway environment without requiring a turning maneuver. From this position, the aircraft needs to cross a parallel taxiway prior to reaching the runway environment, which should increase situational awareness. It is not recommended to remove this deice position due to the resulting deicing capacity impact.
3 The only incursion near this location did not include an aircraft; it involved a vehicle entering the Runway 30L runway safety area from the general aviation ramp without contacting ATCT. The general aviation ramp is removed from this location in the preferred development alternative.
4 Aircraft need to cross a parallel taxiway prior to reaching the runway environment, which should increase situational awareness.
5 Aircraft taxiing from the future terminal apron will need to cross two parallel taxiways prior to reaching the runway environment, which should increase situational awareness.
SOURCES: U.S. Department of Transportation, FAA, Runway Incursion Database, 2022; HNTB Corporation, November 2022 (analysis).

All runways include hold position markings and runway guard lights, which also enhances situational awareness for pilots taxiing in these areas.

Wide Expanse of Pavement – Wide expanses of pavement can result in a loss of situational awareness and may result in visual cues (signs, markings, lights) being placed outside or far from a pilot's field of vision. At MSP, five identified areas are a wide expanse of pavement:

- Areas between Taxiways A and B. Taxiway edge markings are present along both Taxiway A and Taxiway B, reducing the risk of non-channelized taxiing and wingtip conflicts. The LTP does not propose the addition of physical or no-taxi islands, as the ATCT often utilizes this pavement to cross over aircraft to reduce delays and queuing.
- The intersection of Taxiways A, B, C, and D. The LTP does not propose any action at this location. The island is being studied as part of a separate MAC assignment, and any mitigations will be proposed as part of that effort.
- Sections between Taxiways P and Q. Taxiway edge markings are present along both Taxiway P and Taxiway Q, reducing the risk of non-channelized taxiing and wingtip conflicts. The LTP

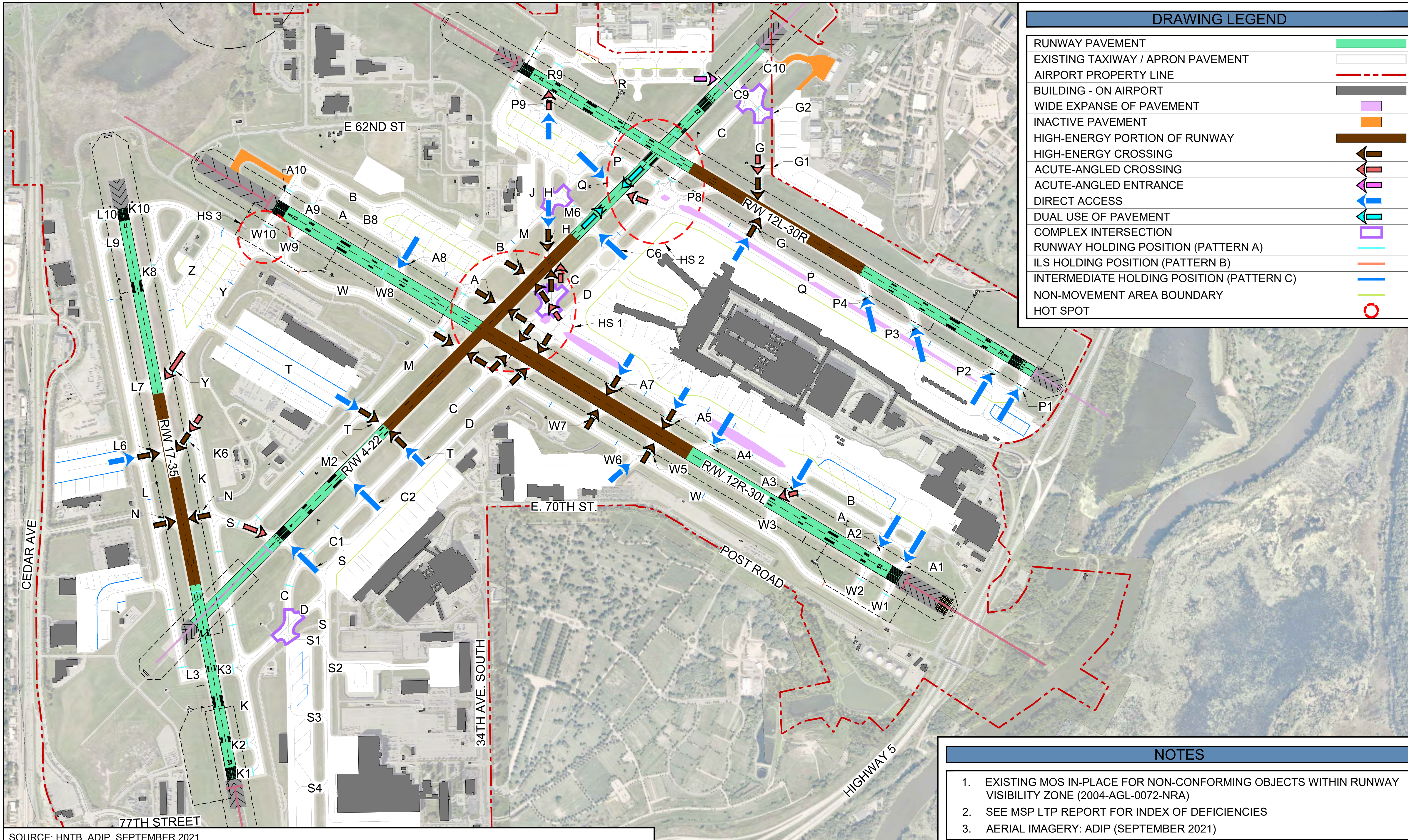
does not propose the addition of physical or no-taxi islands, as the ATCT often utilizes this pavement to cross over aircraft to reduce delays and queuing.

- Intersection between Taxiways P, Q, C, and D. The LTP does not propose any action at this location. The island is being studied as part of a separate MAC assignment, and any mitigations will be proposed as part of that effort.

It should be noted that all other taxiways have designated no-taxi islands that are intended to mitigate each area's wide expanse of pavement.

- **Acute-Angled Crossing** – Right angles provide the best visibility left and right for a pilot at an intersection. At MSP, there are seven acute-angled crossing locations:
  - Runway 4-22 at Taxiway R. The LTP does not propose any realignment of the taxiway. There were no incidents at this location within the timeframe analyzed. The MAC may consider realigning the taxiway the next time it is rehabilitated.
  - Runway 4-22 at Taxiway S. The LTP does not propose any realignment of the taxiway. There were no incidents at this location within the timeframe analyzed. The MAC may consider realigning the taxiway the next time it is rehabilitated.
  - Runway 12L-30R at Taxiway P9. The LTP does not propose any realignment of the taxiway. There were two incidents at this location within the timeframe analyzed. One incident was the result of a mistaken call sign, and the second was the pilot of a General Aviation (GA) aircraft who became confused at the taxi instructions to taxi across the deice pad and on to Taxiway P. Neither incident was the result of the acute angle of Taxiway P9. The MAC may consider realigning the taxiway the next time it is rehabilitated.
  - Runway 12L-30R at Taxiway G. As part of a future taxiway project in the preferred development alternative, this acute-angled crossing is replaced with a 90-degree crossing. There were no incidents within the timeframe analyzed on Taxiway G at the acute-angled crossing location.
  - Runway 12R-30L at Taxiway A3. The LTP does not propose any realignment of the taxiway since Taxiway A3 is a high-speed exit taxiway. There was one incident within the timeframe analyzed at Taxiway A3; however, the incident involved snow removal equipment that passed beyond the hold position markings and held short of the runway within the RSA.
  - Runway 17-35 at Taxiway K6. The LTP does not propose any realignment of the taxiway since Taxiway K6 is a high-speed exit taxiway. There were no incidents at this location within the timeframe analyzed.
  - Runway 17-35 at Taxiway Y. The LTP does not propose any realignment of the taxiway since Taxiway Y is a high-speed exit taxiway. There were no incidents at this location within the timeframe analyzed.
- **Acute-Angled Entrance** – Pilots approaching a runway sometimes mistakenly line up for approach on the parallel taxiway. Rounding out the entrance taxiway to a runway visually enhances both the taxiway and runway. There is one acute-angled entrance located at the approach end of Runway 22 at Taxiway R. The LTP does not propose any realignment of the taxiway. There were no incidents at this location within the timeframe analyzed. The MAC may consider realigning the taxiway the next time it is rehabilitated.

- **Complex Intersection** – Pilots could mistakenly traverse the wrong taxiway at taxiway intersections where there are greater than two intersecting paths. There are four complex intersections that have more than three nodes, which can lead to pilot confusion, and if located near a runway entrance can cause an incursion. These locations are as follows:
  - Taxiway C at Taxiway G intersection. The LTP does not propose any geometric improvements at this intersection. There were no incidents at this location within the timeframe analyzed. The MAC may consider geometric improvements the next time this intersection is rehabilitated, or it may choose to extend the limits of the project shown for Taxiway G in the preferred development alternative.
  - Taxiways M, H, and M6 intersection. The LTP does not propose any geometric improvements at this intersection. There were no incidents at this location within the timeframe analyzed. The MAC may consider geometric improvements at this location the next time the intersection is rehabilitated. However, capacity impacts will need to be considered if taxiways are removed to create a three-node intersection.
  - Taxiways C, D, H, and B intersection. The LTP does not propose any geometric improvements at this intersection. There were no incidents at this location within the timeframe analyzed. The wide expanse of pavement in this vicinity is being studied by the MAC under a separate task assignment. That task may recommend geometric improvements at this intersection to address the wide expanse of pavement and complex intersection.
  - Taxiways C, D, and S1 intersection. The LTP does not propose any geometric improvements at this intersection. There were no incidents at this location within the timeframe analyzed. The MAC may consider geometric improvements at this location the next time the intersection is rehabilitated. However, capacity impacts will need to be considered if taxiways are removed to create a three-node intersection.
- **Dual Use of Pavement** – Runways should always be used solely as runways, and taxiways should always be used solely as taxiways, without mixing of uses or "dual purposes" (i.e., a runway being used as a taxiway and a taxiway being used as a runway). There is one area of dual use pavement located on Runway 4-22 between Taxiway C6 and Taxiway Q. Runway 4-22 is sometimes used as an exit taxiway for arriving aircraft landing on Runways 30L and 30R. It is also sometimes used as a hot-holding location when aircraft are waiting for their arrival gate to open. The LTP does not propose revising the dual use of Runway 4-22, as it is required for the operational and capacity needs of MSP. Sections of Runway 4-22 are equipped with taxiway edge lights to increase situational awareness when the runway is being used for taxiing operations.



DRAWING LEGEND

RUNWAY PAVEMENT	
EXISTING TAXIWAY / APRON PAVEMENT	
AIRPORT PROPERTY LINE	
BUILDING - ON AIRPORT	
WIDE EXPANSE OF PAVEMENT	
INACTIVE PAVEMENT	
HIGH-ENERGY PORTION OF RUNWAY	
HIGH-ENERGY CROSSING	
ACUTE-ANGLED CROSSING	
ACUTE-ANGLED ENTRANCE	
DIRECT ACCESS	
DUAL USE OF PAVEMENT	
COMPLEX INTERSECTION	
RUNWAY HOLDING POSITION (PATTERN A)	
ILS HOLDING POSITION (PATTERN B)	
INTERMEDIATE HOLDING POSITION (PATTERN C)	
NON-MOVEMENT AREA BOUNDARY	
HOT SPOT	

NOTES

1. EXISTING MOS IN-PLACE FOR NON-CONFORMING OBJECTS WITHIN RUNWAY VISIBILITY ZONE (2004-AGL-0072-NRA)
2. SEE MSP LTP REPORT FOR INDEX OF DEFICIENCIES
3. AERIAL IMAGERY: ADIP (SEPTEMBER 2021)

SOURCE: HNTB, ADIP, SEPTEMBER 2021.

MSP
MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

N

0 1,200' 2,400'

OCTOBER 2022

EXHIBIT 3-13

GEOMETRIC CONTRIBUTING FACTORS / HOT SPOT MAP

3.3.7 Deice Pads and Remain-Overnight Parking

At a minimum, the LTP aims to retain the existing number of deice positions and RON parking positions. A reduction in either the number of deice positions or the number of RON positions is not operationally feasible with the anticipated traffic levels at the forecast horizon. The 2020 MSP capacity study modeled the existing deicing operations at PAL 2. The simulation showed the existing deice positions could accommodate the PAL 2 traffic levels; however, some aircraft were required to be held at their gates to avoid overflow conflicts at the deice pads. The preferred airfield layout, discussed in Chapter 4, provides for additional deice and RON capacity, where feasible, considering terminal expansion needs.

3.3.8 Air Traffic Control Tower Line of Sight

As MSP is a Part 139-certified airport with an operating ATCT, ATCT personnel require an unobstructed view from the cab of the ATCT to the movement area, including taxiways and runways, as well as the non-movement area boundary line. The ATCT and top cab should be located to provide a view to all points of the movement area and should preclude parked aircraft, buildings, and equipment from obstructing a controller's view.

The LTP does not propose any improvements to or relocation of the ATCT. Existing line-of-sight concerns related to seeing the far ends of Concourses A and G may be mitigated by local Ramp Control at the far ends of the concourses where aircraft can be directed to a designated location prior to contacting Ground Control.

3.3.9 Cargo Requirements

As previously mentioned, the Air Cargo Assessment Study was conducted in September 2021 by Landrum & Brown, Inc. The results of the facility demand/capacity analysis from the cargo study were used for this update of the LTP. The facility requirements were segmented by building and carrier. The existing air cargo facilities at MSP represent approximately 522,678 square feet of total cargo building area. **Table 3-66** shows the segmented carriers and their respective building, apron, and landside areas, as well as each carrier's 2020 tonnage throughput.

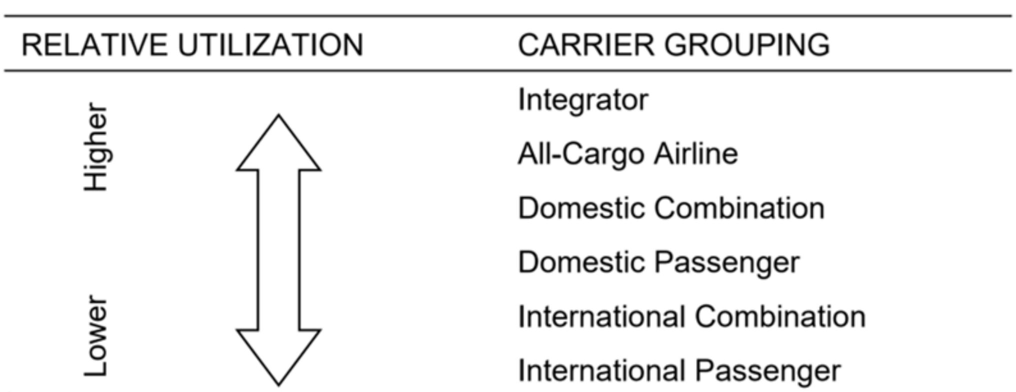
Table 3-66: Existing Air Cargo Facilities at the Airport

Building	Carrier	Building (Sq Ft)	Apron (Sq Ft)	Landside/Other (Sq Ft)	2020 Metric Tonnes
FedEx	FedEx	203,000	341,000	522,540	89,793
UPS	UPS	67,000	406,128	558,374	70,566
Delta	Main Delta Cargo	104,036	-	585,698	18,365
	Delta Dash	2,064	-	33,000	
DHL	Amazon (Atlas Air / Sun Country)	3,009	240,000	54,828	12,216
	DHL	33,284			7,531
	WFS	10,134			Handler Only
Sun Country HQ	Sun Country (belly/Amazon)	6,165	-	Shared	1,837
Air Cargo Center	Other/WFS	23,953	-	Shared	3,389
	Southwest	7,458	-	Shared	
	Air General	7,575	-	Shared	
	Vacant (old DHL)	55,000	-	Shared	-
	Total	522,678	987,128		203,697

SOURCE: Landrum & Brown, Inc., *Air Cargo Assessment Study*, September 2021.

The industry standards for throughput ratio indicate a normal processing rate of 1 ton of cargo per square foot of warehouse per year. Individual carrier practices and many other factors can impact throughput ratios. Each cargo facility at MSP has different space utilization; therefore, each carrier was categorized into carrier groupings and relative utilization. **Exhibit 3-14** shows these carrier groupings.

Exhibit 3-14: Carrier Groupings



SOURCE: Landrum & Brown, Inc., *Air Cargo Assessment Study*, September 2021.

The MAC conducted a theoretical capacity analysis to determine if the existing facilities could accommodate the projected growth in throughput. An estimated throughput ratio was assigned to each carrier based on the different carrier groupings and those assigned throughput ratios. This analysis concluded that the existing facilities could accommodate up to an estimated 600,000 metric tonnes of cargo per year, based on minimum efficient throughput levels from historical industry averages. This suggests that the existing facilities at MSP can handle the air cargo forecast of 394,199 metric tonnes. **Table 3-67** shows the theoretical capacity results for the legacy carriers.

Table 3-67: Theoretical Capacity for Legacy Carriers

Building	Main Tenants	Building (Sq Ft)	Estimated (MT[1] Sq Ft / Year)	Estimated Throughput (MTs)
FedEx	FedEx	203,000	1.5	304,500
UPS	UPS	67,000	1.5	100,500
Delta (Main and Dash)	Delta	106,100	0.75	79,575
DHL	Amazon / DHL	46,427	1.0	46,427
Air Cargo Center	Air General / WFS / Southwest	93,986[2]	0.75	70,489
Sun Country HQ	Sun Country (belly)	6,165	0.75	4,624
	Total Estimate	522,678		606,115

NOTES:
1 MT – Metric Tonnes
2 This includes 55,000 square feet of empty space in the building.
SOURCE: Landrum & Brown, Inc., *Air Cargo Assessment Study*, September 2021.

Cargo requirements were evaluated for the 2030 and 2040 planning horizons. Each carrier has its own set of requirements, which consist of warehouse space, office space, aircraft ramp, auto parking, truck apron, and other miscellaneous space.

Table 3-68 presents the individual carrier cargo requirements. Amazon was the only carrier that did not have enough existing facility space to accommodate projected growth. Amazon currently occupies a 3,000-square-foot space in a shared facility with DHL. The 2040 requirements for Amazon indicate a demand for approximately 110,000 square feet of building footprint.

The Air Cargo Assessment Study concluded with the recommendation that the MAC focus its efforts on providing a future cargo footprint for Amazon expansion, as the existing cargo facilities at the Airport are capable of handling more than the projected growth through 2040.

Table 3-68: Air Cargo Study Individual Carrier Requirements

Main Carriers	Existing Estimated Sq Ft	2030	2040
Amazon			
Warehousing		73,800	99,200
Office		7,400	9,900
Other		3,700	5,000
Footprint	3,009	77,500	109,100
Aircraft Ramp	83,148	184,800	184,800
Auto Parking	17,400	28,800	38,700
Truck Apron	4,899	65,600	90,000
FedEx			
Warehousing		67,300	73,800
Office		6,700	7,400
Other		3,400	3,700
Footprint	203,000	70,700	80,600
Aircraft Ramp	376,937	231,000	277,200
Auto Parking	103,500	72,900	72,900
Truck Apron	75,053	60,000	65,600
UPS			
Warehousing		60,500	56,700
Office		6,100	5,700
Other		3,000	2,800
Footprint	67,000	63,500	62,400
Aircraft Ramp	451,950	237,300	283,500
Auto Parking	74,400	50,400	50,400
Truck Apron	61,917	52,500	65,600
DHL			
Warehousing		10,800	14,200
Office		1,100	1,400
Other		600	700
Footprint	43,418	11,400	14,900
Aircraft Ramp	124,722	138,600	138,600
Auto Parking	28,200	4,200	5,400
Truck Apron	7,735	5,600	9,400
Delta / Other Belly			
Warehousing		86,000	105,600
Office		8,600	10,600
Other		4,300	5,200
Footprint	106,100	90,300	110,800
Aircraft Ramp	N/A	0	0
Auto Parking	87,600	33,600	41,400
Truck Apron	71,094 + 14,792 (Bldg. H) = 85,886	76,900	95,600
Other All-Cargo			
Warehousing		1,000	1,000
Office		100	100
Other		100	100
Footprint	43,036	1,200[1]	1,200[1]
Aircraft Ramp *(shared with DHL)*	N/A	*46,200*	*46,200*
Auto Parking	36,933 (Bldg. H) + 19,081 (Bldg. I) = 56,014	3,000	3,600
Truck Apron	14,792 (Bldg. I)	3,800*	3,800*

NOTES: 1 Estimated to the closest 100
N/A – Not Applicable
SOURCE: Landrum & Brown, Inc., *Air Cargo Assessment Study*, September 2021.

Chapter 4. Airport Facility Alternatives

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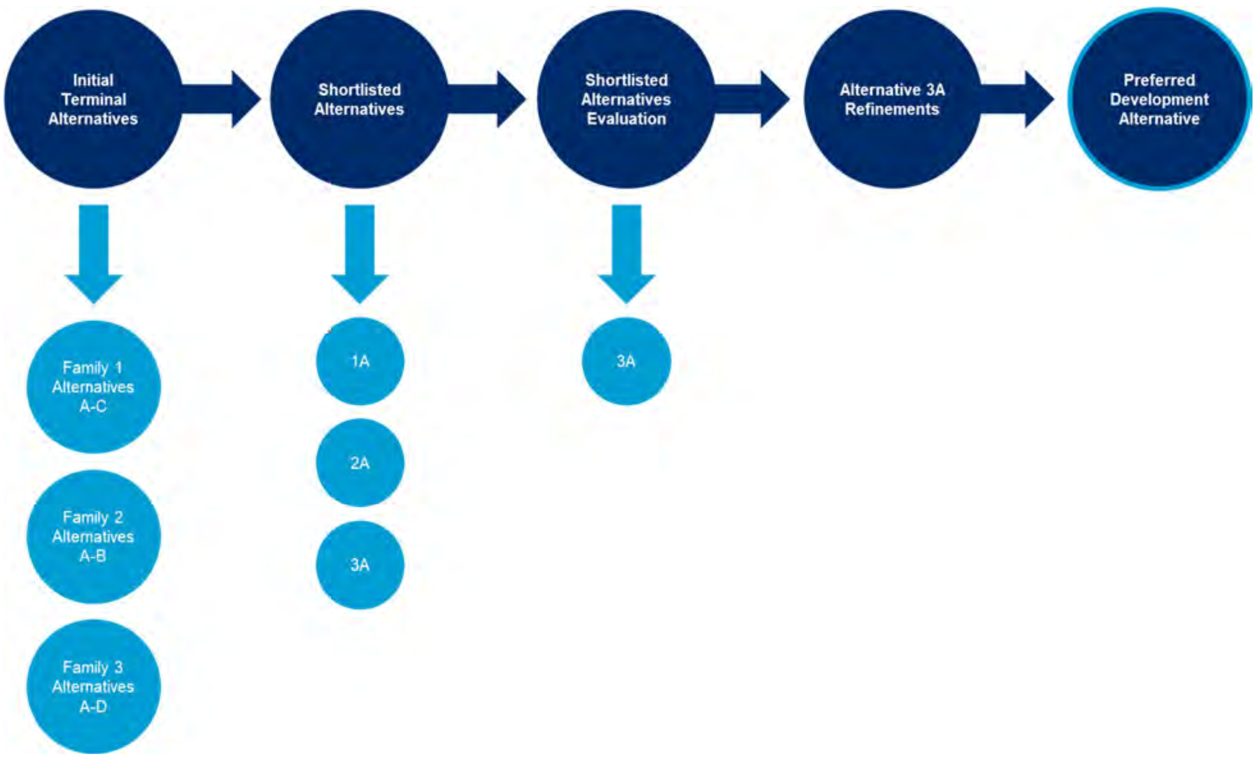
Chapter 4 Airport Facility Alternatives

This chapter describes the alternatives analysis for the 2040 LTP, which includes the initial terminal improvement alternatives and their refinement, airside improvement alternatives, landside alternatives, and support facilities alternatives. The preferred development alternative is a combination of these different elements. Using the facility requirements presented in Chapter 3, the development of alternatives was intended to generate a range of alternatives at a high level. Those alternatives were evaluated and refined through a systematic process, arriving at a preferred development alternative. **Exhibit 4-1** displays the process to select a preferred development alternative. This chapter summarizes the steps of the study and provides the preferred development alternative area layout plan.

Exhibit 4-1: Preferred Development Alternative Selection Process



SOURCE: Ricondo & Associates, Inc., February 2023.

At the beginning of the LTP, a Stakeholder Advisory Panel (SAP) was created and included community partners, airlines, passengers, agency partners, as well as business and travel groups. The intent of forming the panel was to present information about the planning process to major stakeholder groups and to ensure that those tasked with making planning decisions hear and consider public concerns and aspirations related to the process. The panel served in an advisory-level capacity. The MAC considered feedback through the process, but ultimately was responsible for all final planning decisions made. The following SAP meetings were completed throughout the LTP process:

- SAP Event #1: June 10, 2019 – Introduction to the MSP LTP
- SAP Event #2: August 27, 2019 – Forecast and Airfield Capacity
- SAP Event #3: January 30, 2020 – Public Survey Results, Forecast Update
- SAP Event #4: December 10, 2021 – Refresher on MSP LTP Process and Goals
- SAP Event #5: August 4, 2022 – Facility Requirements and Preliminary Alternatives
- SAP Event #6: April 13, 2023 – Preferred Alternative Overview

Additionally, public-facing meetings were held concurrently throughout the LTP process for community engagement and outreach efforts. “Experience MSP Event” meetings were held with Airport staff and the public to discuss and solicit feedback regarding the LTP process, facility requirements and preliminary alternatives, and selection of a preferred development alternative. Successive public events to discuss the process were held on:

- Public Event #1: October 2, 2019 – Introduction to the MSP LTP, Forecast & Capacity
- Public Event #2: April 12, 2022 – Refresher on MSP LTP Process and Goals
- Public Event #3: August 23, 2022 – Facility Requirements and Preliminary Alternatives
- Public Event #4: July 11, 2023 – Preferred Alternative Overview

4.1 AIRPORT FACILITY GOALS AND OBJECTIVES

It was determined through the LTP process that an emphasized need of additional aircraft gates and terminal space was the primary objective in future growth and demand at MSP. This conclusion came from the culmination of data obtained in the existing conditions analysis, forecast results, and a comprehensive facility gap standards review. The need for additional gates and terminal space did not preclude reviewing airside (taxiways, apron areas) or landside needs (vehicle parking, roadway accessibility), but did serve as the starting point when considering preliminary alternatives. The alternatives development process focused on fundamental needs at MSP, which included:

- prompt delivery of accessible contact gates;
- flexibility for different use scenarios and development changes;
- improvement of airfield movement and operations;
- flexibility for redevelopment and fixed points for strategic planning modifications;
- expansion of the FIS facilities for growing future demand; and
- landside improvements supporting terminal development.

It should be noted that, based on the airfield capacity study completed early in the LTP process, no runway modifications were proposed in the alternative analysis process. It is anticipated the existing runway configuration, quantity, and length of each runway will adequately serve MSP aircraft activity through the 2040 planning cycle.

4.2 TERMINAL ALTERNATIVES DEVELOPMENT

The following subsections review the terminal alternatives development, such as terminal considerations, initial terminal alternatives, and the alternatives that were short-listed for evaluation. The primary objective for the development of terminal alternatives was to maximize gate expansion in the shortest amount of time, while maintaining an acceptable airside connectivity between gates.

4.2.1 Terminal Considerations

The alternatives process began by identifying potential terminal development areas at the Airport. Each area was judged for available developable land, ease of access for both airside and landside, proximity to existing facilities, conflicting land uses, and approved project areas covered by the EA process. **Exhibit 4-2** identifies the existing Airport constraints and development areas identified as part of this study**.**

MSP contains seven distinct potential development areas divided by the runway configurations. Two separate passenger terminal complexes and associated facilities (e.g., terminal roadways, light rail, public and employee parking, and rental car facilities) occupy the Airport's southeast and east development envelopes. The T1 complex consists of terminal facilities and Concourses A through F. The T2 complex consists of terminal facilities and Concourse H. More information on the existing terminal facilities can be found in **Chapter 1**.

The other envelopes have less direct landside access to Highway 5, the primary landside access corridor to the Airport. The two northeast envelopes adjacent to Runway 30L-12R are occupied by the U.S. Air Force and Minnesota Army National Guard (MNANG), with limited future development potential. The north envelope between Runways 12R-30L and 12L-30R is limited in potential development with dieicing facilities, Federal Aviation Administration (FAA) offices, ATCT, Aircraft Rescue and Fire Fighting (ARFF) Station 2, and MAC offices and support, as well as areas allocated for currently developed Capital Improvement Plan (CIP) projects. The two western envelopes adjacent to the north end of Runway 17-35 are primarily cargo areas with limited pockets of developable area, which may provide higher and better use with the adjacent facilities.

The areas identified for the best future expansion opportunities were limited to the north of T2, south of T2, and T1 Concourse G extension. This study assessed the existing Airport configuration with the airline allocation, total gate numbers, and major elements, as well as the terminal development areas.

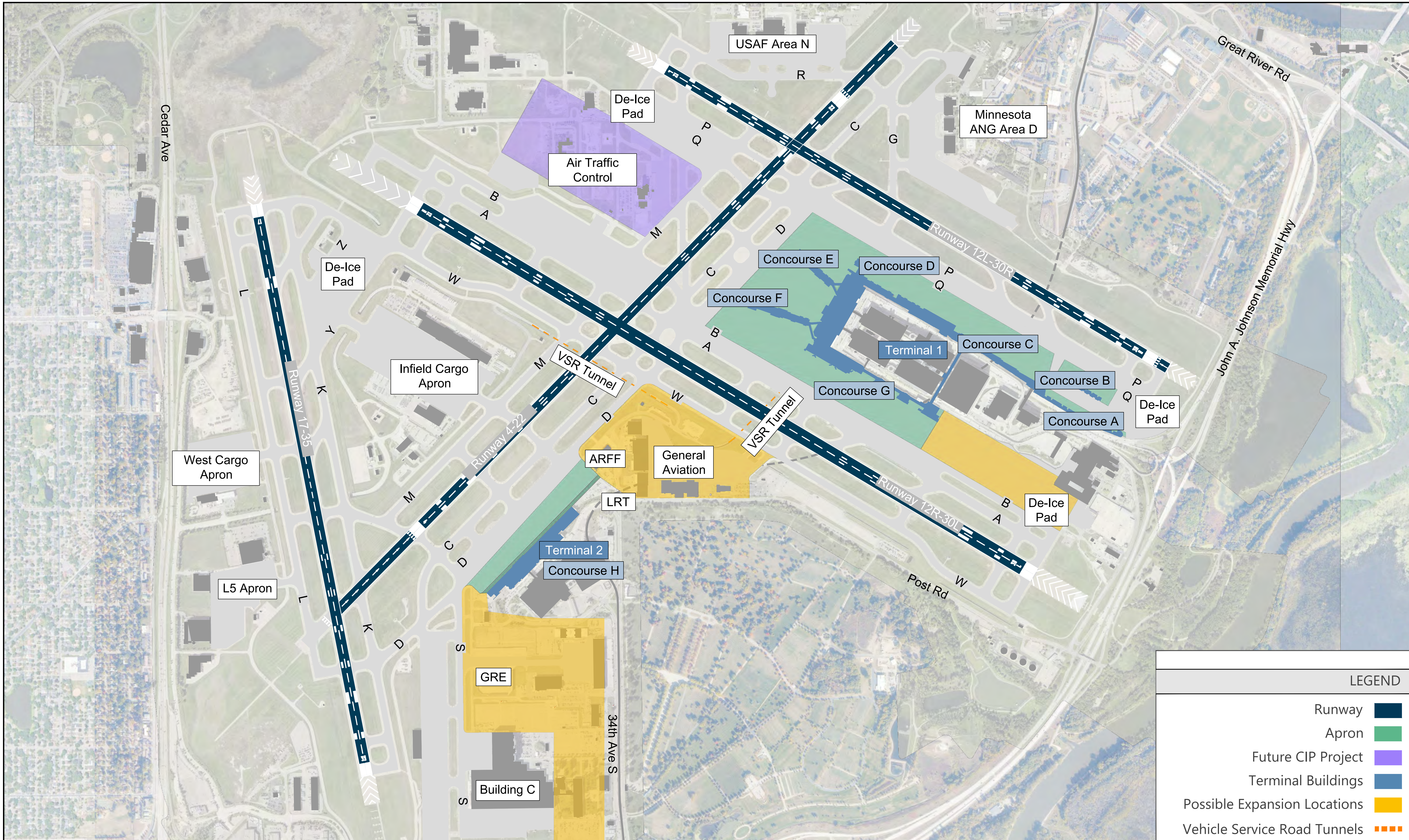


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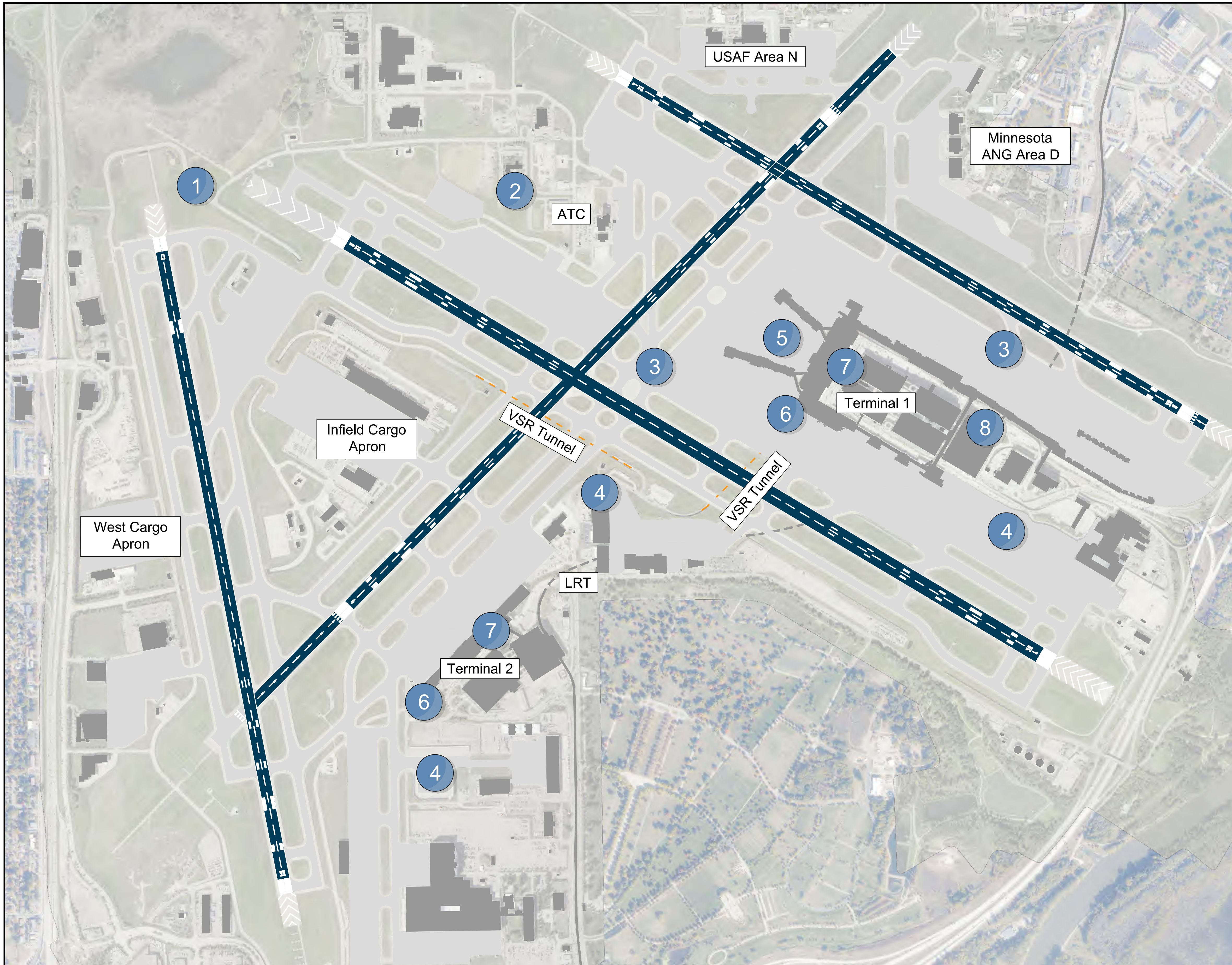
EXHIBIT 4-2
Existing Airport Constraints and Terminal Development Areas

4.2.1.1 Potential Project Challenges

During the initial alternatives development process, a list of challenges was indentified for the project. The project constraints are numbered as follows and referenced on **Exhibit 4-3**.

1. Northern runway convergence between Runways 17-35 and 12R-30L
2. Possible ATCT line-of-sight issues with an extension of Concourse G to the southeast
3. Taxiway congestion, primarily in:
    - Taxiways adjacent to Runway 4-22 within the bounds of Runways 12R-30L and 12L-30R
    - Widebody aircraft restrictions and gate pushback issues along Taxiways Q and P
    - Runway ends 30L and 30R and the adjacent deicing facilities
4. Extensive enabling projects in several locations to relocate existing facilities:
    - Deicing reconfiguration/relocation for T1 expansion in the east terminal complex
    - Possible FBO relocation for the T2 adjacent expansion in the north
    - Relocation of airside facilities, such as the flight kitchen and ground runup enclosure (GRE) for the T2 expansion in the south
5. Age of existing facilities:
    - Concourses E and F – over 40 years old
    - Green/Gold Ramp with limited useful life without extensive remodeling
    - 10-year life limit on the Concourse C tram system due to obsolescence
6. Suboptimal Federal Inspection Services (FIS) facilities in both functionality and capacity for future international arrivals demand:
    - Limited FIS facility expansion/modernization options in current locations due to constraints in location, adjacent facilities, and existing geometry
7. Suboptimal landside facilities in both functionality and capacity due to existing geometries limiting expansion capabilities:
    - Limited expansion capabilities for T1 and T2 curbsides with the existing configurations
        - T1 terminal complex enclosed by the airside on three sides
        - Landside expansion in T2 limited by Fort Snelling National Cemetery to the east and airside to the west
8. T1 passenger convenience:
    - Limited to no capability for the airside tram system (along Concourse C) to expand beyond its current configuration
    - Hub Tram system (landside) located away from the terminal cores with outdoor platforms; reconfiguration not possible without extensive infrastructure projects
    - Long walking distances for connecting passengers
        - Approximately 1.1 miles for transfer between Concourse F and Concourse A
    - Potential confusion related to wayfinding between areas
        - Efficient Concourse G to Concourse A/B pathways not easily evident
        - Circuitous routes to curbsides and parking via lower-level tunnels



Project Constraints & Challenges:

1. **Runway Convergence**
2. **Tower LOS with G Extension**
3. **Taxiway Congestion**
4. **Extensive Enabling Projects**
5. **Age of Facilities**
   - **Concourses E and F 40+ Years Old**
   - **Green/Gold Ramps**
   - **10 years EOL on Tram System**
6. **Suboptimal FIS (functionality and capacity)**
7. **Suboptimal Landside (functionality and capacity)**
8. **Terminal 1 Passenger Convenience**
   - **Airside Tram System (Along Concourse C)**
   - **Hub Core Tram System (Landside)**
   - **Walking Distances (ex. F to A 1.1 miles)**
   - **Alternate Route for Hub Core Tram is Outside**
   - **40% Connecting PAX Overall Airport**

0 1,200' 2,400'

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EXHIBIT 4-3
Potential Project Challenges

4.2.1.2 2030 Long-Term Plan Preferred Alternative

The 2030 LTP preferred alternative was used as a guide to ensure the planning, development, and operation of the Airport is compatible with current CIP projects and their surrounding environment. Completed in 2009, the 2030 LTP has been used as the basis for development at the Airport during the past decade. The plan was used as the source for the EA conducted in 2013 that includes most of the major environmentally approved projects at the Airport. With the understanding that most of the projects covered by the 2030 LTP have a faster implementation schedule than the non-environmentally approved projects, MAC used the 2030 LTP as the initial starting point for the 2040 LTP alternatives development process.

The 2030 LTP included the following project elements:

- Expand T2 terminal and gates to aid in relocation of airlines.
- Modernize and expand T1, balancing passenger loads between the two terminals.
- Develop a new International Arrivals Hall in the expanded Concourse G.
- Develop new contact gates along the Runway 30L corridor.
- Construct crossover taxiways and access road improvements at T1.
- Simplify and expand landside access to the two terminals.

Exhibit 4-4 shows the major elements from the 2030 LTP.

4.2.1.3 Planning Parameters for the Terminal Alternatives

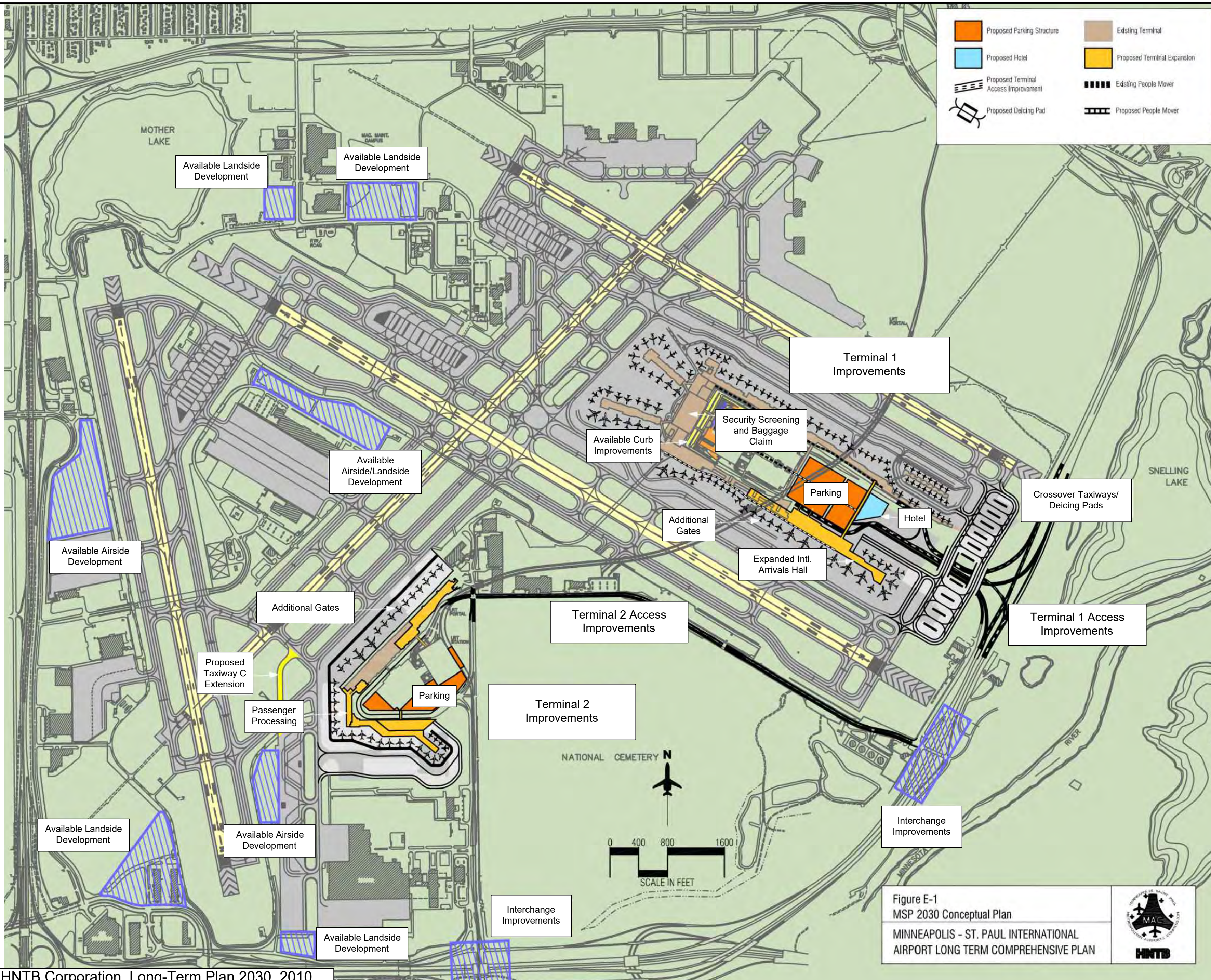
The 2040 LTP used Planning Activity Levels PALs to represent future passenger volumes and aircraft operations. PALs are an important consideration in the development, as they help to determine the infrastructure and facilities that will be needed to support the anticipated level of activity at the Airport. Using PALs instead of years allows the MAC to adjust plans accordingly, based on when those passenger volumes reach their potential. The following PALs were used to represent demand at MSP (in million annual passengers [MAP]):

- PAL 1 – 45.0 MAP (forecast to occur by 2026 per the revised forecast)
- PAL 2 – 48.8 MAP (forecast to occur by 2031 per the revised forecast)
- PAL 3 – 56.2 MAP (forecast to occur by 2040 per the revised forecast)

One of the goals of this alternatives analysis was to plan for future facilities that ultimately meet the PAL 3 demand level, while achieving benchmark goals during PAL 2 phasing for each terminal alternative.

4.2.2 Initial Terminal Alternatives

This section describes the initial terminal alternatives developed as part of the terminal alternatives process. The focus of the terminal alternatives effort was the identification of long-range terminal alternatives that would remedy existing facility deficiencies and accommodate demand through PAL 3. The alternatives were developed in a manner that complements the capacity of existing and planned facilities and integrates efficiently with the landside and airfield.



SOURCE: HNTB Corporation, Long-Term Plan 2030, 2010

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EXHIBIT 4-4
2030 Long-Term Plan

The facility requirements defined in **Chapter 3** provided the quantitative basis for formulating development alternatives to accommodate forecast demand. The ultimate objective was to define a preferred alternative that allows for logical and incremental development of facilities, while protecting long-term future Airport development. The process was intended to capture a broad range of alternatives at a high level and evaluate and refine them through a systematic progression to arrive at a preferred alternative. After an analysis of past studies, the 2030 LTP preferred alternative, and the existing conditions, three families of initial alternatives were developed. Each family was based on an alternative strategy that allowed for development in the key areas of gate expansion, international arrivals capacity, and improvement of passenger convenience. The three families were:

- **Alternative Family 1** – Using the framework of the 2030 LTP preferred alternative, the alternatives expanded the gates' capabilities at both terminals. Updates to the original preferred alternative included consolidating all international arrival operations to T1, while replacing Concourses E, D, and F. These alternatives also eliminated the proposed Runway 30L-30R east crossfield taxiway due to the impacts to the apron and the landside entryway for T1, as well as constructability issues.
- **Alternative Family 2** – Developed as a unified terminal operation, T1 and T2 would be connected on the airside by underground tunnel/Automated People Mover (APM) system, allowing for secure passenger movement between terminals. Gate expansion would occur at both terminals by extending existing Concourses G and H. Concourses E, D, and F would be replaced as well.
- **Alternative Family 3** – Based on the 2030 LTP preferred alternative, the alternatives expanded the gates capabilities at both terminals by extending existing Concourses G and H, with international arrival operations at both T1 and T2. These alternatives also eliminated the proposed Runway 30L-30R east crossfield taxiway due to the impacts to the apron and the landside entryway for T1, as well as constructability issues.

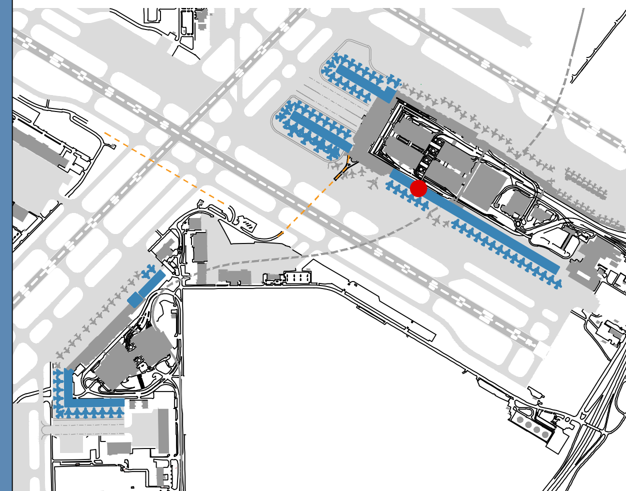
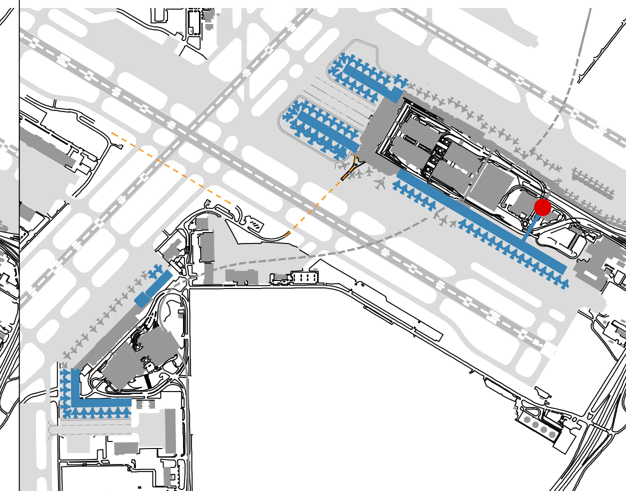
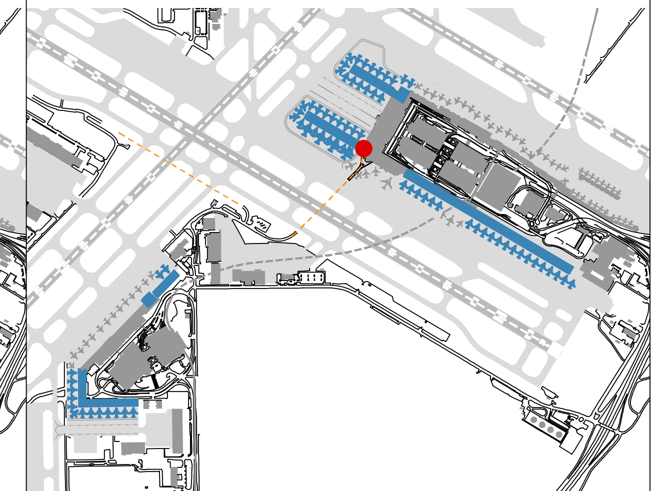
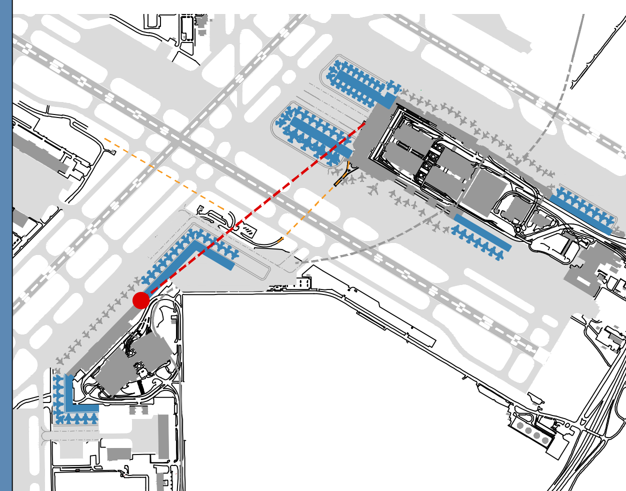
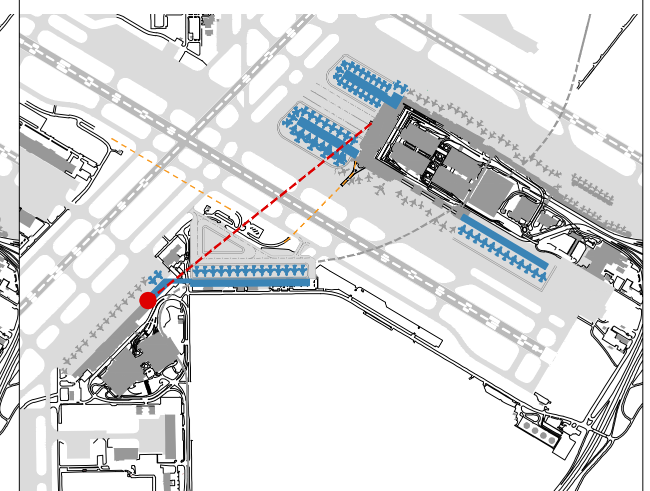
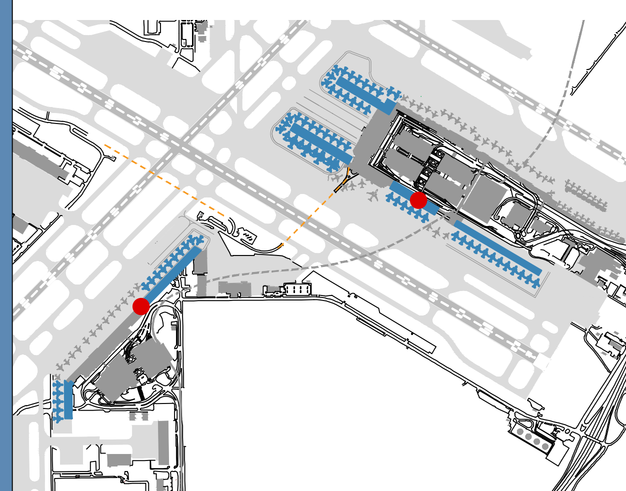
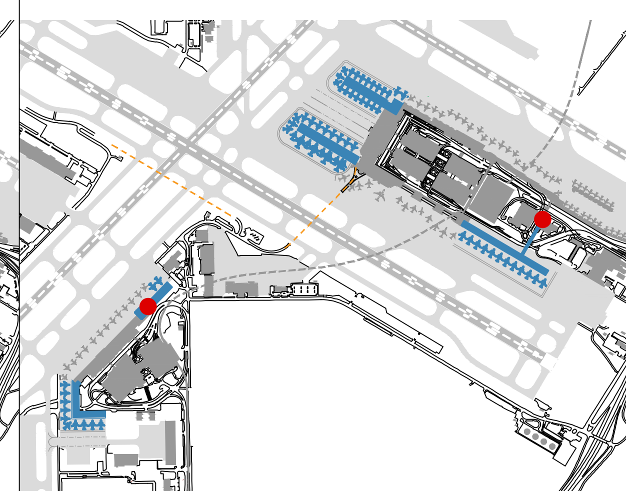
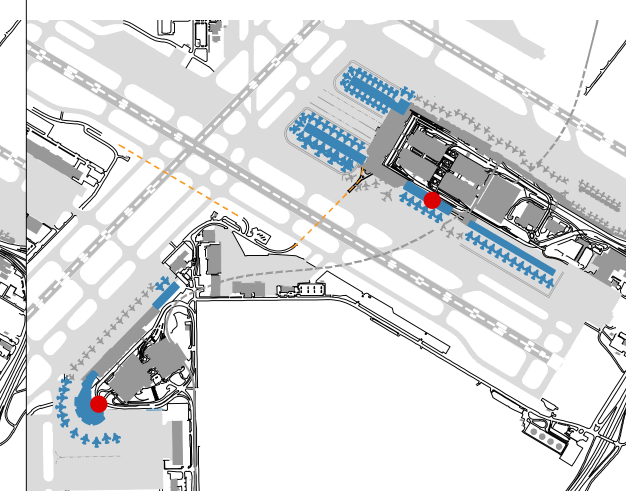
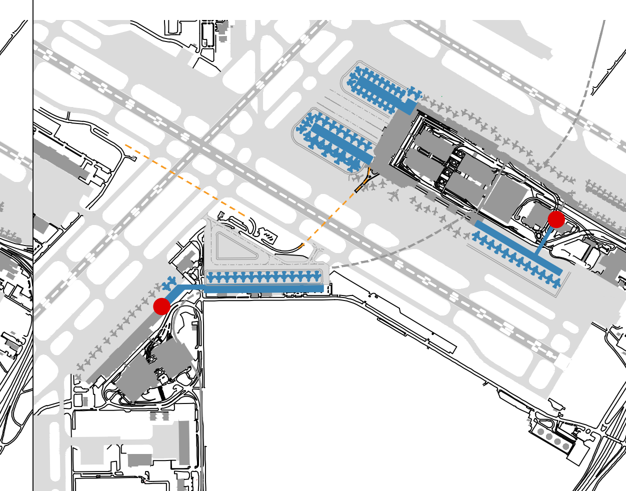
Exhibit 4-5 depicts the initial terminal alternatives based on the three families.

4.2.3 Short-Listed Terminal Alternatives

The MAC and Airport stakeholders vetted the initial alternatives to identify alternatives that fulfilled the Airport's fundamental needs, while best supporting the primary goals for accommodating growth at the Airport. An alternative that best achieved these objectives was picked from each family and refined with stakeholder input.

Three short-listed terminal alternatives were carried forward in the analysis and labeled as 1A, 2A, and 3A. At this stage of the analysis, landside and airside components were refined to accompany the terminal alternatives. Common elements among all three terminal alternatives included:

- Redevelopment of Concourses D, E, and F
- Concourse G expansion
- Sharing of contact gates among carriers in PAL 3
- Redeveloped multi-purpose ramps
- T2 expansion to the south

	Alternative A	Alternative B	Alternative C	Alternative D
Family 1 Updated Long-Term Plan 2023 with One Federal Inspection Services Facilities				
Family 2 Unified Terminal				
Family 3 Updated Long-Term Plan 2023 with Two Federal Inspection Services Facilities				

SOURCE: Ricondo & Associates December 2022

The following subsections describe each short-listed alternative in greater detail, including the facility development, primary enabling projects, gate counts, and passenger convenience.

4.2.3.1 Terminal – Alternative 1A

Exhibit 4-6 displays the Alternative 1A terminal layout. The following subsections describe this alternative.

Facility Development

Alternative 1A would maintain two separate terminals, and a single consolidated FIS facility would be provided in T1. The FIS facility would take approximately five years to construct.

For Alternative 1A, T1 consists of a single-loaded 10-gate expansion on Concourse G, with the redevelopment of Concourses D, E, and F to align with the existing Concourses C and G flight lines. The alternative would also provide a single-loaded 13-gate expansion on the south end of T2.

Enabling Projects

The enabling projects for T1 include redevelopment of the Green/Gold Ramps, relocation of the Runway 30L deicing facility, and demolition of Concourses D, E, and F, with temporary relocation of their contact gates.

The enabling projects for T2 include relocation of the landside Quick Turn Around (QTA) facility, flight kitchen, and Ground Runup Enclosure (GRE), as well as realignment of Taxiway S2 for the southern concourse extension.

Gate Summary

A total of 137 gates would be provided, meeting the gate requirements for both PAL 2 and PAL 3. PAL 2 does not require gate sharing between carriers in T1, while sharing is required as the gate demand approaches PAL 3.

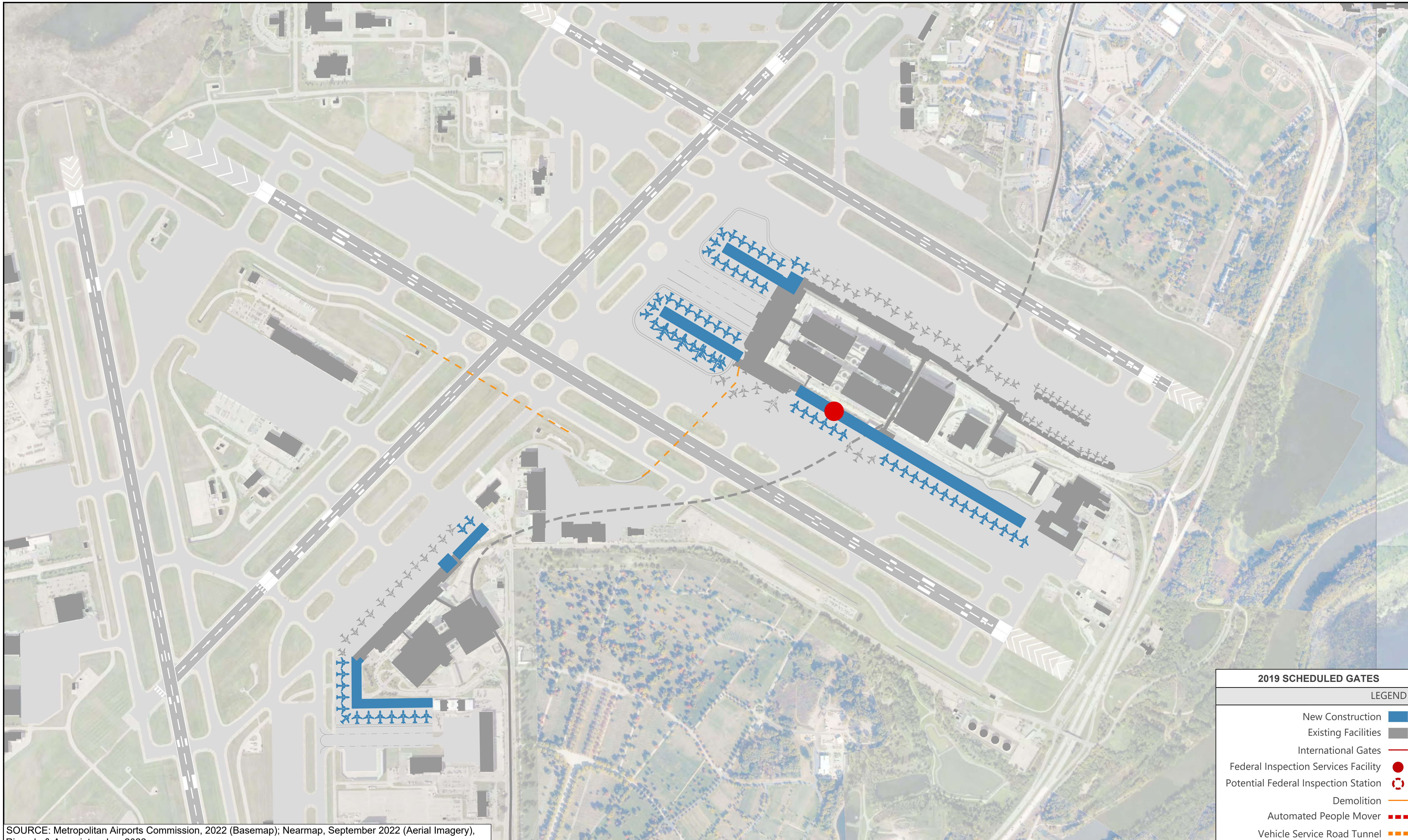
Walking Distances and Connectivity

T1 provides 86 gates within a 10-minute walking distance of the FIS facility and 71 gates within a 10-minute walking distance of a Safety and Security Checkpoint (SSCP). T2 provides 29 gates within a 10-minute walking distance of a SSCP, without airside access to the FIS facility.

Passengers can connect between the two terminals via two non-secure routes: the Metro Blue Line and commercial vehicles via landside access. There is no airside connectivity between the terminals.

Airfield Considerations

The largest airfield impacts associated with this alternative are to the Runway 30L deice pad and adjacent Remain Overnight (RON) positions and Delta maintenance ramp. The Concourse G expansion extends southeast from the existing terminal to the Delta maintenance hangar abeam the Runway 30L approach end. The terminal expansion results in the elimination of RON parking positions (exact number dependent on the size/type of aircraft being parked at any given time), as well as elimination of the five deicing positions on the Runway 30L deice pad. The Delta maintenance ramp would also be impacted by the last gate position on the concourse.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Nearmap, September 2022 (Aerial Imagery), Ricondo & Associates, Inc, 2022.

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EXHIBIT 4-6
Alternative 1A Terminal Layout

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Airfield impacts from the T2 expansion in Alternative 1A are limited to the elimination of two RON parking positions to the north of the existing terminal, adjacent to the ARFF building. A minor reconfiguration of access to the GRE and Delta cargo facilities south of T2 would be required in Alternative 1A; however, these two facilities would remain in their current location.

4.2.3.2 Terminal – Alternative 2A

Exhibit 4-7 displays the Alternative 2A terminal layout. The following subsections describe this alternative.

Facility Development

Alternative 2A would unify the terminals via an airside APM and provide a single FIS facility in T2. The FIS facility would take approximately five years to construct.

For Alternative 2A, T1 would have a single-loaded 4-gate expansion on Concourse G, with the redevelopment of Concourses D, E, and F to align with the existing Concourses C and G flight lines.

T2 would extend to both the north and the south of the existing footprint. On the south end of T2, a single-loaded 10-gate expansion would be provided. On the north end of T2, a single-loaded 13-gate expansion would be provided, causing the displacement of the existing Fixed Base Operator (FBO).

Enabling Projects

The enabling projects for T1 include reconfiguration of the Runway 30L deicing facility, realignment of the Runway 12R-30L Vehicle Service Road (VSR) tunnel, and demolition of Concourses D, E, and F, with temporary relocation of their contact gates.

The enabling projects for T2 include relocation of the landside QTA facility, flight kitchen, and GRE, as well as realignment of Taxiway S2 for the southern concourse extension. The northern concourse extension enabling projects include relocation of the FBO and adjacent surface parking lots and realignment of the Runway 12R-30L VSR tunnel.

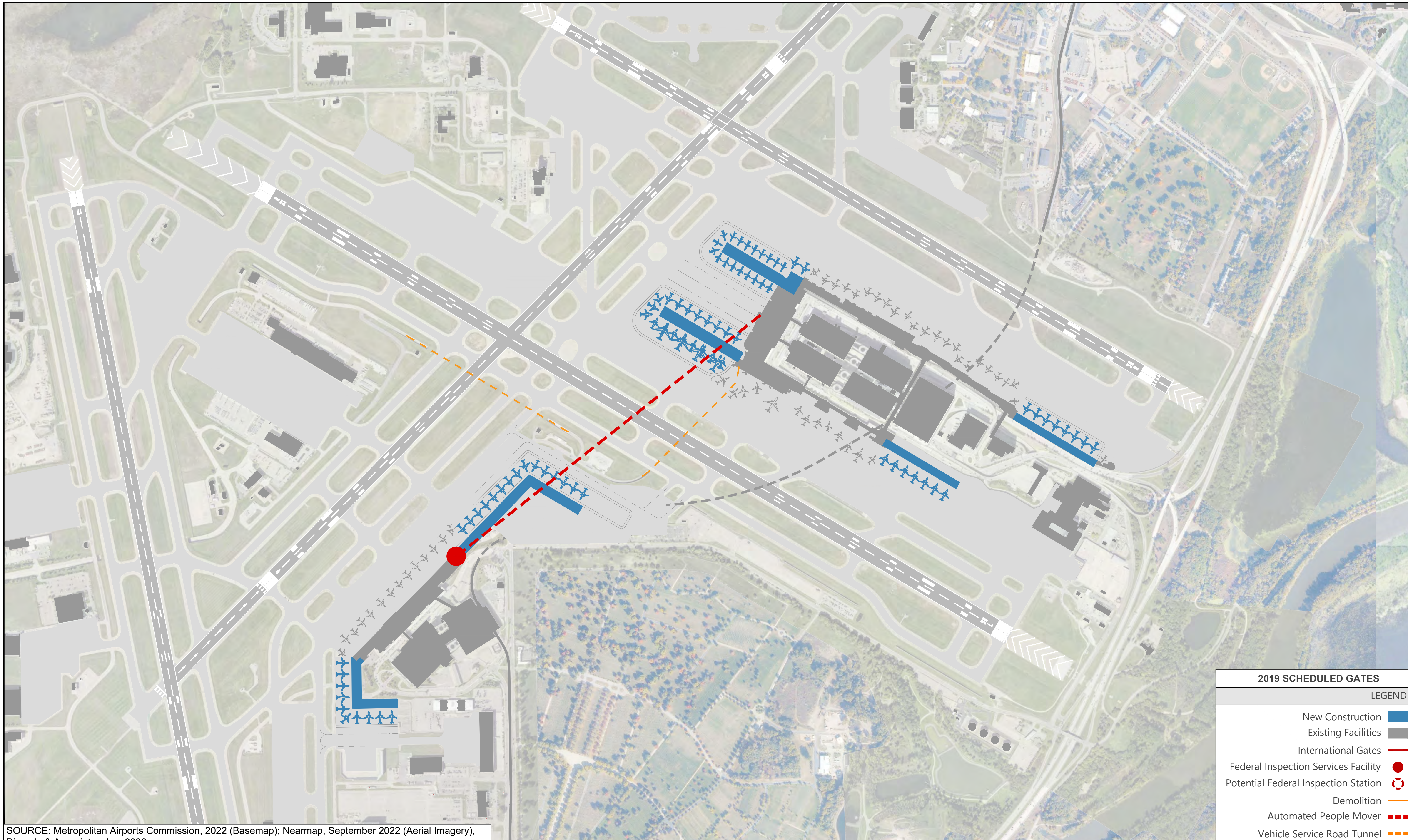
Gate Summary

A total of 139 gates would be provided in PAL 2, meeting the gate requirements, with room for expansion, and a total of 128 gates would be provided in PAL 3, meeting the gate requirements. The PAL 2 configuration requires international gate sharing in T1. The PAL 3 configuration does require gate sharing in both terminals to accommodate PAL 3 gate demand.

Based on existing operations, some airlines, such as Delta, would be required to use split-operations in this alternative, where international traffic operates in T2 and domestic out of T1.

Walking Distances and Connectivity

T1 provides 71 gates within a 10-minute walking distance of a SSCP. T2 provides 96 gates within a 10-minute walking distance of the FIS facility and 96 gates within a 10-minute walking distance of a SSCP.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Nearmap, September 2022 (Aerial Imagery), Ricondo & Associates, Inc, 2022.

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EXHIBIT 4-7
Alternative 2A Terminal Layout

This alternative is based on the capability to use gates on either terminal, regardless of which terminal passengers process through. Passengers can connect between the two terminals via one secure and two non-secure routes. The non-secure routes are the Metro Blue Line and commercial vehicles via landside access. The terminals are connected on the secure airside via a future APM crossing under Runway 12R-30L, with single termination points at the T1 headhouse and T2 headhouse, adjacent to the relocated centralized FIS facility.

Airfield Considerations

The primary airfield impacts associated with this alternative are to the existing FBO apron north of T2. The north expansion of T2 would require the relocation of the FBO terminal and hangars. Like Alternative 1A, a minor reconfiguration of the access to the GRE and Delta cargo facility is required. Both facilities would remain in their existing location.

4.2.3.3 Terminal – Alternative 3A

Exhibit 4-8 displays the Alternative 3A terminal layout. The following subsections describe this alternative.

Facility Development

Alternative 3A would provide an FIS facility in each terminal and maintain separation between the two terminals and is how the airfield operates today.

Regarding Terminal 1, Alternative 3A would provide a single-loaded 4-gate expansion on Concourse G and the redevelopment of Concourses D, E, and F to align with the existing Concourses C and G flight lines.

A single-loaded 10-gate expansion would be provided on the south end of T2. On the north end, a single-loaded 9-gate expansion would be developed northeast of the existing ARFF facility connected by an airside bridge.

Enabling Projects

The enabling projects for T1 include redevelopment of the Green/Gold Ramps, reconfiguration of both the Runway 30L and 30R deicing facilities, realignment of the Runway 12R-30L VSR tunnel, and demolition of Concourses A, B, D, E, and F, with temporary relocation of their contact gates.

The enabling projects for T2 include relocation of the landside QTA facility, flight kitchen, and GRE, as well as realignment of Taxiway S2 for the southern concourse extension. The northern concourse extension enabling projects include relocation of the FBO and adjacent surface parking lots and realignment of the Runway 12R-30L VSR tunnel.

Gate Summary

A total of 132 gates would be provided in PAL 2, meeting the gate requirements, and a total of 129 gates would be provided in PAL 3, meeting the gate requirements. PAL 2 requires international gate sharing in T1 and T2. In PAL 3, the alternative does require sharing in both terminals.

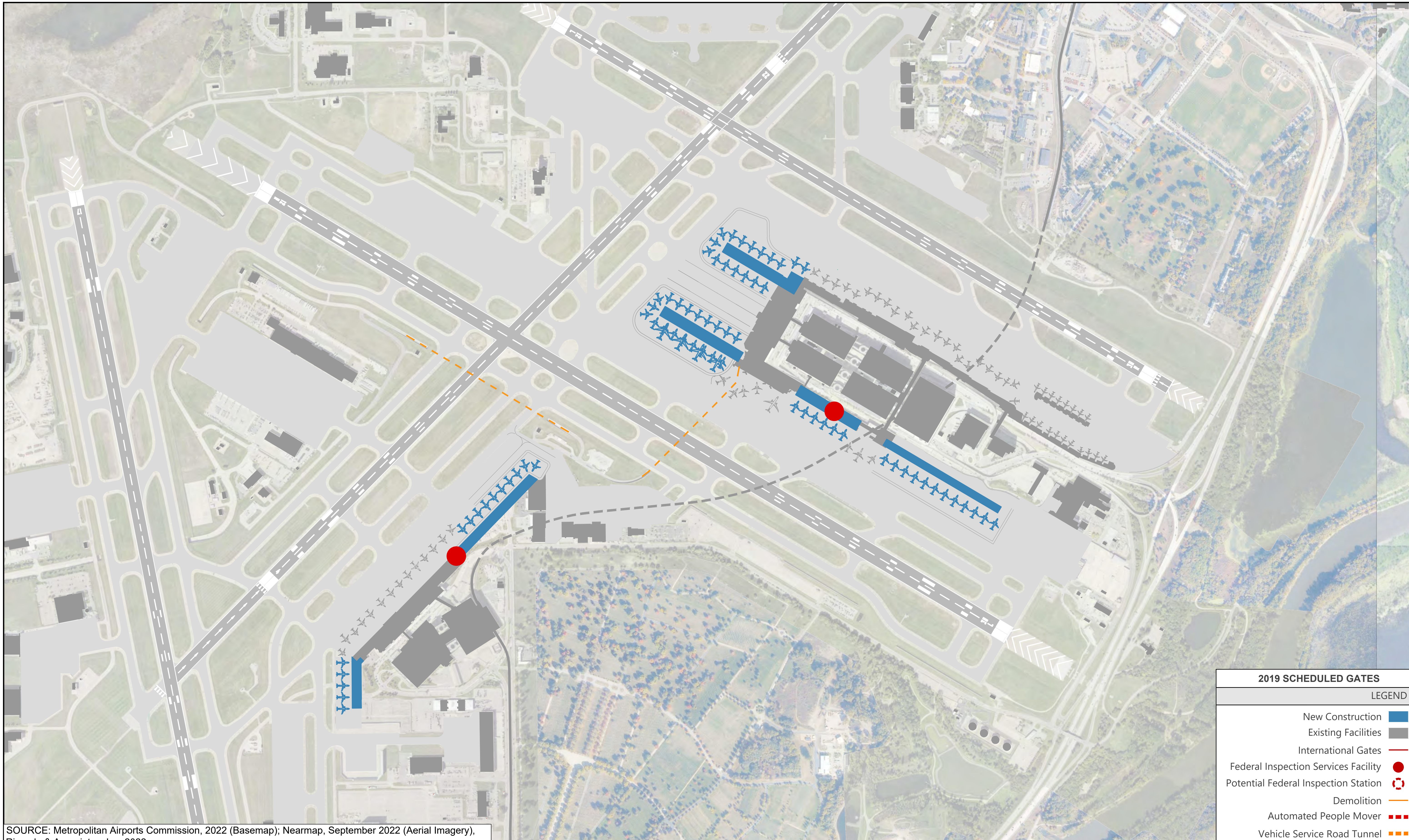
Walking Distances and Connectivity

T1 provides 91 gates within a 10-minute walking distance of the FIS facility and 71 gates within a 10-minute walking distance of a SSCP. T2 provides 32 gates within a 10-minute walking distance of the FIS facility and 32 gates within a 10-minute walking distance of a SSCP.

Passengers can connect between the two terminals via two non-secure routes: the Metro Blue Line and commercial vehicles via landside access. There is no airside connectivity between the terminals.

Airfield Considerations

The primary airfield impacts associated with this alternative are to the existing FBO apron north of T2. The north expansion of T2 would require the relocation of the FBO terminal and hangars. Like Alternative 1A, a minor reconfiguration of the access to the GRE and Delta cargo facility is required, but both facilities would remain in their existing location. Deice and RON parking east of Concourses B and G would also be impacted.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Nearmap, September 2022 (Aerial Imagery), Ricondo & Associates, Inc, 2022.

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EXHIBIT 4-8
Alternative 3A Terminal Layout

4.3 AIRFIELD DEVELOPMENT

Chapter 3 reviewed the existing conditions at MSP, considering the design standards set forth in FAA AC 13B, and it identified Airport components not in compliance with the AC. Chapter 3 also identified other airfield improvements needed to meet operational needs and airfield capacity throughout the forecast horizon. The requirements determined in Chapter 3 were used to develop this section. This section describes the airfield alternatives according to geometric alternatives, airfield capacity, deice facilities, RON parking, air cargo, and FBO.

4.3.1 Geometric Alternatives

4.3.1.1 Safety Areas

The gap analysis summarized in Chapter 3 identified several objects within safety areas (i.e., RSA, ROFA, taxiway safety area, and TOFA) that are not fixed by function and therefore not allowed within these areas. Objects such as wind cones, weather reporting stations (automated surface observing system [ASOS]), NAVAID shelters, and VSRs should be relocated outside the applicable safety areas. These objects are tabulated in Chapter 3.

4.3.1.2 Taxiway Edge Geometry

The standards in 13B call for the outer pavement edges of taxiways located at runway ends to be curved. The curved taxiway edge distinguishes the taxiway from the runway and has been identified as a runway incursion mitigation (RIM) factor, which guards against wrong-surface landings. MSP has five locations where the outer edge of taxiway pavement at a runway end was constructed with a 90-degree angle. These locations are the Taxiway L / Taxiway L3 intersection, Taxiway L / Taxiway L10 intersection, Taxiway K / Taxiway K1 intersection, Taxiway W / Taxiway W1 intersection, and Taxiway R / Taxiway R10 intersection. Implementation of the improvements at these locations entails removing existing taxiway pavement and replacing it with grass.

4.3.1.3 Taxiway Edge Safety Margin

Standard taxiway corners are constructed with a series of straight-line tangents along the inner portion of the turn. The TESM analysis conducted as part of the LTP identified numerous taxiway turning movements throughout the airfield where the TESM was not met for both TDG 5 and TDG 6 aircraft. Violations of the TESM criteria were identified through turning movement analysis in AutoCAD using the AviPLAN application. The largest violations indicated that for some turning movements, the aircraft’s main landing gear would track outside the taxiway width and onto the shoulder. This situation would likely result in taxiway edge lights being hit and knocked over. However, there was no feedback received from Airport operations staff noting that this was a common occurrence, which indicates pilots may use judgmental oversteer while taxiing at MSP.

As taxiways are either reconstructed or rehabilitated through the CIP, standard taxiway fillets should be installed at taxiway intersections. Locations likely to experience movements by TDG 5 and TDG 6 aircraft should be prioritized for improvements. These locations include intersections along Taxiway T leading to the Central Cargo Apron and intersections along Taxiways A, B, C, D, and W, which are the primary taxiway routes between the terminals and runways.

4.3.2 Airfield Capacity

Airfield capacity regarding runway quantity, alignment, and length were not considered as facility needs in the alternative analysis process. The airfield capacity study analysis, completed at the onset of the LTP, concluded the current runway configuration meets the future demand of MSP operations. This analysis considered multiple future improvements with the goal of enhancing the airfield's capacity. These improvements included alternatives for a crossfield taxiway between Runways 30L and 30R, an End-Around Taxiway (EAT), a Runway 30R partial parallel taxiway, and removing a pinch point along of Taxiways A and B.

4.3.2.1 Crossfield Taxiway

The location of T1 between two of the Airport's primary runways can lead to long taxi times for aircraft on gates at Concourses A and B and Concourse G when they need to access a runway on the opposite side of the terminal. The taxiway route for this condition is on Taxiway C or Taxiway D, which can be further congested by aircraft accessing gates at Concourses F and G. To provide more direct access between the ends of Runway 30L and Runway 30R, a crossfield taxiway built to ADG V standards was considered.

Two taxiway alignments were considered for the capacity enhancement. The first alignment maintained a straight taxiway path connecting the ends of Runway 30L and Runway 30R. The second alignment avoided impacting the Runway 30R deice pad by offsetting the alignment to the west. **Exhibits 4-9** and **4-10** present the two alignments as Alternatives 1 and 2, respectively. Both alignments would require partial demolition of Concourse A and would cause significant impacts to the Delta maintenance facility located east of T1. Significant landside impacts would be expected from the required lowering of the T1 access roads to allow for the crossfield taxiways to cross over the landside roadways. For these reasons, both crossfield taxiways were eliminated from further consideration.

4.3.2.2 End-Around Taxiway (EAT)

An EAT enhances airfield capacity by allowing aircraft to safely taxi from one side of a runway to the other during departure operations, as well as cross the extended runway centerline without a clearance from ATC. At MSP, capacity improvements would be expected through the construction of an EAT at the departure end of Runway 30L. During North Flow, a Runway 30L EAT would allow an aircraft landing on Runway 35 to access the T1 gates without crossing Runway 30L. Similarly, during Mixed Flow A, aircraft taxiing from T1 to Runway 17 for departure would not need to cross Runway 30L and experience a crossing delay. Three EAT alignment alternatives were considered, as shown on **Exhibits 4-11** to **4-13**.

EAT Alternative 1 - EAT Alternative 1 includes an EAT connecting Taxiway B to Taxiway L. Alternative 1 crosses the extended Runway 30L centerline approximately 2,800 feet from the Runway 12R threshold.

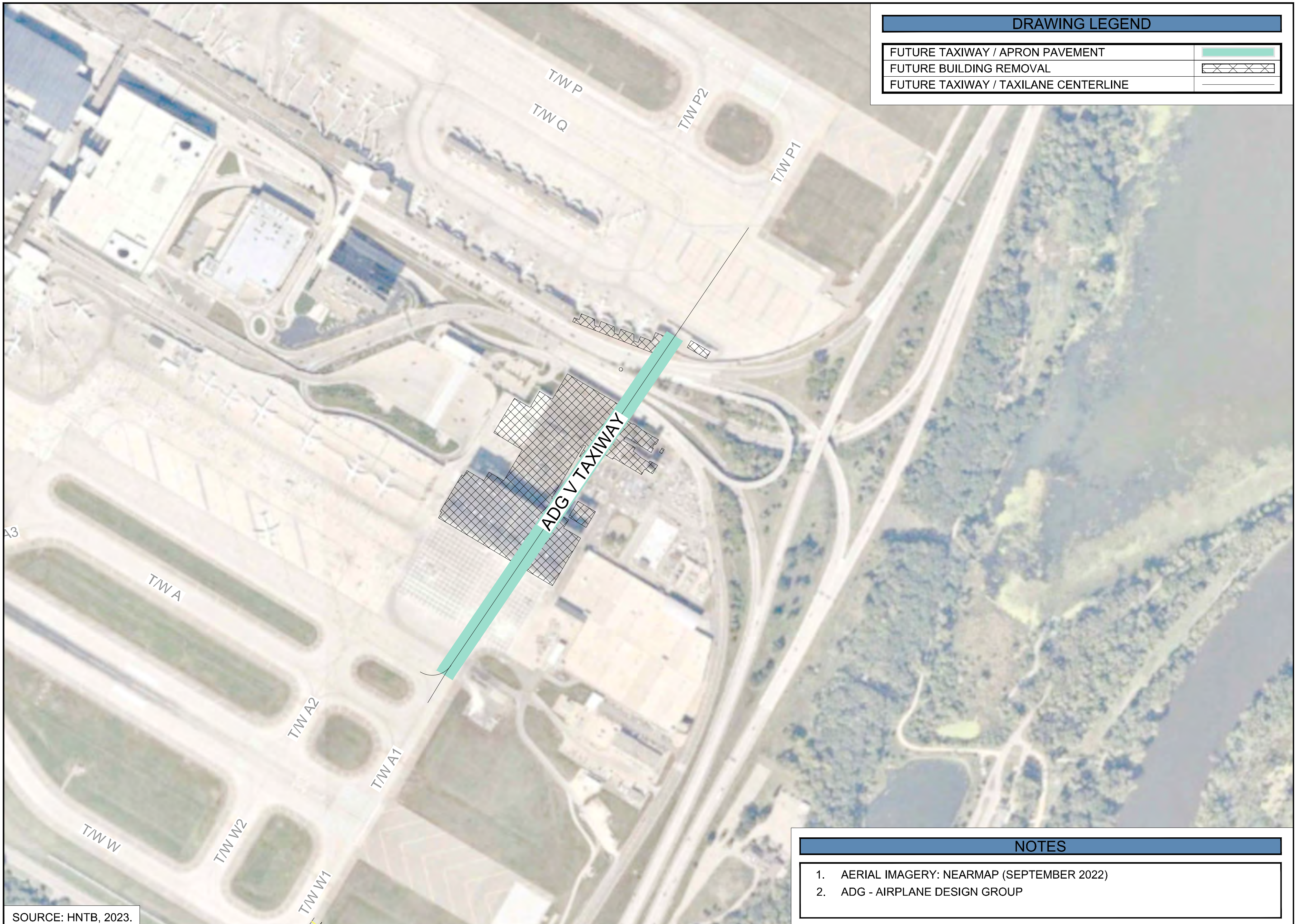
Construction of EAT Alternative 1 would likely impact Mother Lake and its surrounding wetland areas. Therefore, Alternative 1 was eliminated from further consideration.

EAT Alternative 2 - EAT Alternative 2 includes an EAT connecting Taxiway B to Taxiway K. Alternative 2 crosses the extended Runway 30L centerline approximately 2,800 feet from the Runway 12R threshold.

Like EAT Alternative 1, construction of EAT Alternative 2 would likely impact Mother Lake and its surrounding wetland areas. Therefore, Alternative 2 was eliminated from further consideration.

EAT Alternative 3 - EAT Alternative 3 also includes an EAT connecting Taxiway B to Taxiway K. However, Alternative 3 would cross the extended Runway 30L centerline 1,800 feet from the Runway 12R threshold. This alignment avoids impacts to Mother Lake and surrounding areas, but it would require reconfiguration of the ALS for Runway 12R.

Since the EAT crosses the extended runway centerline closer to the Runway 12R threshold, there is not as much clearance to the Runway 30L departure surface as in Alternatives 1 and 2. Aircraft operating on the EAT Alternative 3 alignment would be limited to a tail height of 45 feet (i.e., Boeing 757-200) to operate on the EAT without a specific ATC clearance. However, most aircraft that would be expected to use the EAT would be smaller, as larger aircraft typically operate on Runway 12L-30R due to its longer length and would not need to use the EAT to access Runway 17-35.



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE BUILDING REMOVAL	
FUTURE TAXIWAY / TAXILANE CENTERLINE	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

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MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT

2040 LONG-TERM PLAN

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0 500' 1000'

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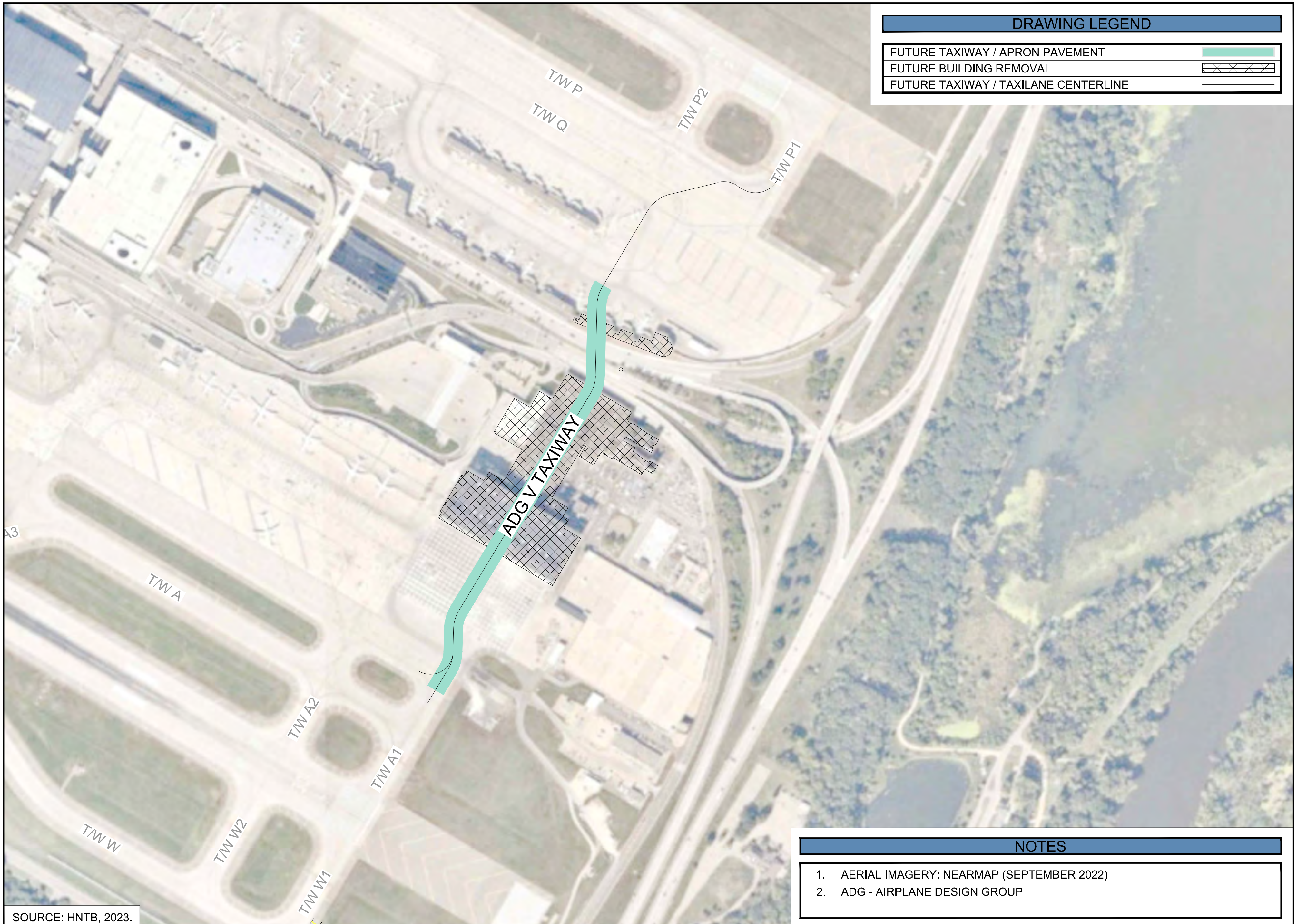
EXHIBIT 4-9

EAST CROSSFIELD ALTERNATIVE - ALTERNATIVE 1



MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT

2040 LONG-TERM PLAN

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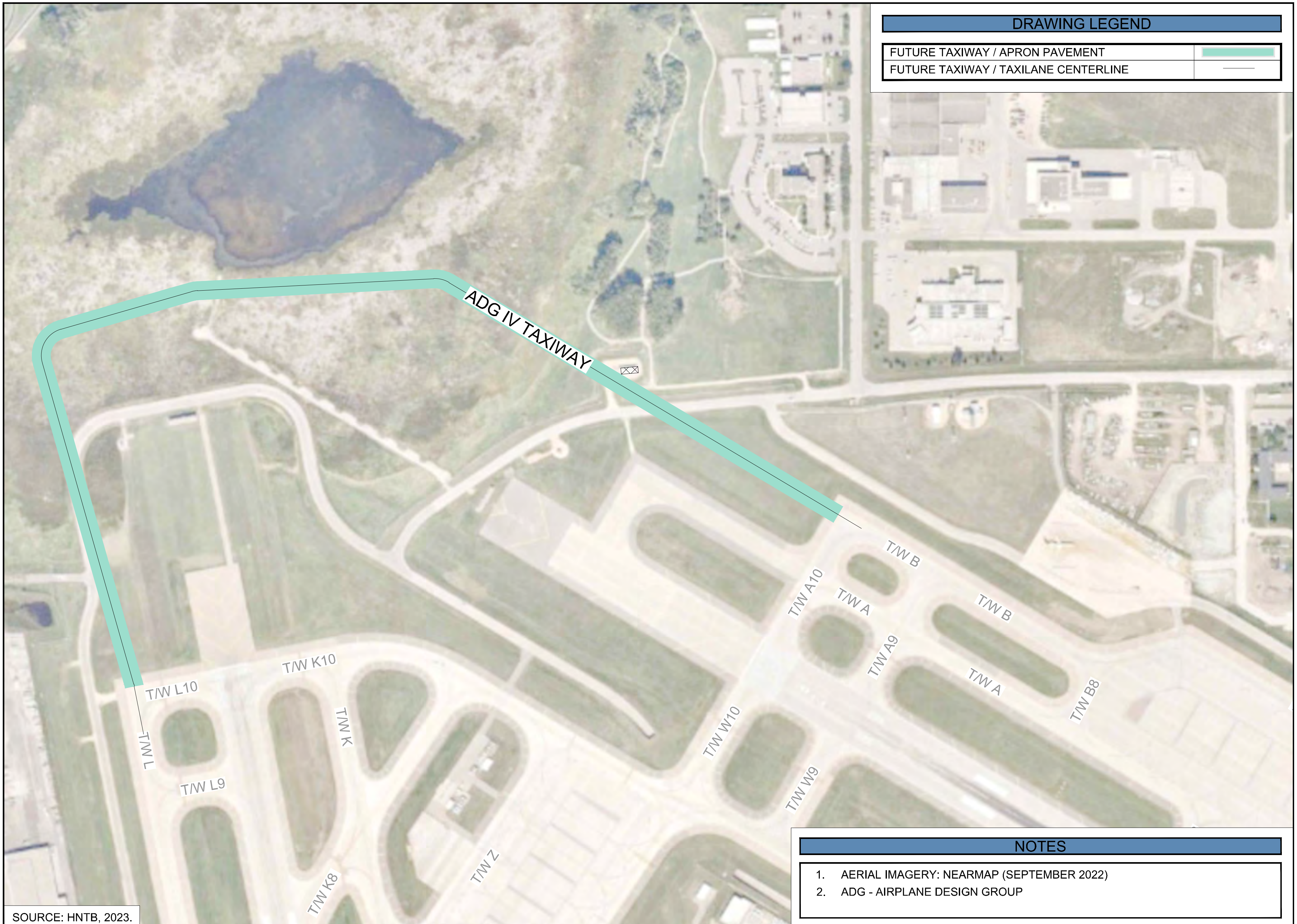
EXHIBIT 4-10

EAST CROSSFIELD ALTERNATIVE - ALTERNATIVE 2



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

N

0 500' 1000'

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MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

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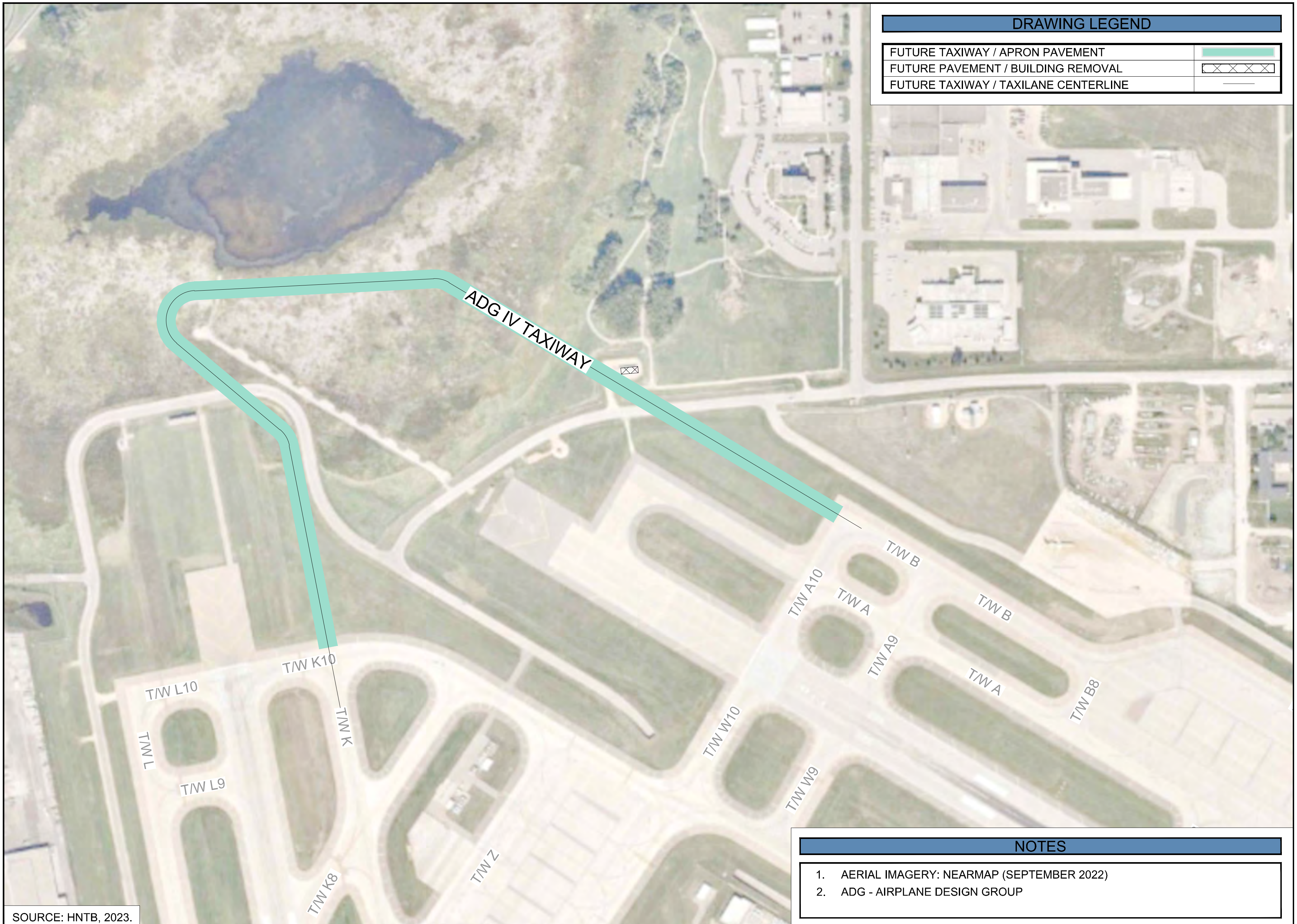
EXHIBIT 4-11

END-AROUND TAXIWAY - ALTERNATIVE 1



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE PAVEMENT / BUILDING REMOVAL	
FUTURE TAXIWAY / TAXILANE CENTERLINE	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

N
0 500' 1000'

MSP MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

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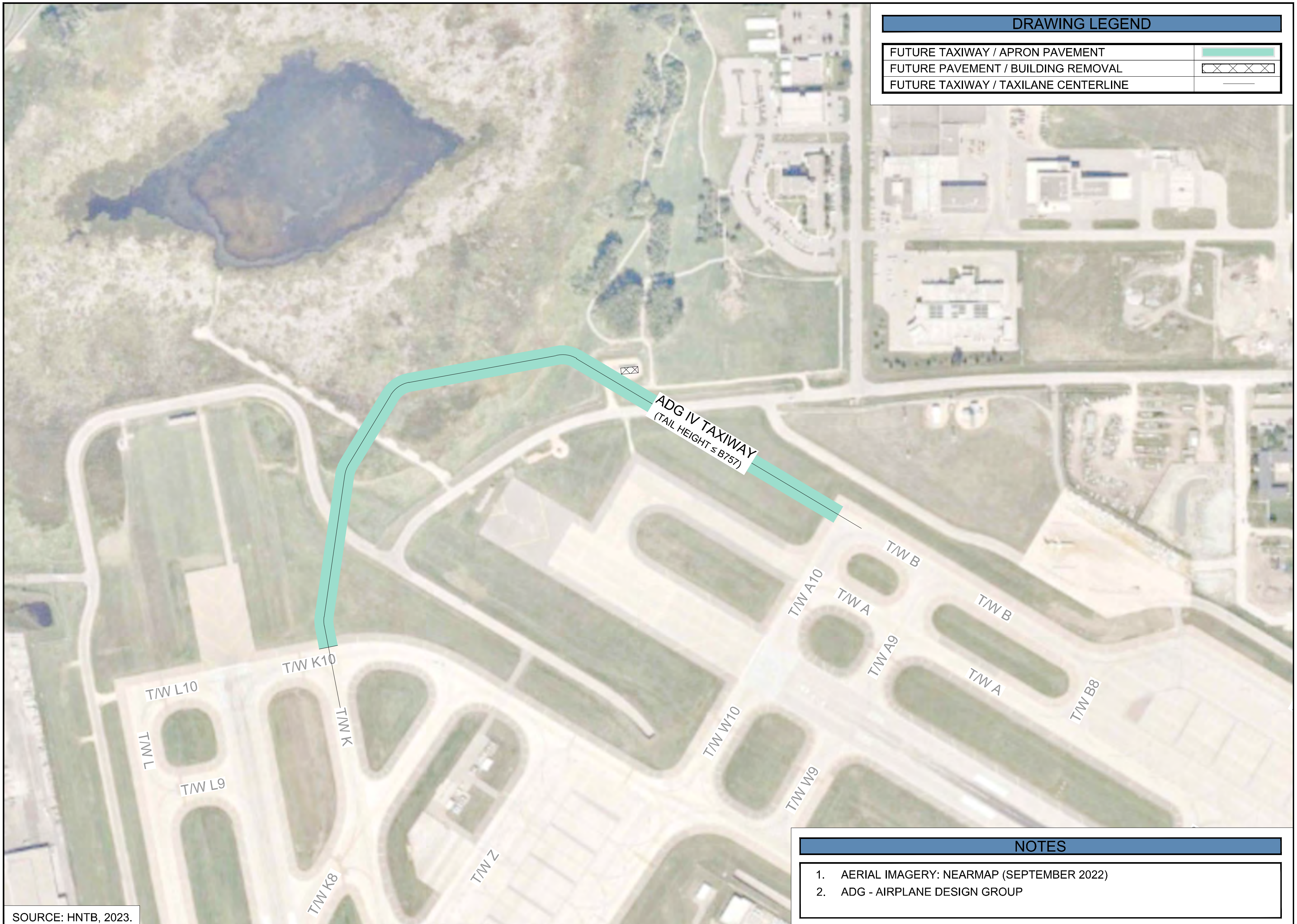
EXHIBIT 4-12

END-AROUND TAXIWAY - ALTERNATIVE 2



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE PAVEMENT / BUILDING REMOVAL	
FUTURE TAXIWAY / TAXILANE CENTERLINE	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

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2040 LONG-TERM PLAN

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0 500' 1000'

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EXHIBIT 4-13

END-AROUND TAXIWAY - ALTERNATIVE 3

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4.3.2.3 Runway 30R Partial Parallel Taxiway

Today, aircraft operating to and from the MNANG apron must cross Runway 12L-30R to access all runways, except for Runway 22. To eliminate the runway crossing when the MNANG is operating on Runway 12L-30R in either of the Airport's five primary operating conditions, an outboard taxiway connecting Taxiway G to the approach end of Runway 30R was evaluated, as shown on **Exhibit 4-14**. This alternative includes the realignment of Taxiway G and Taxiway P3 to 90-degree crossings of Runway 12R-30L and a bypass entrance taxiway at the Runway 30R approach end.

In addition to serving MNANG operations, the outboard taxiway can be used for additional aircraft staging and departure queuing for Runway 30R, eliminating congestion on Taxiway P and Taxiway Q. Currently, Taxiways P and Q have ADG wingspan limitations. This north partial parallel taxiway would permit fully conforming ADG V aircraft access to the Runway 30R approach end. Enabling this project would likely require the relocation of the existing Runway 30R glideslope antenna.

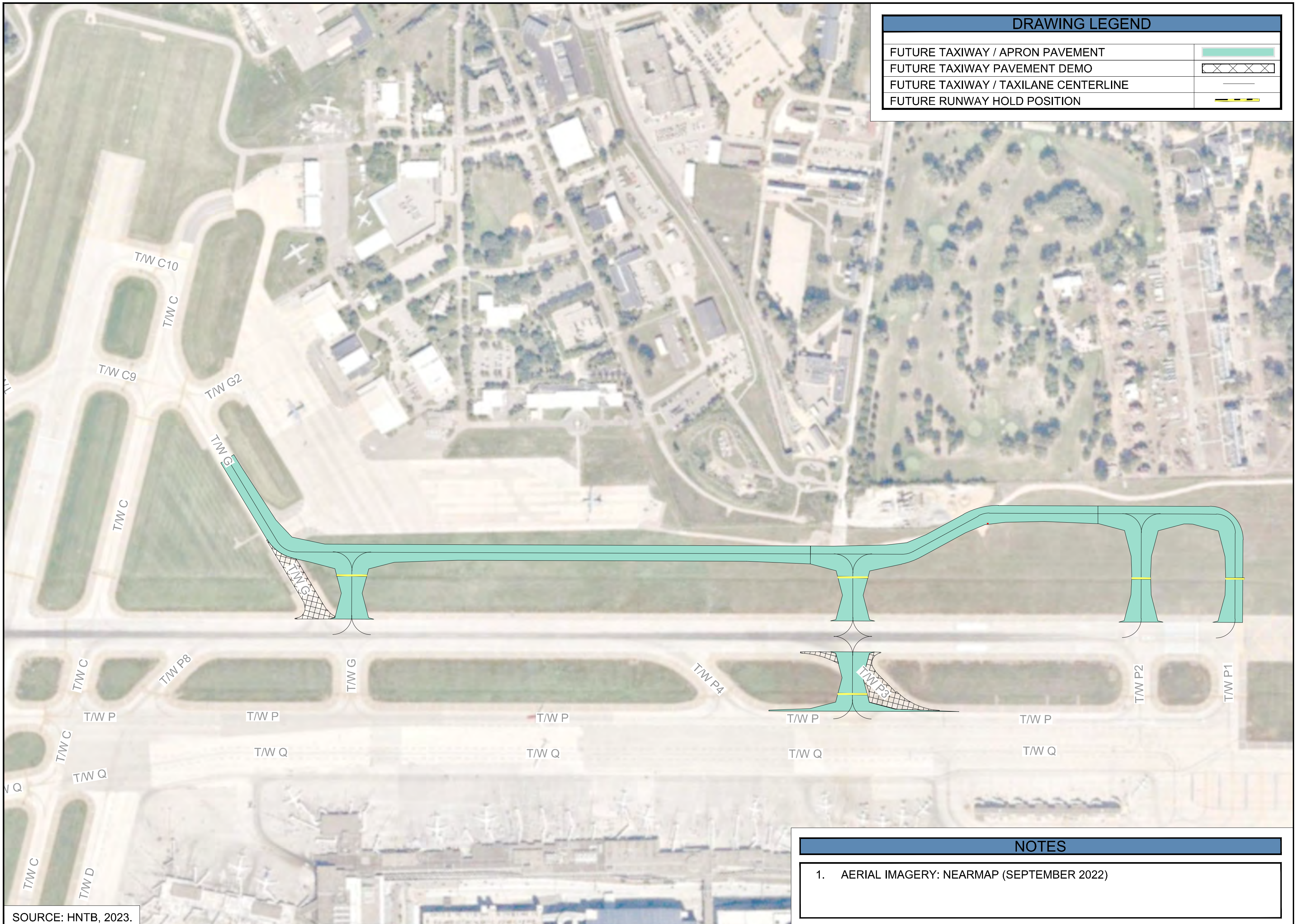
4.3.2.4 Reconfiguration of Taxiway A and Taxiway B

The separation between the centerlines of Taxiway A and Taxiway B between Taxiway A5 and Taxiway A7 is reduced to 55 feet due to the existing VSR tunnel between T1 and T2. The centerline spacing results in an operational restriction where only one aircraft on either Taxiway A or Taxiway B can taxi past the tunnel at a time. This area can become a bottleneck for aircraft taxiing to or from the terminal or the Runway 30L approach end. **Exhibit 4-15** shows the realignment of Taxiway B to a straight-line configuration to remove the bottleneck condition. Straightening the Taxiway B centerline alignment requires reconstruction of the tunnel under Runway 12R-30L to fill in over the existing tunnel. The daylight location of the tunnel is shifted closer to T1 in this alternative. As a result, the Taxiway A to Taxiway B centerline spacing increases to 240.0 feet, meeting ADG IV standards. The Taxiway B centerline spacing to the proposed VSR is 121.5 feet, meeting the requirements for an ADG IV TOFA.

4.3.3 Deice Facilities

The Runway 30R and Runway 30L deice facilities would both be impacted by the Alternative 3A terminal layout. The removal of Concourse B and the reduction in size of Concourse A allow the size of the Runway 30R deice pad to be increased beyond its existing footprint. As shown on **Exhibit 4-16** (same exhibit as in **Section 4.3.2.4**), a 4-position deice pad accommodating ADG III aircraft fits in the available space resulting from the Concourse A and Concourse B reconfigurations.

The aircraft parking positions resulting from the Concourse G expansion overlap with the Runway 30L deice pad. Seven deice pad options were evaluated with the common goal of matching or exceeding the existing deice pad capability and providing RON parking near the approach end of Runway 30L. **Exhibit 4-17** through **Exhibit 4-23** show the seven deicing options.



DRAWING LEGEND

- FUTURE TAXIWAY / APRON PAVEMENT
- FUTURE TAXIWAY PAVEMENT DEMO
- FUTURE TAXIWAY / TAXILANE CENTERLINE
- FUTURE RUNWAY HOLD POSITION

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)

SOURCE: HNTB, 2023.

0 600' 1200'

MSP

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2040 LONG-TERM PLAN

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EXHIBIT 4-14

RUNWAY 30R PARTIAL PARALLEL TAXIWAY

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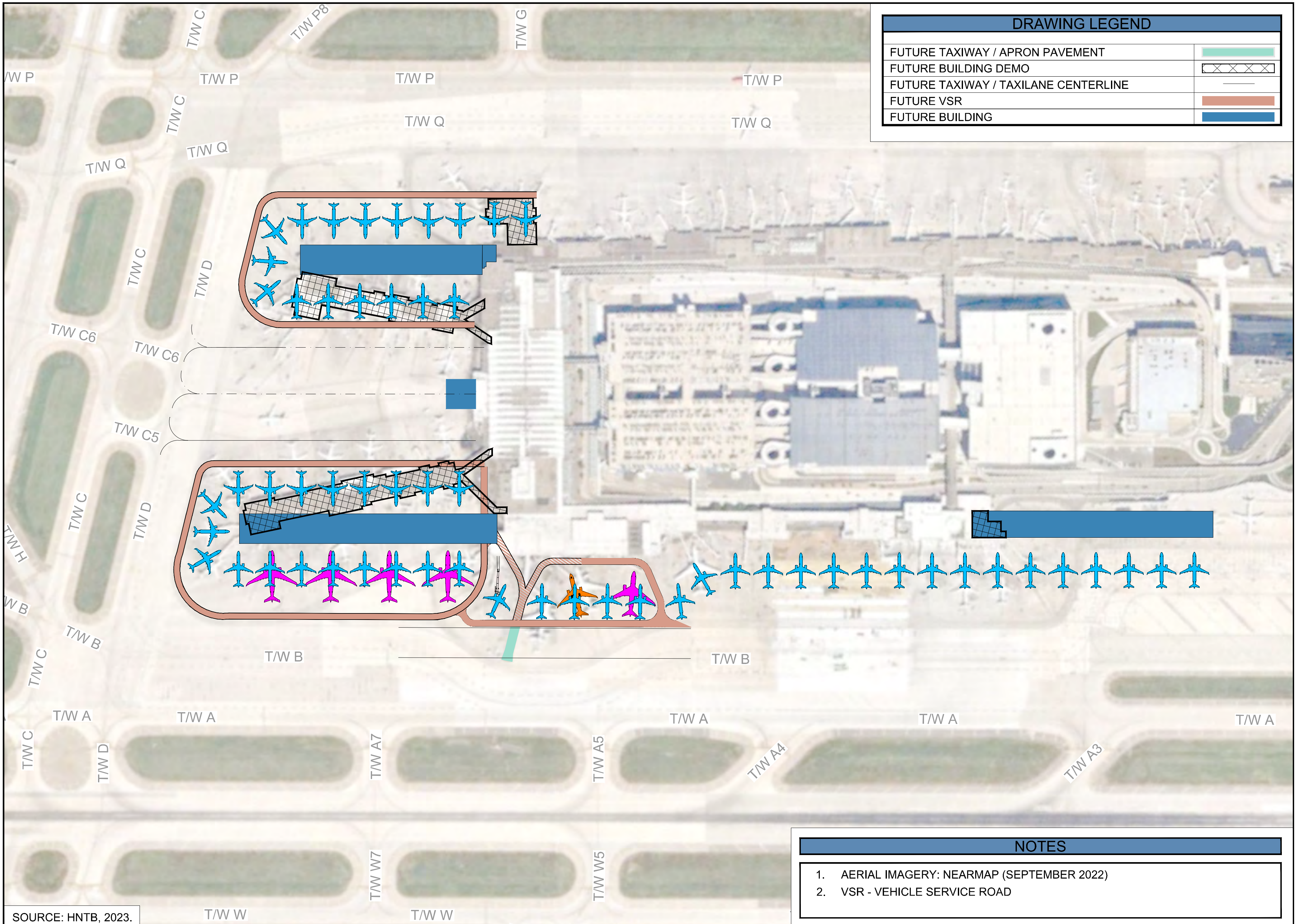

DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE BUILDING DEMO	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
FUTURE VSR	
FUTURE BUILDING	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. VSR - VEHICLE SERVICE ROAD

SOURCE: HNTB, 2023.

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0 500' 1000'

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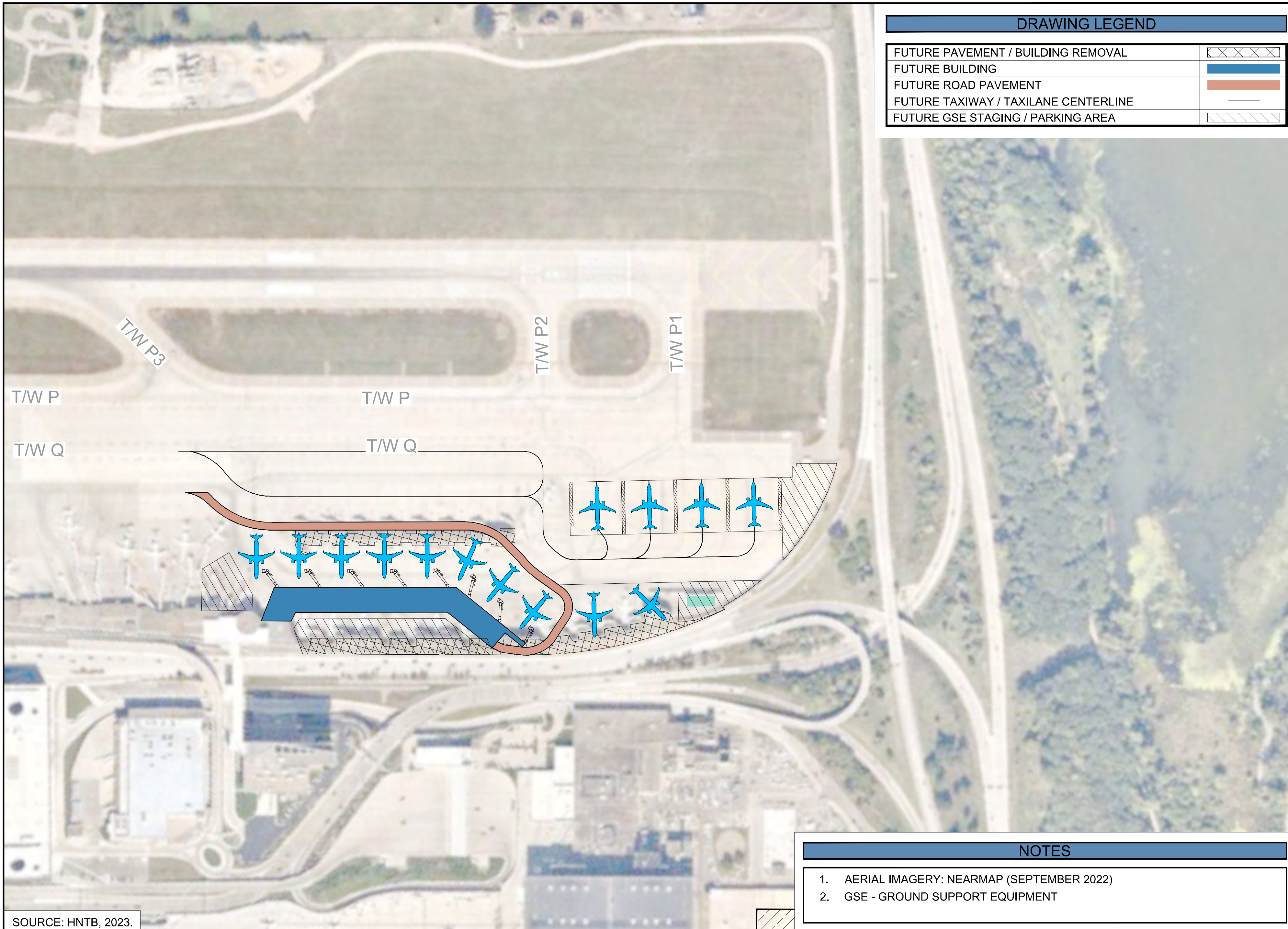
EXHIBIT 4-15

RECONFIGURATION OF TAXIWAY A AND TAXIWAY B



DRAWING LEGEND

FUTURE PAVEMENT / BUILDING REMOVAL	
FUTURE BUILDING	
FUTURE ROAD PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
FUTURE GSE STAGING / PARKING AREA	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. GSE - GROUND SUPPORT EQUIPMENT

SOURCE: HNTB, 2023.

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2040 LONG-TERM PLAN

0 400' 800'

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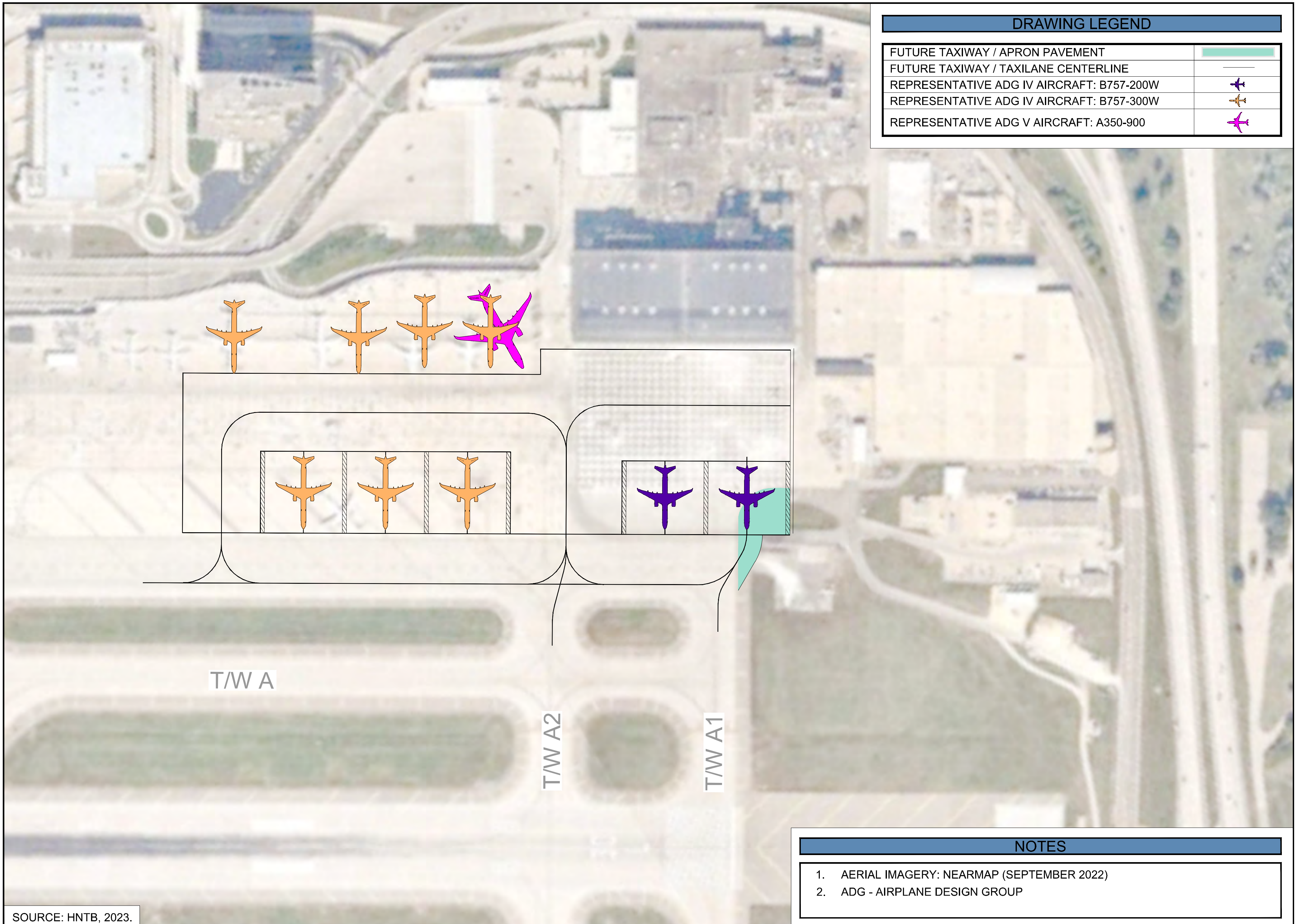
EXHIBIT 4-16

TERMINAL 1 CONCOURSE A / B DEICE PAD



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG IV AIRCRAFT: B757-200W	
REPRESENTATIVE ADG IV AIRCRAFT: B757-300W	
REPRESENTATIVE ADG V AIRCRAFT: A350-900	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

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2040 LONG-TERM PLAN

0 300' 600'

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EXHIBIT 4-17

RUNWAY 30L DEICE PAD - ALTERNATIVE 1

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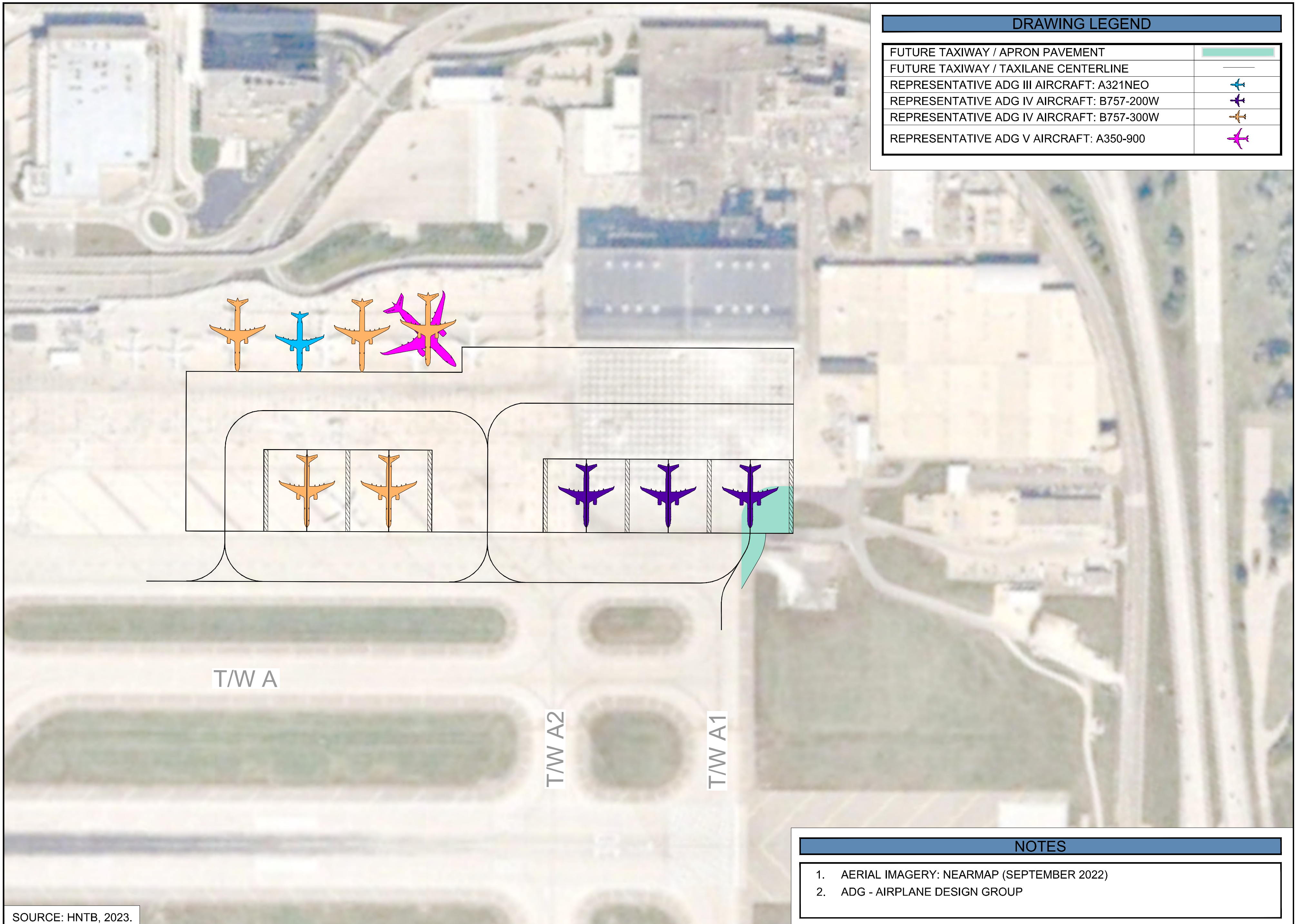

DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: A321NEO	
REPRESENTATIVE ADG IV AIRCRAFT: B757-200W	
REPRESENTATIVE ADG IV AIRCRAFT: B757-300W	
REPRESENTATIVE ADG V AIRCRAFT: A350-900	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

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2040 LONG-TERM PLAN

N 0 300' 600'

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EXHIBIT 4-18

RUNWAY 30L DEICE PAD - ALTERNATIVE 2

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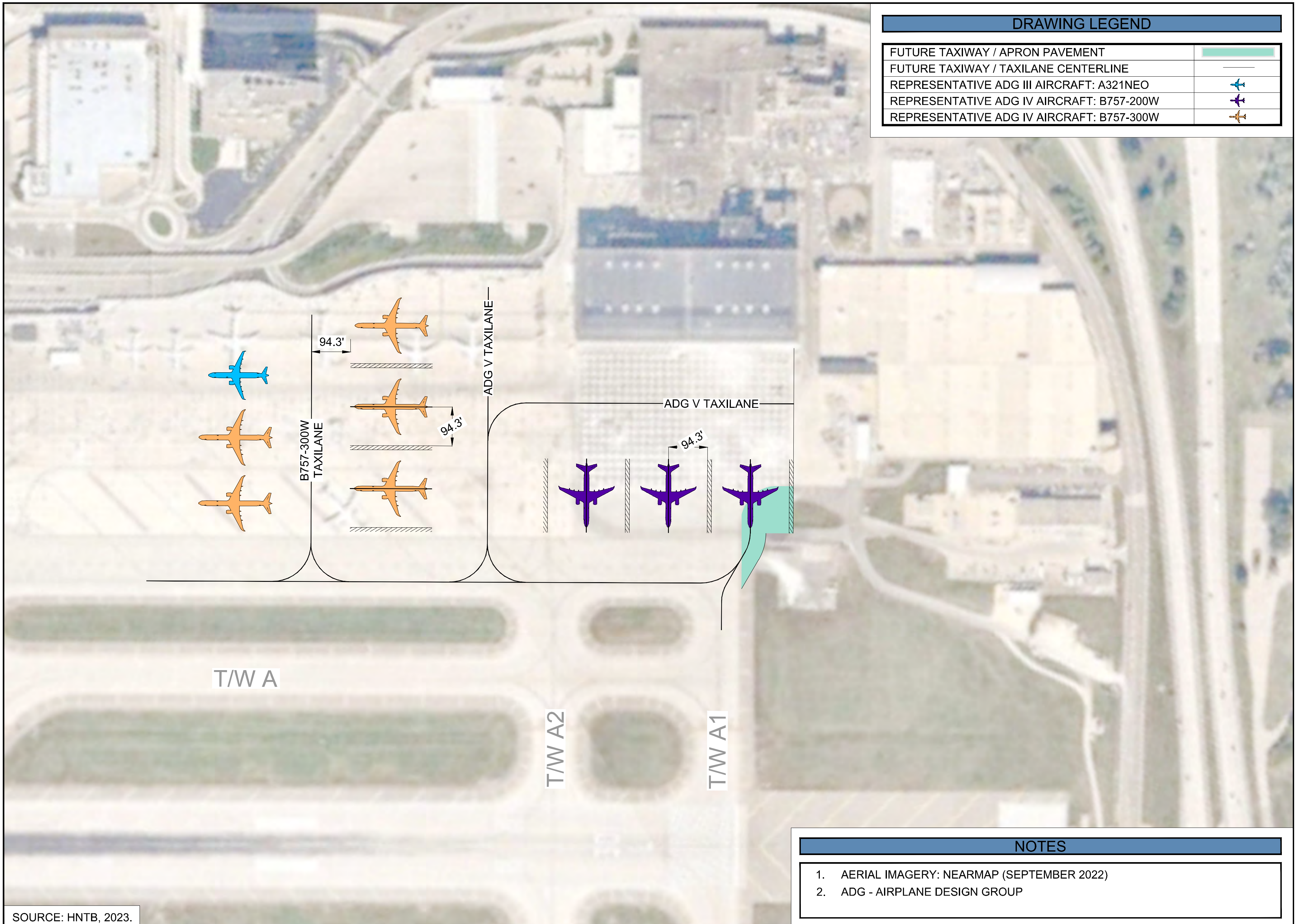

DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: A321NEO	
REPRESENTATIVE ADG IV AIRCRAFT: B757-200W	
REPRESENTATIVE ADG IV AIRCRAFT: B757-300W	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

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2040 LONG-TERM PLAN

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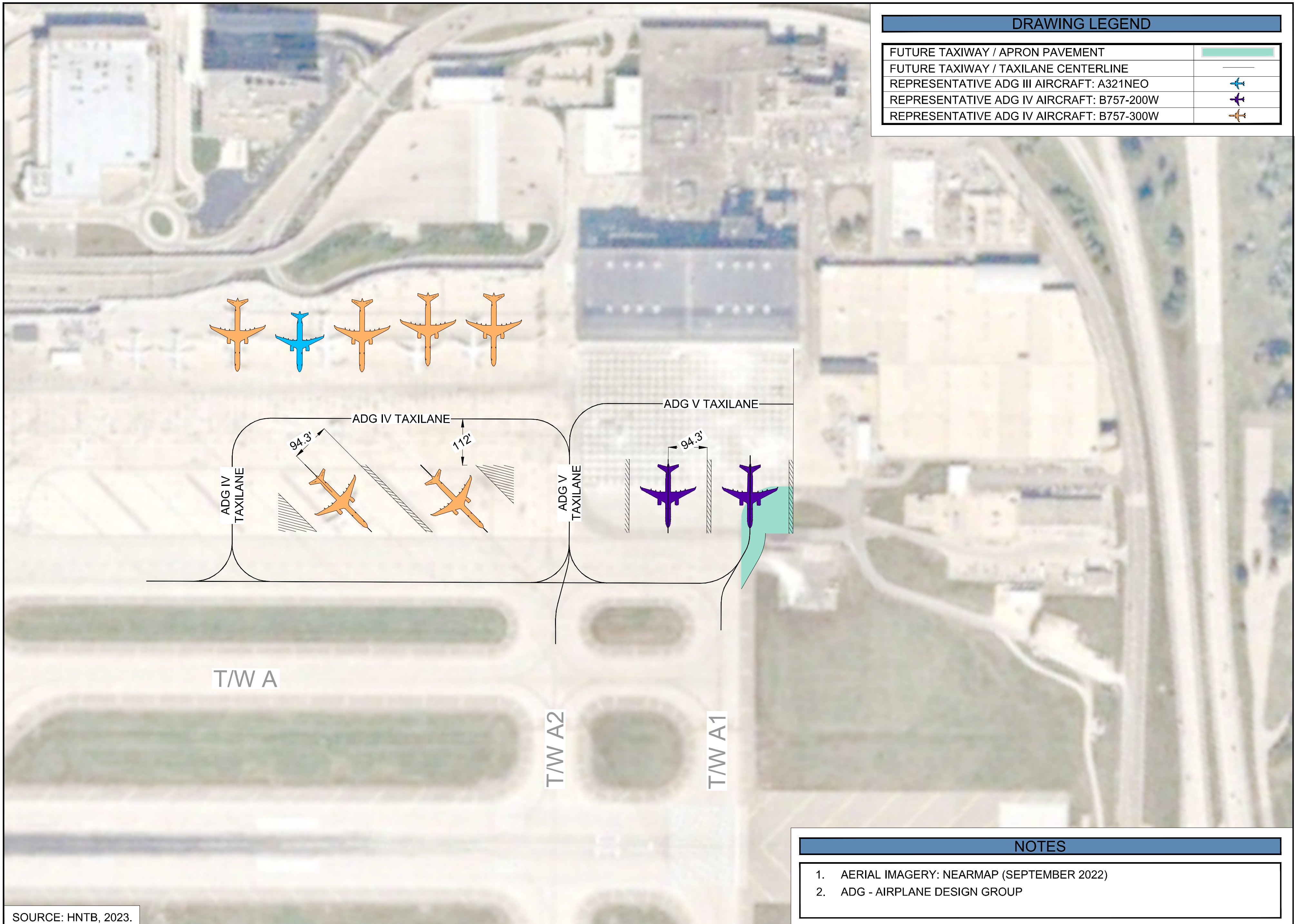
EXHIBIT 4-19

RUNWAY 30L DEICE PAD - ALTERNATIVE 3

DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: A321NEO	
REPRESENTATIVE ADG IV AIRCRAFT: B757-200W	
REPRESENTATIVE ADG IV AIRCRAFT: B757-300W	



NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

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MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

0 300' 600'

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EXHIBIT 4-20

RUNWAY 30L DEICE PAD - ALTERNATIVE 4

DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: A321NEO	
REPRESENTATIVE ADG IV AIRCRAFT: B757-200/300	
REPRESENTATIVE ADG V AIRCRAFT: A350-900	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

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MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

0 300' 600'

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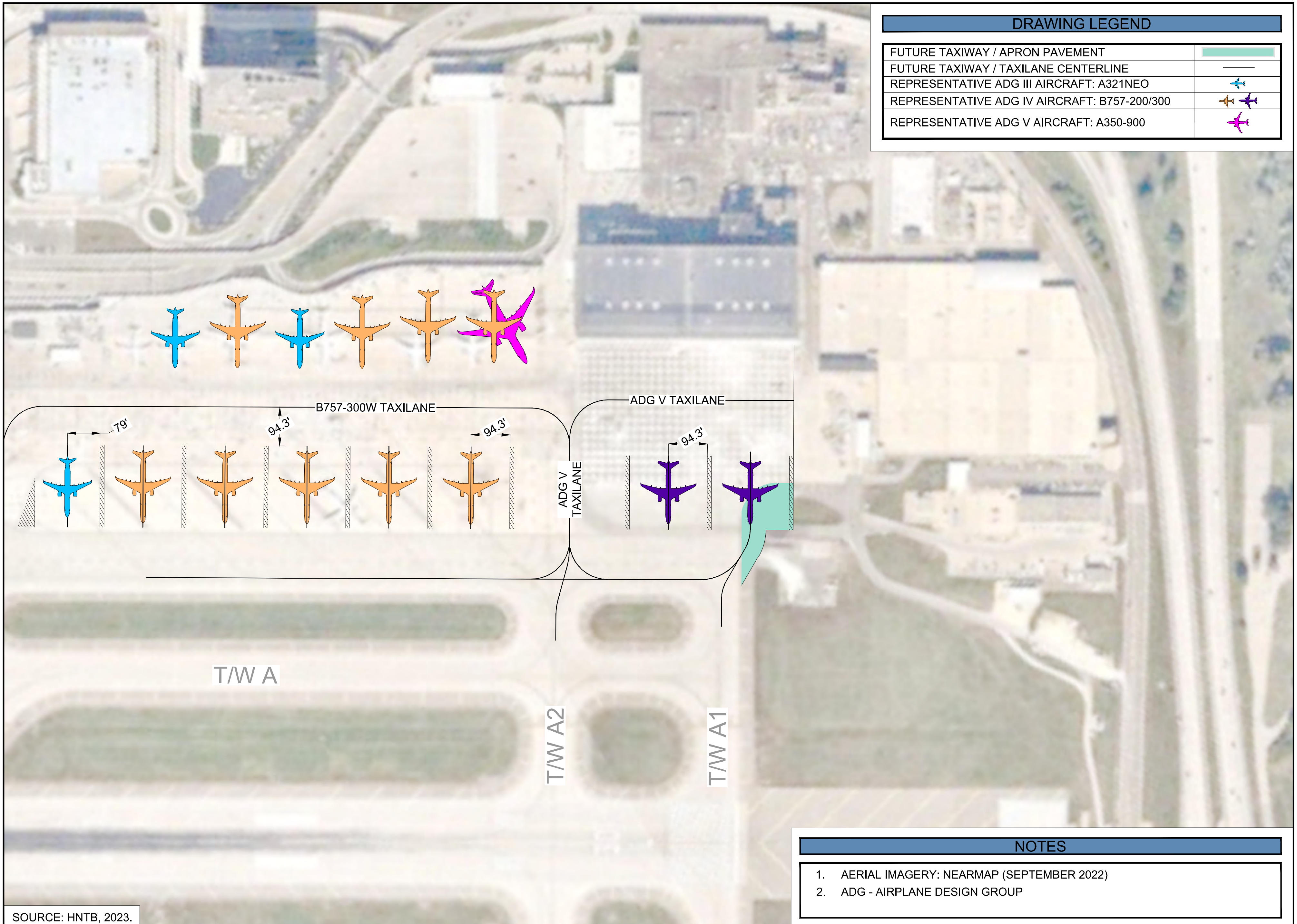
EXHIBIT 4-21

RUNWAY 30L DEICE PAD - ALTERNATIVE 5



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: A321NEO	
REPRESENTATIVE ADG IV AIRCRAFT: B757-200/300	
REPRESENTATIVE ADG V AIRCRAFT: A350-900	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

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2040 LONG-TERM PLAN

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0 300' 600'

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EXHIBIT 4-22

RUNWAY 30L DEICE PAD - ALTERNATIVE 6

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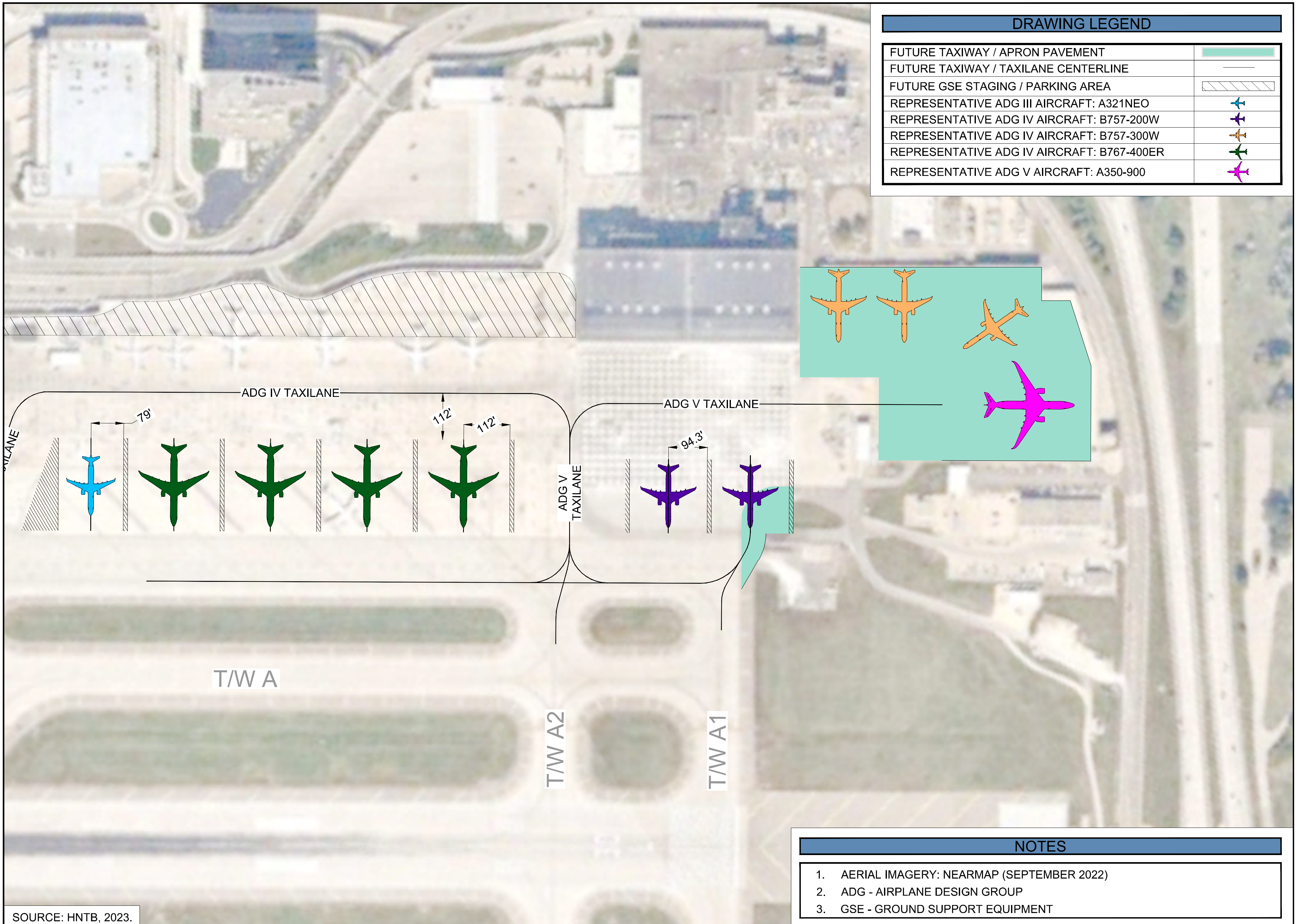

DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
FUTURE GSE STAGING / PARKING AREA	
REPRESENTATIVE ADG III AIRCRAFT: A321NEO	
REPRESENTATIVE ADG IV AIRCRAFT: B757-200W	
REPRESENTATIVE ADG IV AIRCRAFT: B757-300W	
REPRESENTATIVE ADG IV AIRCRAFT: B767-400ER	
REPRESENTATIVE ADG V AIRCRAFT: A350-900	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP
3. GSE - GROUND SUPPORT EQUIPMENT

SOURCE: HNTB, 2023.

MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

0 300' 600'

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EXHIBIT 4-23

RUNWAY 30L DEICE PAD - ALTERNATIVE 7

Runway 30L Deice Pad Alternative 1 was chosen as the preferred layout, since it maximizes the available space for RON parking, increases the existing deice pad capability, and minimizes impacts to the Delta maintenance apron. Alternative 1 includes three deice positions that can accommodate aircraft up to a Boeing 757-300W and two deice positions that can accommodate aircraft up to a Boeing 757-200W. The five deice positions increase the deice pad's capability from the existing condition as it accommodates ADG IV aircraft. Access to the Delta maintenance ramp is maintained through an ADG V taxilane, which also provides access to the two B757-200W deice positions. The three B757-300W deice positions and RON parking are accessed through a B757-300W–specific taxilane. Aircraft larger than the B757-300W would be restricted from using this taxilane. However, ADG V capabilities are maintained adjacent to existing taxiway A2, which allows for RON parking of one widebody aircraft in the veranda area north of the future deice pad layout.

4.3.4 Remain-Overnight Parking

The existing RON parking available at MSP is not adequate to meet the future demand. Three alternative locations were considered for future RON parking expansion including the existing Delta parking lot south of Delta's maintenance facility on Taxiway S, the north side of the airfield at the approach end of Runway 12R, and north of the T2 expansion adjacent to Taxiway W.

Alternative 1, shown on **Exhibit 4-24**, can accommodate a mixture of ADG II, III, and IV aircraft. This alternative accommodates 7 ADG II aircraft, 10 ADG III aircraft, and 3 ADG IV aircraft. The exact number of aircraft that can be accommodated is dependent on the type of parking configuration used: dependent or independent. A dependent parking position requires at least one aircraft to be moved to allow movement of the position in question. As shown, a mix of dependent and independent positions is included, which can be configured based on shifting demands.

Alternative 2, shown on **Exhibit 4-25**, also includes a mix of dependent and independent parking positions. The area accommodates 15 ADG III aircraft and 5 ADG V aircraft. The primary advantage of the north RON site over the south site is the ability to accommodate ADG V aircraft. The primary disadvantage of the north RON site is the loss of proximity to the terminals and maintenance facilitates. Alternative 2 is identified as the preferred location for the relocated FBO apron; therefore, RON parking at this location was eliminated from further consideration.

Alternative 3, shown on **Exhibit 4-26**, accommodates 10 ADG III aircraft. This location is immediately adjacent to T2, requiring short tow distances. The RON apron will need to be configured to limit impacts to the existing VSR, which passes through this area from T1 to the central cargo area. Impacts to the VSR tunnels under the runways are not desired due to the cost and complexity of reconstruction.

Alternative 1 was selected as the preferred location for future RON parking. The south RON apron location is closer to the terminals and maintenance facilities where these aircraft will be towed to and from. Most aircraft requiring RON parking are expected to be ADG III–sized aircraft, which the south location accommodates. Alternative 3 would be best suited as a deice pad, as discussed in **Section 4.3.3**. However, during non-deicing conditions, aircraft can also be parked on the deice pad, adding RON parking capacity to the Airport.

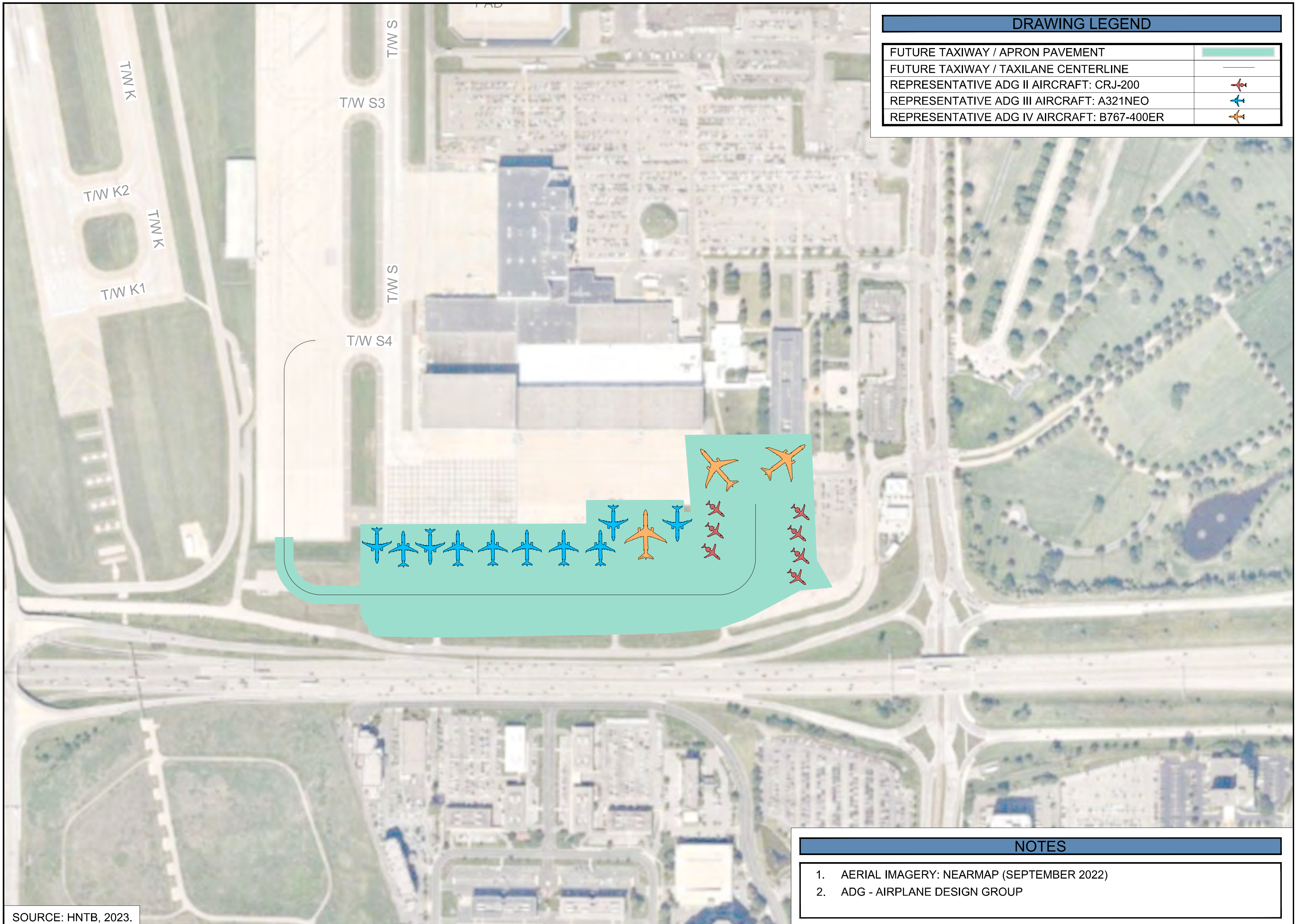

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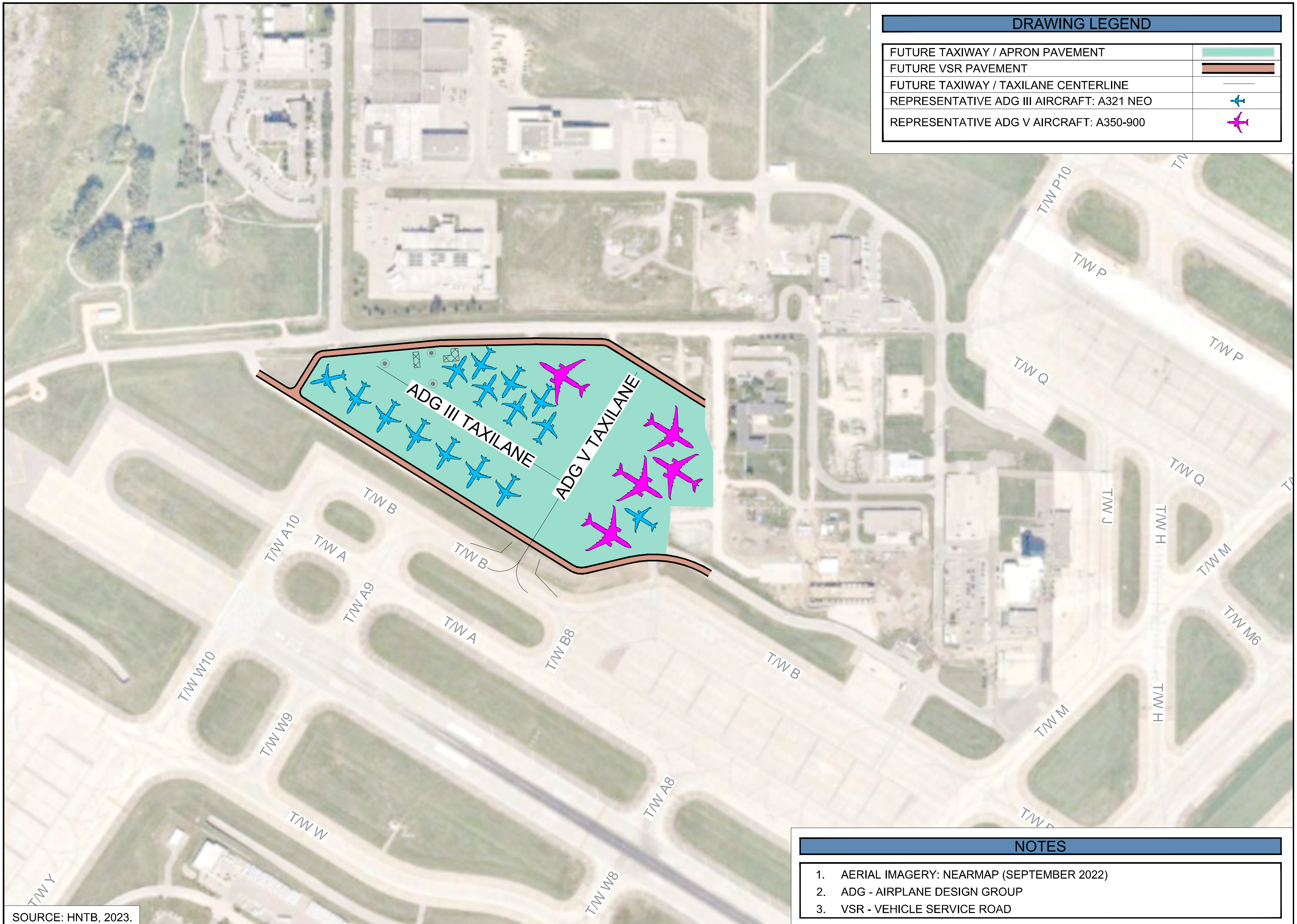
EXHIBIT 4-24

REMAIN-OVERNIGHT PARKING - ALTERNATIVE 1



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE VSR PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: A321 NEO	
REPRESENTATIVE ADG V AIRCRAFT: A350-900	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP
3. VSR - VEHICLE SERVICE ROAD

SOURCE: HNTB, 2023.

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0 500' 1000'

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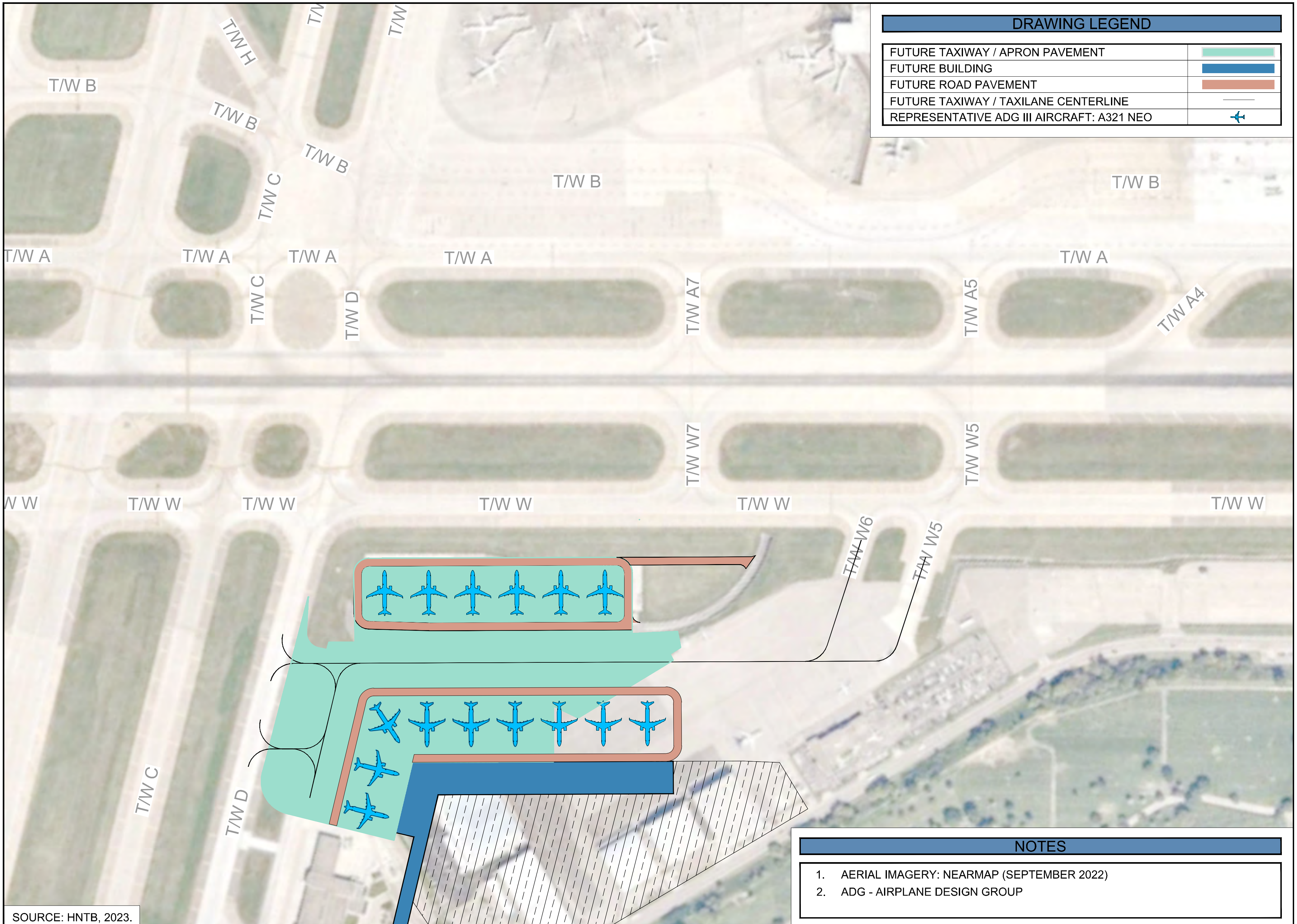
EXHIBIT 4-25

REMAIN-OVERNIGHT PARKING - ALTERNATIVE 2



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE BUILDING	
FUTURE ROAD PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: A321 NEO	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

0 400' 800'

MSP

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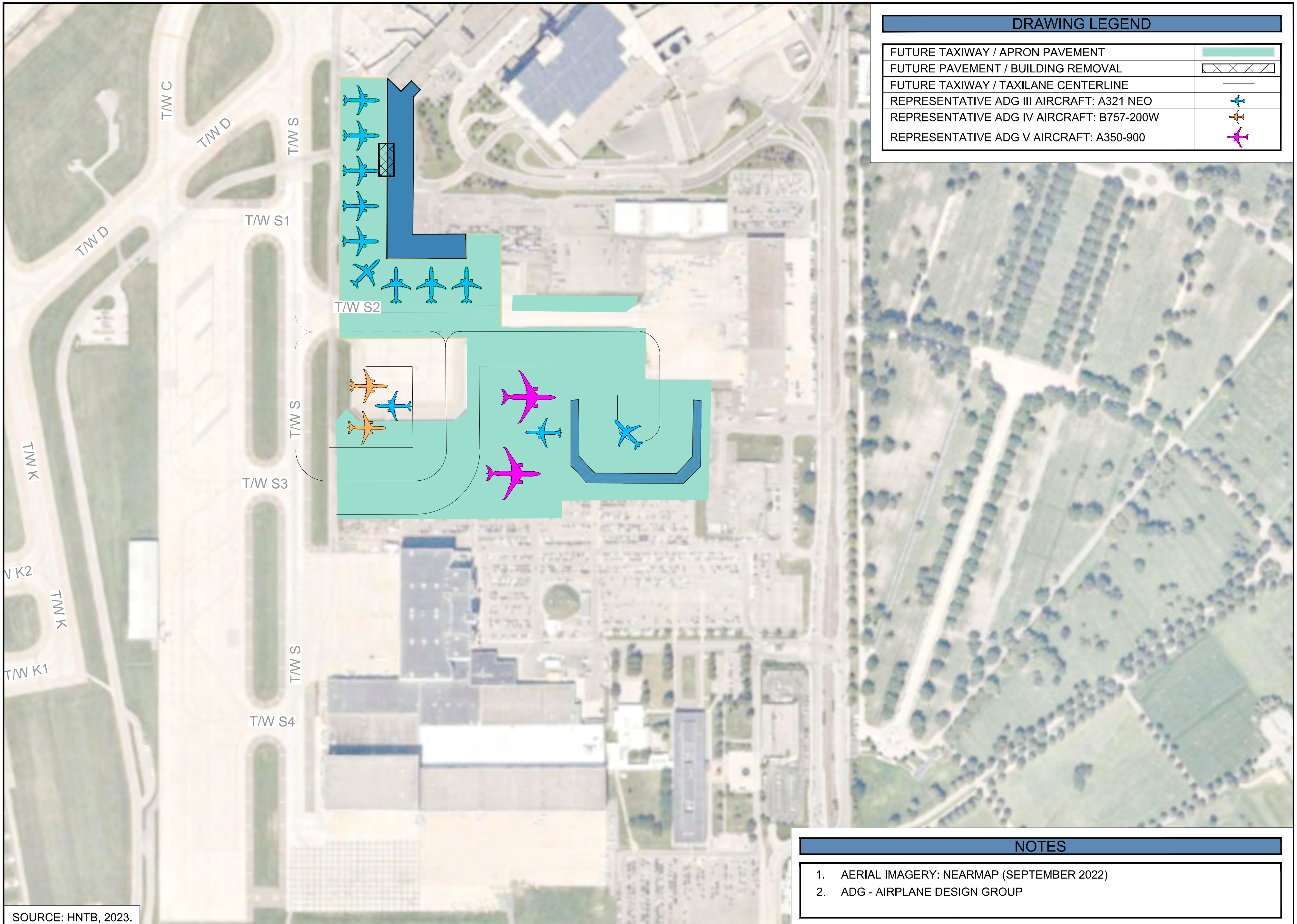
EXHIBIT 4-26

REMAIN-OVERNIGHT PARKING - ALTERNATIVE 3



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE PAVEMENT / BUILDING REMOVAL	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: A321 NEO	
REPRESENTATIVE ADG IV AIRCRAFT: B757-200W	
REPRESENTATIVE ADG V AIRCRAFT: A350-900	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

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EXHIBIT 4-27

SOUTH REMAIN-OVERNIGHT PARKING LOCATION

Other areas on the airfield can provide limited additional RON parking capacity including south of the T2 expansion at the site of the existing GRE, as well as adjacent to the Runway 320L deicing pad. **Exhibit 4-27** and **Exhibit 4-15** (same exhibit showing Concourses A and B) show these additional RON parking locations.

Depending on operational needs, the location south of T2 at the existing GRE site can accommodate two ADG III aircraft, two ADG IV aircraft, and two ADG V aircraft. This location might be best suited for short-term parking to free up T2 gate positions since it is located close to T2.

The 30L RON parking location is an existing location used for RON parking. Changes to the Runway 30L deice pad, because of the Concourse G expansion, may change the size of aircraft that are able to use this location for RON parking. The possible RON parking configurations for this site are shown on **Exhibits 4-24** through **4-26** in **Section 4.3.4**.

4.3.5 Air Cargo

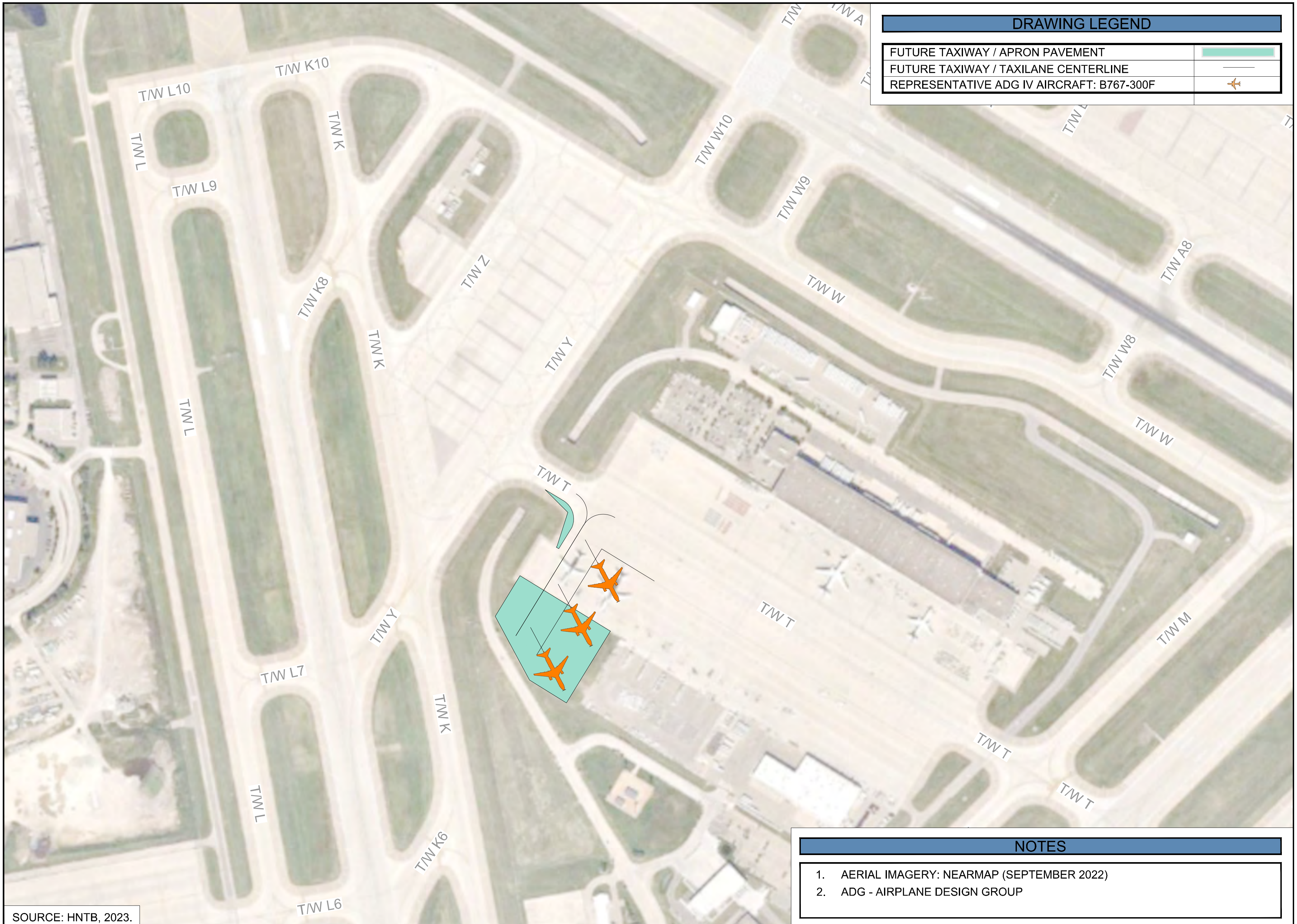
Section 3.1.9 discusses specific requirements for future air cargo buildings and apron area. The requirements presented in the 2021 Landrum & Brown, Inc., study were incorporated into the preferred alternative at the existing FedEx / UPS cargo apron and in a new air cargo facility located on the west side of the airfield.

4.3.5.1 FedEx / UPS Ramp

Two additional UPS parking positions are required to meet future demand, per the Landrum & Brown, Inc., study. Expansion of the UPS apron to accommodate two additional parking positions is possible on the west side of the apron. As shown on **Exhibit 4-28**, a new ADG IV taxilane extending south from Taxiway T to an extended apron provides access to the two new positions, with a limited amount of new apron required.

4.3.5.2 West Cargo

According to the Air Cargo Assessment Study, Amazon does not have enough existing facility space to accommodate its future forecast growth. A 110,000-square-foot building footprint was identified as the requirement for meeting future growth. The only feasible location identified in the long-term planning process that is suitable for a building of this size was an open parcel on the west side of the airfield, north of the existing shared Amazon / DHL apron. The parcel provides direct access to Longfellow Avenue for landside trucking and to Taxiway L for airside access. **Exhibit 4-29** shows a building footprint meeting the Amazon requirement for an aircraft parking apron with access to Taxiway L. The future cargo facility apron is separated from the existing West Cargo Apron, but there is flexibility to merge the two aprons and reconfigure aircraft parking, if desired. Four Boeing 767-300 freighter parking positions are included, with an option for a single Boeing 747-800 freighter parking position. The Boeing 747 parking position is limited to the south end of the site due to the tail height of the aircraft in relation to the Title 14 Code of Federal Regulations (CFR) Part 77 transitional surface.



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG IV AIRCRAFT: B767-300F	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP

SOURCE: HNTB, 2023.

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2040 LONG-TERM PLAN

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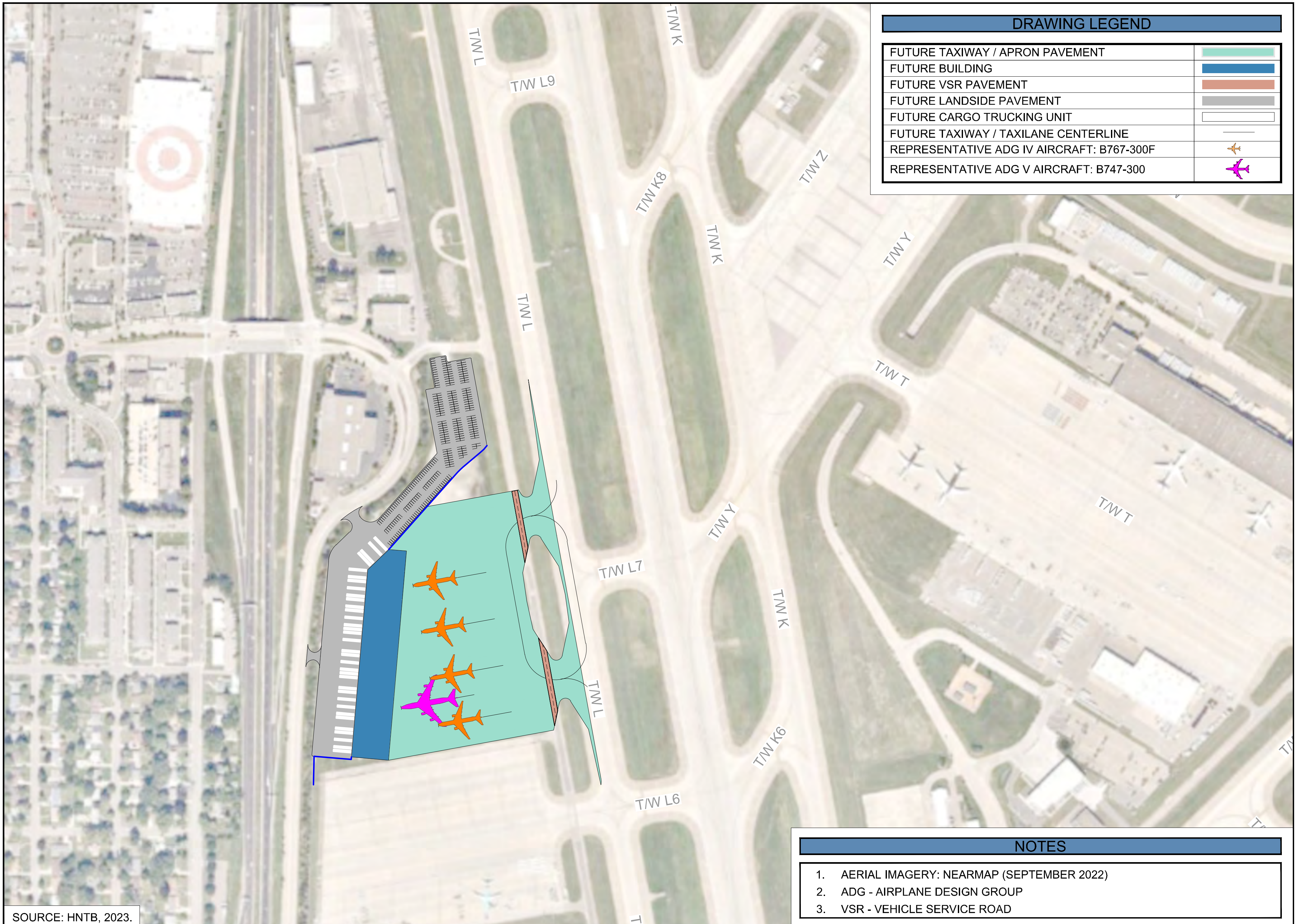
EXHIBIT 4-28

PREFERRED FED EX / UPS RAMP ALTERNATIVE



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE BUILDING	
FUTURE VSR PAVEMENT	
FUTURE LANDSIDE PAVEMENT	
FUTURE CARGO TRUCKING UNIT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG IV AIRCRAFT: B767-300F	
REPRESENTATIVE ADG V AIRCRAFT: B747-300	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP
3. VSR - VEHICLE SERVICE ROAD

SOURCE: HNTB, 2023.

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EXHIBIT 4-29

PREFERRED WEST CARGO ALTERNATIVE

4.3.6 Fixed Base Operator

As proposed in the preferred terminal alternative, the northward expansion of T2 would require relocation of the existing FBO. Three initial alternative locations were evaluated including:

- **Delta Surface Parking Lot** – existing Delta surface parking lot south of the Delta maintenance facility on Taxiway S.
- **South of Terminal 2** – south of the proposed T2 expansion at the location of the existing GRE and QTA facility.
- **North Airfield** – the north side of the airfield adjacent to Taxiway B at the approach end of Runway 12R.

4.3.6.1 South Alternative - Delta Surface Parking Lot

The location on the south side of the airfield alternative was dismissed from further consideration. A best-use determination concluded that this parcel of land is better suited for RON parking. The south FBO site is constrained by the existing Delta maintenance facility to the north and Airport Lane and I-494 to the south, and it does not provide adequate space for an FBO apron and hangars. **Exhibit 4-30** shows Alternative 1.

4.3.6.2 South of Terminal 2 Alternative

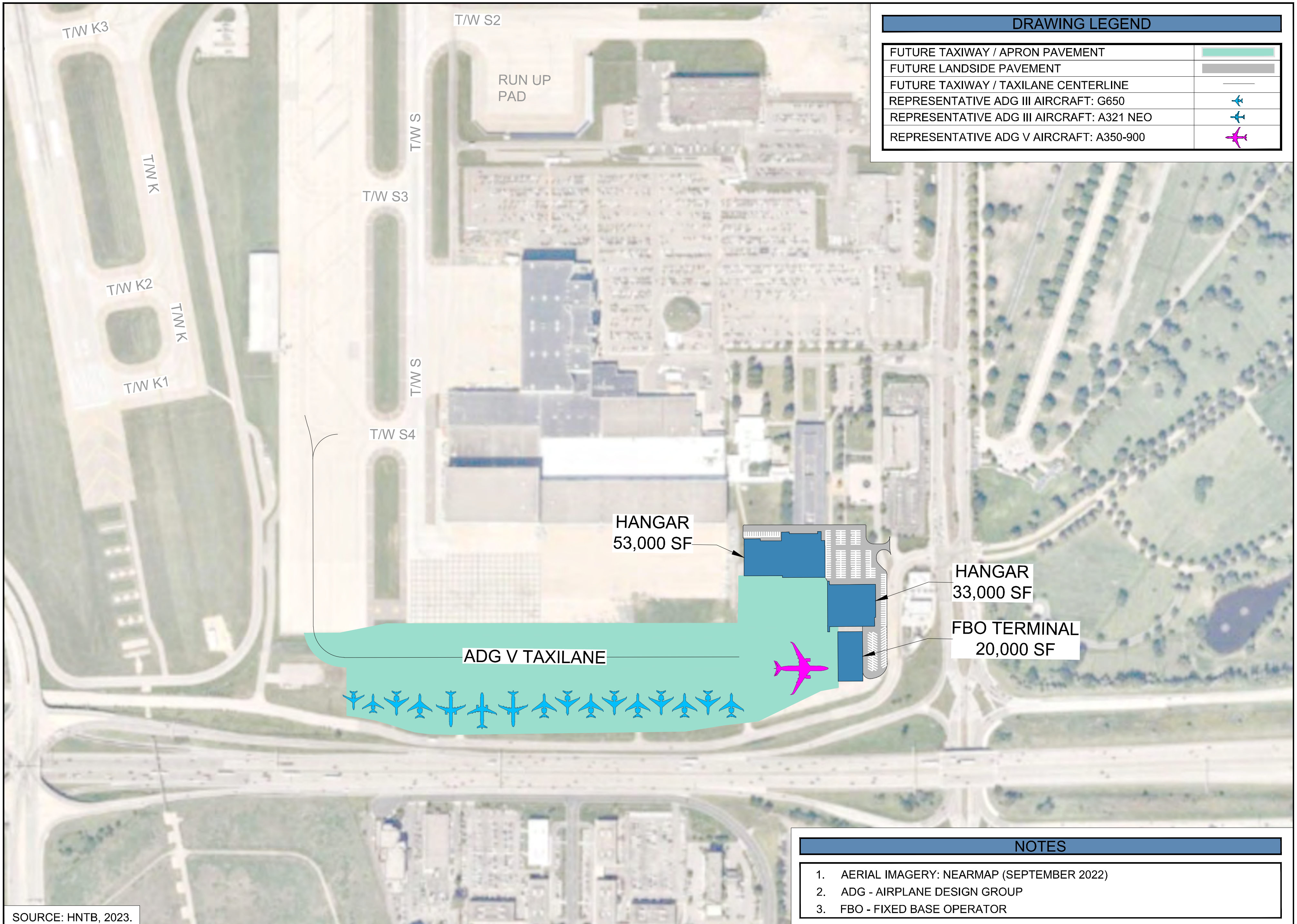
The location south of the proposed T2 expansion alternative was also dismissed from further consideration because this area is required for relocation of the GRE and the impacts to the QTA facility. **Exhibit 4-31** shows Alternative 2.

4.3.6.3 North Airfield Alternatives

The location on the north side of the airfield alternative was chosen as the preferred location of the relocated FBO. Three separate alternatives were evaluated on the north site; these alternatives were developed considering the future security center development planned north of the Runway 12R deice pad. All three alternatives require relocation of the remote transmitter/receiver (RTR) and remove center air/ground (RCAG) antennas and supporting buildings at the site. These facilities are owned by the FAA. All three options include an ADG III and ADG V taxilane connection from Taxiway B for access to the FBO site, and all three alternatives include a proposed parking lot north of East 62nd Street within the existing dog park. **Exhibit 4-32** through **Exhibit 4-34** show the three north FBO alternatives.

- **North Airfield Alternative (Alternative 1)** - Alternative 1 includes a 20,000-square-foot FBO terminal building with landside access to East 62nd Street, three hangars totaling approximately 175,000 square feet, and an apron area of approximately 15 acres. This alternative fits wholly within the existing available footprint, without impacts to East 62nd Street or the planned security center development site. The building area is an increase over the existing FBO terminal, which is only approximately 14,000 square feet. The site is smaller than the existing FBO footprint, resulting in a reduction in both the available hangar space and apron space. The existing hangar space is approximately 263,000 square feet (a 33% decrease), and the existing apron area is approximately 17.5 acres (a 15% decrease).

- **North Airfield Alternative (Alternative 2)** - Alternative 2 includes a 20,000-square-foot FBO terminal building and approximately 175,000 square feet of hangar space. The primary difference with this alternative, compared to Alternative 1, is that the northeast portion of the apron is extended east approximately 50 feet. This provides an apron footprint of approximately 15.7 acres, which is a 10% decrease from the existing area. With the eastward expansion of the FBO apron, the security center access location is shifted from the existing driveway west of the old US Navy building to 32nd Avenue South. There are no other impacts to the planned security center development, other than moving the access point to the employee parking lot, which remains in its proposed configuration. Alternative 2 was chosen as the preferred north FBO alternative since it maximizes the FBO apron area, while limiting impacts to the future security center under design.
- **North Airfield Alternative (Alternative 3)** - Alternative 3 provides the 20,000-square-foot FBO terminal building and hangar space provided in Alternatives 1 and 2 and extends the northeast quadrant of the apron to the east as in Alternative 2, and it also extends the apron to the northwest across East 62nd Street. This results in an apron area of approximately 20.3 acres, a 16% increase over the existing area. This alternative reduces the existing dog park footprint by approximately 4.0 acres, requires reconfiguration of the security gate leading to the airfield on East 62nd Street, and requires reconfiguration of the airfield perimeter road north of the Runway 12R approach. Due to the impacts to the dog park and required reconfiguration of the security gate and perimeter road, this alternative was not chosen as the preferred alternative.



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE LANDSIDE PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: G650	
REPRESENTATIVE ADG III AIRCRAFT: A321 NEO	
REPRESENTATIVE ADG V AIRCRAFT: A350-900	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP
3. FBO - FIXED BASE OPERATOR

SOURCE: HNTB, 2023.

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EXHIBIT 4-30

ALTERNATIVE - DELTA SURFACE PARKING LOT

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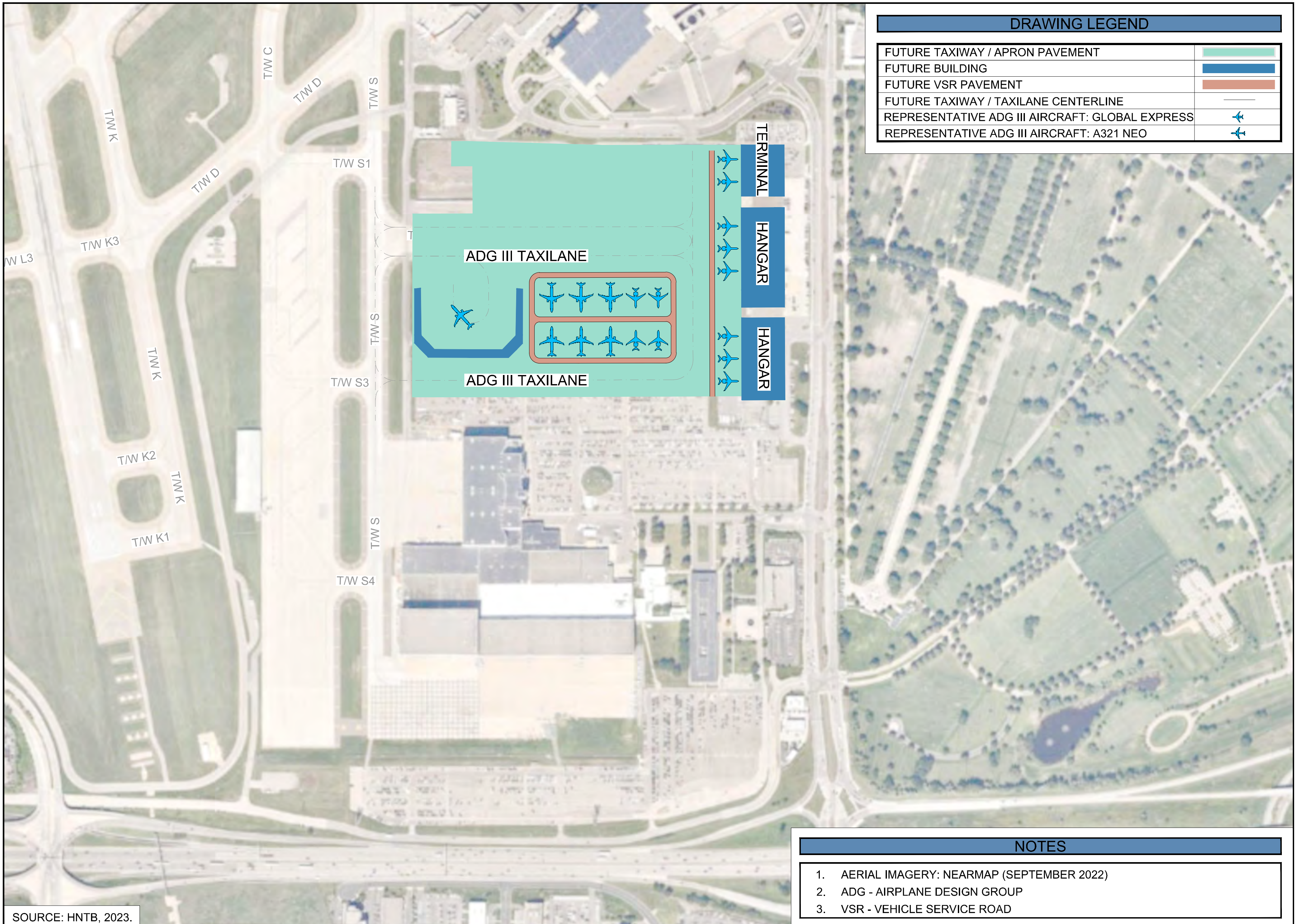

DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE BUILDING	
FUTURE VSR PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
REPRESENTATIVE ADG III AIRCRAFT: GLOBAL EXPRESS	
REPRESENTATIVE ADG III AIRCRAFT: A321 NEO	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP
3. VSR - VEHICLE SERVICE ROAD

SOURCE: HNTB, 2023.

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MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

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EXHIBIT 4-31

SOUTH OF TERMINAL 2 ALTERNATIVE

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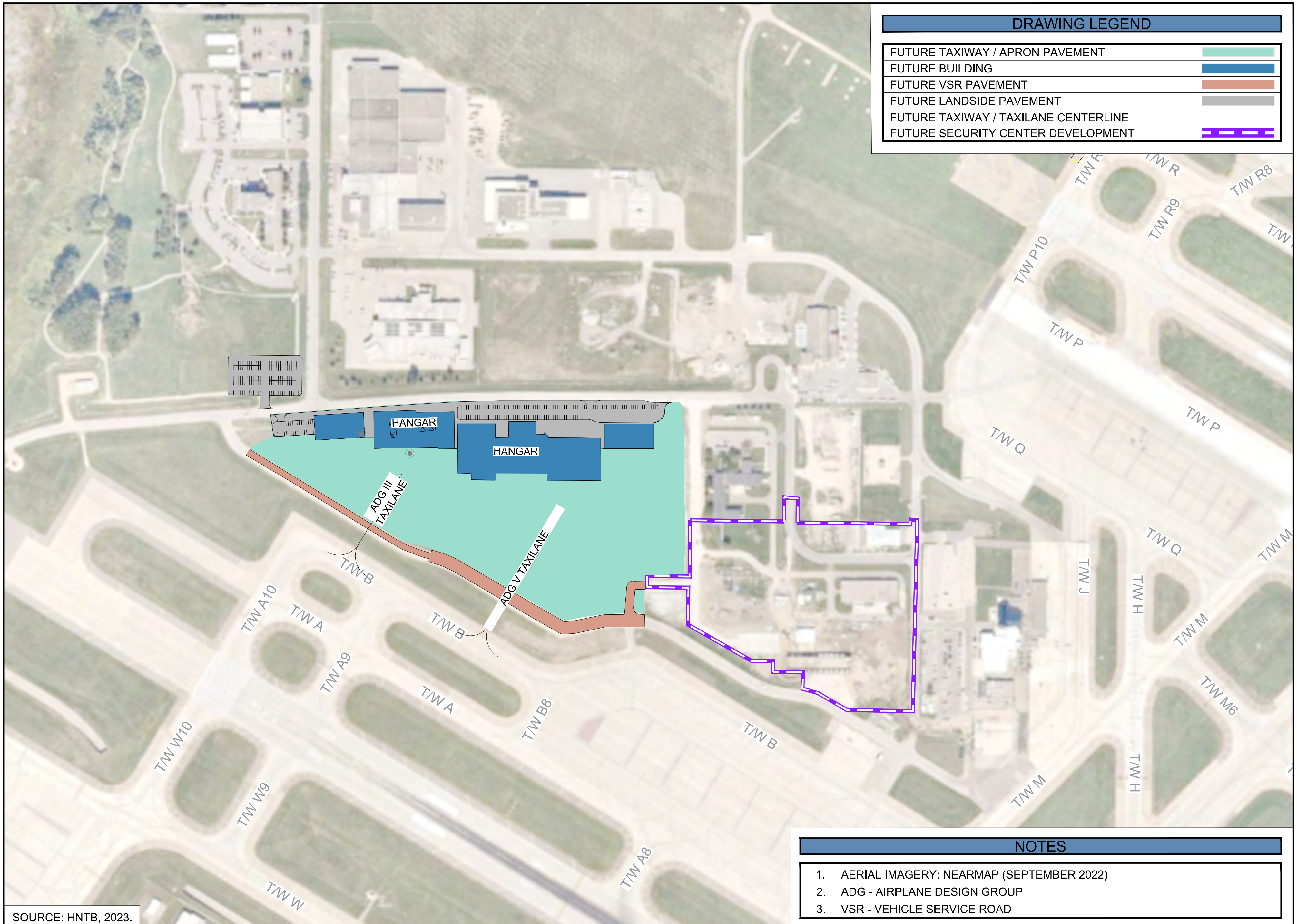

DRAWING LEGEND	
FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE BUILDING	
FUTURE VSR PAVEMENT	
FUTURE LANDSIDE PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
FUTURE SECURITY CENTER DEVELOPMENT	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP
3. VSR - VEHICLE SERVICE ROAD

SOURCE: HNTB, 2023.

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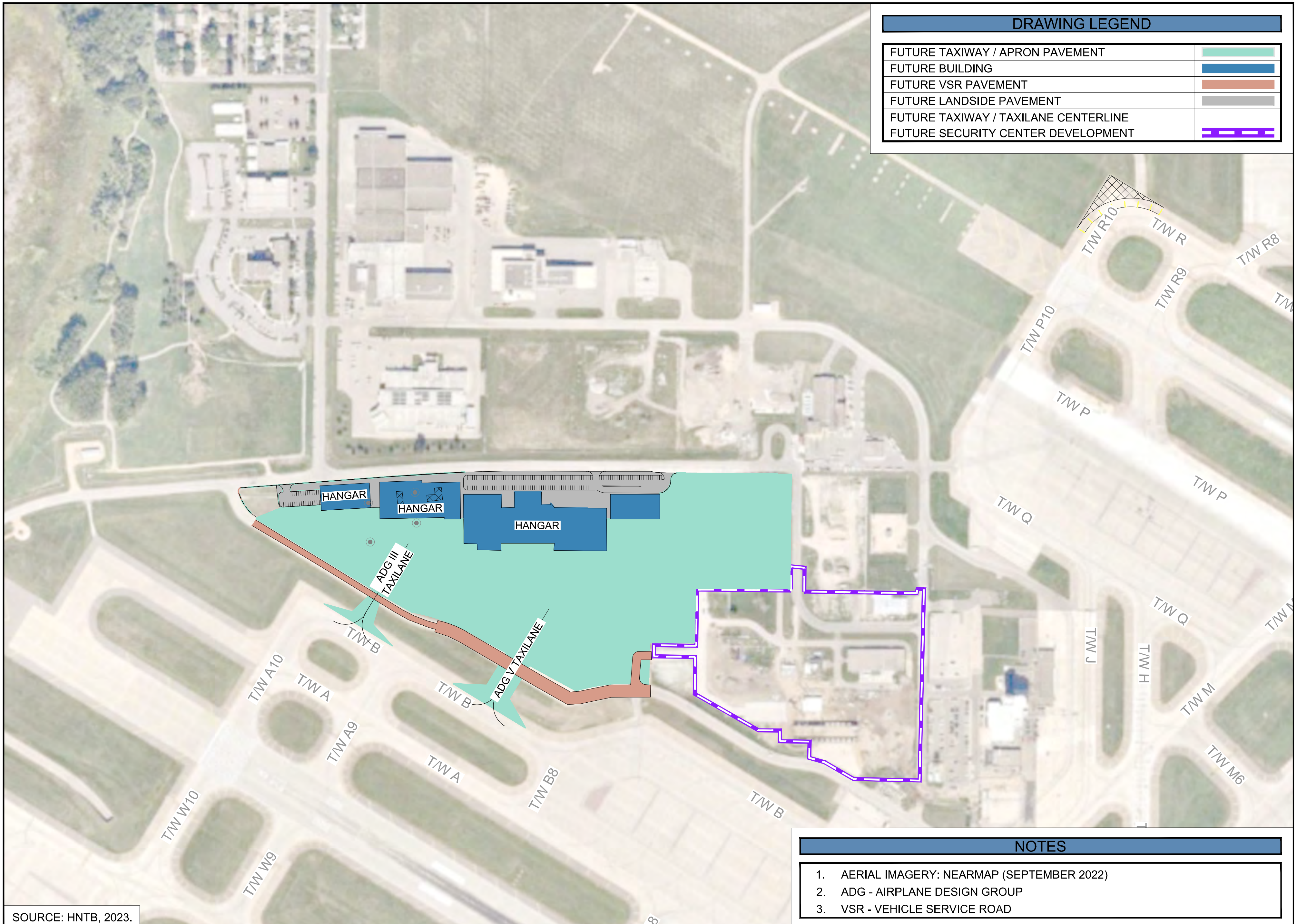
EXHIBIT 4-32

NORTH AIRFIELD ALTERNATIVE - ALTERNATIVE 1



DRAWING LEGEND

FUTURE TAXIWAY / APRON PAVEMENT	
FUTURE BUILDING	
FUTURE VSR PAVEMENT	
FUTURE LANDSIDE PAVEMENT	
FUTURE TAXIWAY / TAXILANE CENTERLINE	
FUTURE SECURITY CENTER DEVELOPMENT	

NOTES

1. AERIAL IMAGERY: NEARMAP (SEPTEMBER 2022)
2. ADG - AIRPLANE DESIGN GROUP
3. VSR - VEHICLE SERVICE ROAD

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EXHIBIT 4-33
NORTH AIRFIELD ALTERNATIVE - ALTERNATIVE 2

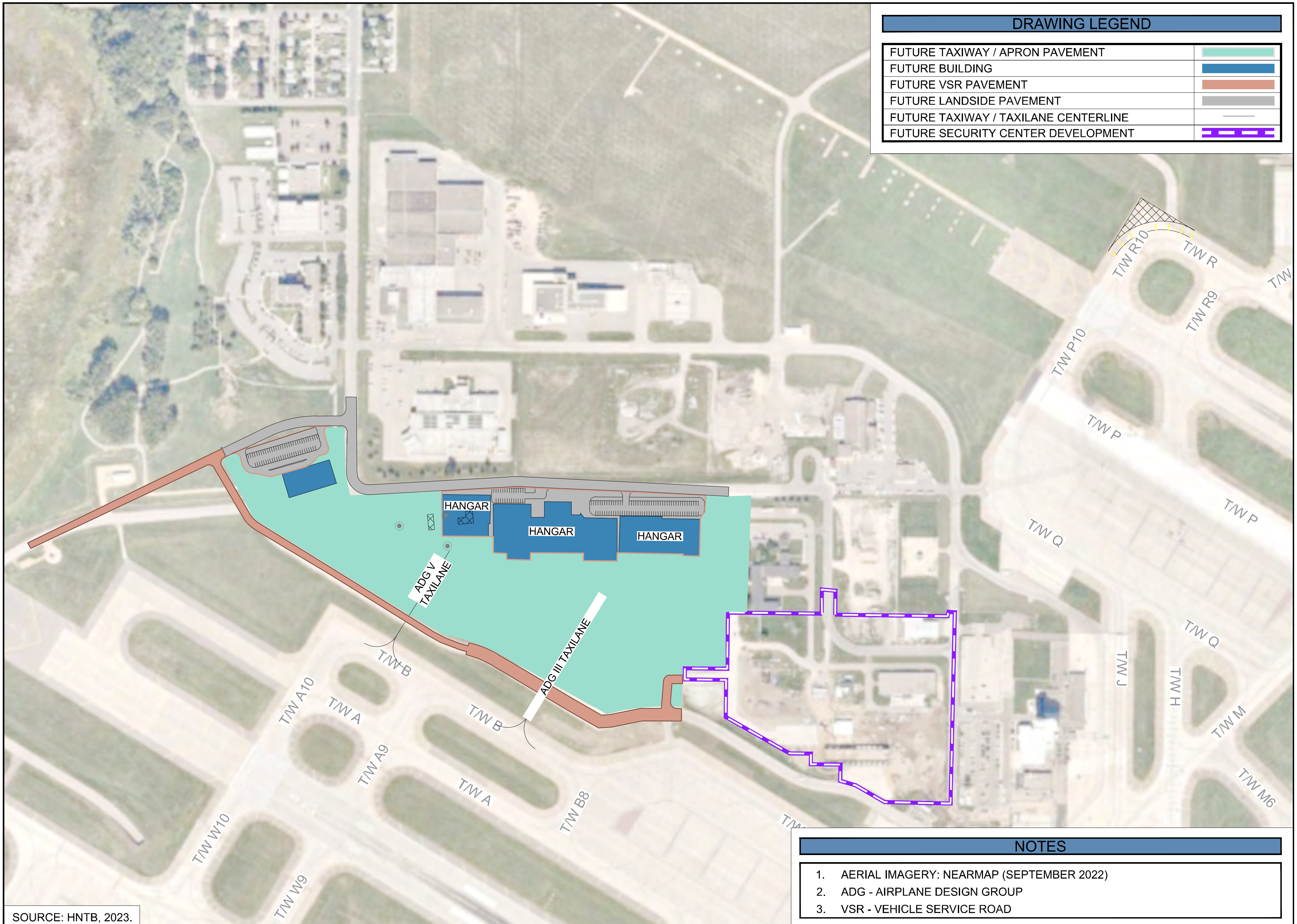

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EXHIBIT 4-34

NORTH AIRFIELD ALTERNATIVE - ALTERNATIVE 3

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4.4 LANDSIDE ALTERNATIVE DEVELOPMENT

This section reviews the landside elements considered during the initial planning process, such as curbside, parking, rental cars, and regional roadway access. Three landside alternatives were developed based on the alternative terminal families described in **Section 4.2.2**. These alternatives were developed to reflect a range of potential improvements based on each family. Specific landside improvements are dependent upon a preferred terminal plan; therefore, refined landside alternatives are reviewed in **Section 4.6**.

4.4.1 Landside Considerations

While MSP has a relatively large total area, it has limited existing undeveloped landside areas to meet the facility requirements. The following subsections provide a brief overview of the approach to identifying priority areas for landside development.

4.4.1.1 Privately-Owned Vehicle Curbside

Privately-owned vehicle (POV) curbside operations serve direct passenger drop-off and pick-up at the passenger terminal. POV curbside operations are most effective when placed near the terminal ticketing and baggage claim facilities. T1 and T2 have differing site constraints and facility requirements that impact the feasible POV alternatives. Planning should consider both the projected curbside requirements for the preferred terminal operation scheme and requirements based on the number of gates, understanding that operating schemes can change over time.

Terminal 1

The existing ticketing and baggage claim facilities are planned to remain in their current location throughout the planning horizon. The existing pick-up and drop-off curbside facilities east of the passenger processor should remain in all alternatives to continue providing convenient passenger service. Alternatives should explore POV curbside development within the Green/Gold Ramp redevelopment footprint to meet facility requirements, as this is the next closest location to the passenger terminal. Multiple parallel north–south curbs are required to meet facility requirements due to the limited distance between Concourse C and Concourse G.

Terminal 2

The existing single-level, combined pick-up and drop-off curbside east of the passenger processor is not adequate to meet the long-term facility requirements. MAC stakeholders expressed a desire to explore traditional grade separated POV curbside operations, as well as strategies utilizing the existing parking facilities to address growing curbside requirements.

4.4.1.2 Parking

The parking alternatives must consider the total Airport parking requirement, as well as the parking requirement at each terminal. The requirement at each terminal is driven by the terminal operational scenarios and the airlines allocated to each terminal. Parking alternatives must also consider the end-of-life demolition of the Green and Gold Ramps and off-Airport parking supply impacts.

T2 parking facilities include accommodations for the parking expansion that should be considered with the alternatives. The planned expansion includes:

- Purple Ramp Outrigger (Level 2 to Level 8) – 1,275 stalls
- Orange Ramp Outrigger (Level 4 to Level 8) – 750 stalls
- Orange Ramp LRT Outrigger (Level 4 to Level 8) – 360 stalls
- Orange Ramp Vertical (Level 9 and Level 10) – 1,250 stalls

Parking alternatives must consider developments that impact the existing Delta employee parking along 34th Avenue. Prior MSP planning efforts identified a structured parking development to consolidate Delta employee parking and provide an opportunity for additional economy public parking.

4.4.1.3 Rental Cars

The rental car facility alternatives must consider the total Airport rental car facility requirement, as well as the requirement at each terminal. The requirement at each terminal is driven by the terminal operational scenarios and the airlines allocated to each terminal. Both T1 and T2 have existing rental car facilities that must be considered with any alternative. The T1 CSB and ready/return area were relocated to the Silver Ramp in 2020; Airport stakeholders identified these rental car operations remaining in the Silver Ramp as a development constraint.

The remote consolidated rental car facility alternative was recommended as part of a prior MSP planning study. This rental car operating alternative was discussed with stakeholders during initial screening. The stakeholder feedback did not support this alternative due to negative customer experience associated with travel times to/from remote facilities, high costs associated with passenger movement between passenger terminals and the consolidated rental car facility, and recent Silver Ramp development with new rental car facilities.

4.4.1.4 United States Postal Service Site

The existing MSP USPS sortation and customer-facing operations are located east of the Silver Ramp. This site includes structured parking that supports valet parking for the Airport hotel. The USPS leases the existing facility. MAC can end the USPS lease early through a buyout; the buyout cost reduces each year. As of 2020, the USPS ended its sortation operations. MSP stakeholders directed the planning team to assume the USPS operations can be removed from the MSP campus.

4.4.1.5 Energy Management Center

The Energy Management Center (EMC) is the central utility plant for MSP T1. MAC commissioned a separate study evaluating alternative locations for the EMC. The consolidated landside alternatives incorporate potential landside EMC sites, as identified by the separate study.

4.4.1.6 Commercial Development Corridor

A T2 study completed in 2020 identified a commercial development corridor west of 34th Avenue. This corridor is envisioned as an opportunity to generate non-aeronautical revenue. The corridor vision includes shifting northbound 34th Avenue west of the LRT tracks and shifting southbound 34th Avenue west of the commercial development space. This alternative requires modifications to the 34th Avenue and I-494 interchange; modifications were not explored as part of this study.

4.4.1.7 Regional Roadway Access

The MAC identified improvements to the regional roadway system as part of a separate planning study and EA for the 2030 LTP. The alternatives developed in the prior study were incorporated into this planning effort as the basis for alternative development.

MSP stakeholders expressed interest in a more intuitive, consolidated Airport entry in lieu of the existing split entry for T1 and T2. However, this study did not include refinements to the prior planning work that identified improvements to the regional roadway network to accommodate this change in preferred Airport access. Future coordination is required with the Minnesota Department of Transportation (MnDOT) to align the proposed MSP access modification with planned improvements to I-494 and TH 5.

4.4.1.8 Bicycle Access

Hennepin County published a feasibility study titled "Bicycle Route Access to Minneapolis-Saint Paul International Airport (MSP)" in October 2016. The study identified a preference for bicycle facilities connecting with the regional trail network on roadways including Longfellow Avenue (dual cycle track), East 77th Street (dual cycle track), Airport Lane (dual bike lanes), 34th Avenue (shared path on the west side of the road), East Street / Post Road (dual cycle track). The study proposed bicycle access to Terminal 1 via Northwest Drive with a termination at the Silver Ramp transportation center. The bicycle facilities along Northwest Drive could use dedicated bicycle lanes between Post Road and the Quick Ride Ramp; shared bicycle and vehicle lanes were proposed between the Quick Ride Ramp and Silver Ramp due to existing roadway widths.

4.4.2 Consolidated Landside Alternatives

The planning team explored a range of landside improvements to meet the facility requirements and accommodate demand for terminal and aeronautical facilities. The improvements identified for each family alternative are intended to reflect a range of potential landside improvements in lieu of a specific set of improvements directly tied to each terminal operating alternative. The input from Airport stakeholders on priorities related to airline allocations among terminals and anticipated gates at each terminal will influence the refined and preferred landside alternative.

4.4.2.1 Family 1 Landside Alternative

The Family 1 Landside Alternative responds to a terminal operating alternative that focuses FIS operations at T1 and locates airlines requiring access to the FIS accordingly. This alternative is shown in **Exhibit 4-35** and includes:

- **T1**
    - FIS facility within the Green/Gold Ramp redevelopment site
    - POV curbside expansion within the Green/Gold Ramp redevelopment site
    - Public parking development within the Green/Gold Ramp redevelopment site
    - Public parking and rental car QTA facility development within the USPS site
    - EMC facilities south of the exit plaza
    - Access/egress roadway realignment/reconfiguration for the crossfield taxiway

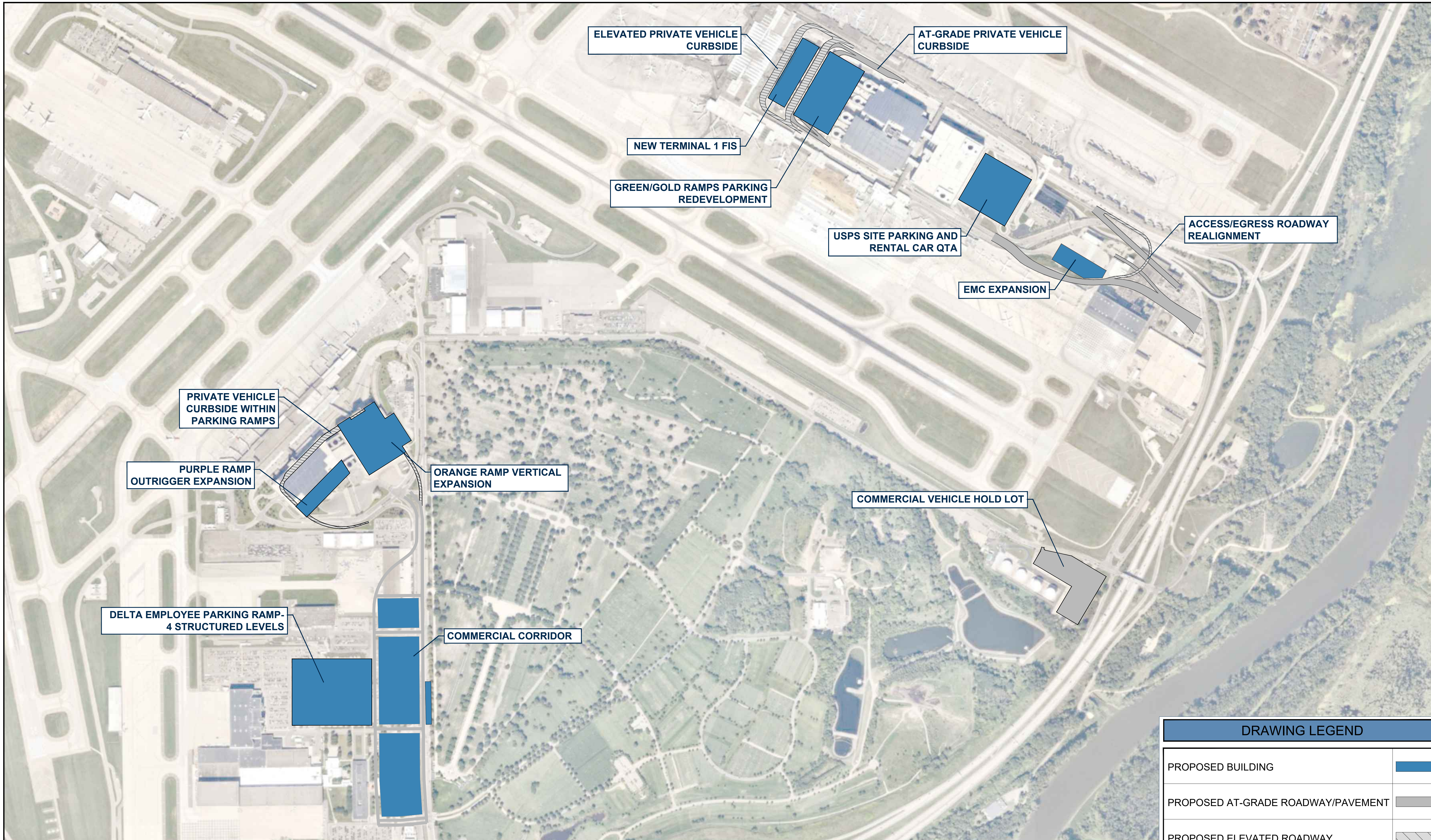
- **T2**
    - Purple Ramp outrigger expansion
    - Orange Ramp expansion
    - POV curbside expansion within the parking ramps
- **Other**
    - Commercial vehicle hold lot and cell phone lot operations relocated to the vacated Super America site along Post Road
    - Delta employee / remote public parking ramp west of 34th Avenue at 75th Street
    - Commercial corridor west of 34th Avenue

The general landside advantages of this alternative include:

- The USPS site parking development offsets a portion of parking displaced by the Green and Gold Ramps demolition.
- Rental car operations are efficient at T1, including an opportunity for a new QTA facility designed to meet EV requirements.
- A new T1 rental car QTA facility provides an opportunity to redevelop the existing Red/Blue Ramp Level 1.

The general landside challenges of this alternative include:

- The FIS facility placement reduces the supply of highest value walking-distance parking at T1.
- There are significant roadway reconfiguration costs, and extended coordination is required with MnDOT and other outside agencies to construct the T1 access roadway modifications.
- The T2 gate expansion impacts the existing rental car QTA facility, requiring relocation or consolidation in another location not identified in this alternative.
- T2 parking is required to meet the T1 parking demand due to T1 site constraints.



SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-35
Family 1 Landside Alternative

4.4.2.2 Family 2 Landside Alternative

The Family 2 Landside Alternative responds to a terminal operating alternative that focuses FIS operations at T2 and provides secure passenger connectivity between T1 and T2. This alternative generates the highest landside facility requirements at T1 due to the airline allocation. This alternative is shown in **Exhibit 4-36** includes:

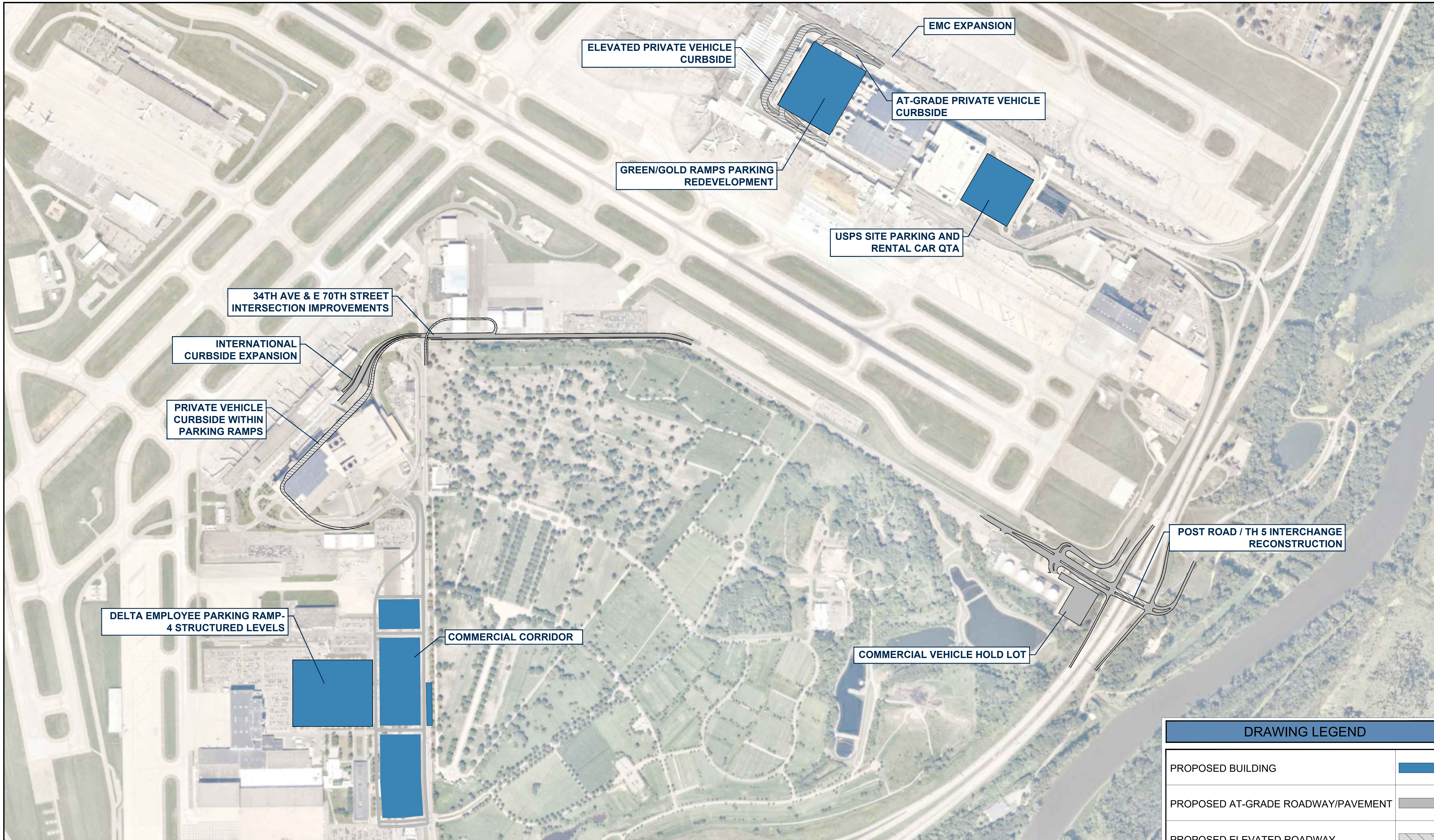
- **T1**
  - POV curbside expansion within the Green/Gold Ramp redevelopment site
  - Public parking development within the Green/Gold Ramp redevelopment site
  - Public parking and rental car QTA facility development within the USPS site
  - EMC facilities expanded in place within Concourse C
- **T2**
  - Northern POV curbside expansion for international arrivals
  - POV curbside expansion within the parking garages
  - Access relocated from 34th Avenue to Post Road / East 70th Street
  - 34th Avenue and East 70th Street intersection improvements
- **Other**
  - Commercial vehicle hold lot and cell phone lot operations relocated to the vacated Super America site along Post Road
  - Post Road / TH 5 interchange reconstruction
  - Delta employee / remote public parking ramp west of 34th Avenue at 75th Street
  - Commercial corridor west of 34th Avenue

The general landside advantages of this alternative include:

- The USPS site parking development offsets a portion of parking displaced by the Green and Gold Ramps demolition.
- Rental car operations are efficient at T1, including an opportunity for a new QTA facility designed to meet EV requirements.
- T1 parking demand is met at T1 without diversion to T2 during peaks.
- The existing T2 rental car QTA facility remains.
- Enhanced Airport wayfinding through consolidated entry to both T1 and T2 from TH 5.

The general landside challenges of this alternative include:

- The commercial vehicle hold lot and cell phone lot site is inadequate to meet long-term Airport needs.
- This alternative does not take advantage of the planned parking expansion capacity at T2.
- Improvements at Post Road and TH 5 are constrained by existing airspace and require MnDOT coordination for improvements off Airport property.



SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-36

Family 2 Landside Alternative

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4.4.2.3 Family 3 Landside Alternative

The Family 3 Landside Alternative responds to a terminal operating alternative with FIS operations at both T1 and T2, along with the relocation of multiple airlines to T2. This alternative generates the highest landside facility requirements at T2 due to the airline allocation. This alternative is shown in **Exhibit 4-37** and includes:

- **T1**
  - FIS facility within the Gold Ramp redevelopment site
  - POV curbside expansion within the Green/Gold Ramp redevelopment site using alternative operational schemes to traditional linear curbside (i.e., kiss and ride curb or ultra-short-term parking)
  - Public parking development within the Green/Gold Ramp redevelopment site
  - Public parking development within the USPS site
  - EMC facilities within the USPS site
  - Rental car QTA facility development within the Quick Ride Ramp site
- **T2**
  - Purple Ramp outrigger expansion
  - Orange Ramp outrigger, LRT, and vertical expansion
  - Orange Ramp north expansion
  - Stacked POV curbside development above existing curbside
  - Access relocated from 34th Avenue to Post Road / East 70th Street
  - 34th Avenue and East 70th Street intersection improvements
- **Other**
  - Post Road / TH 5 interchange reconstruction
  - Rental car QTA facility support operations along Post Road
  - Commercial vehicle hold lot and cell phone lot operations along Post Road
  - Delta employee / remote public parking ramp west of 34th Avenue at 75th Street
  - Commercial corridor west of 34th Avenue

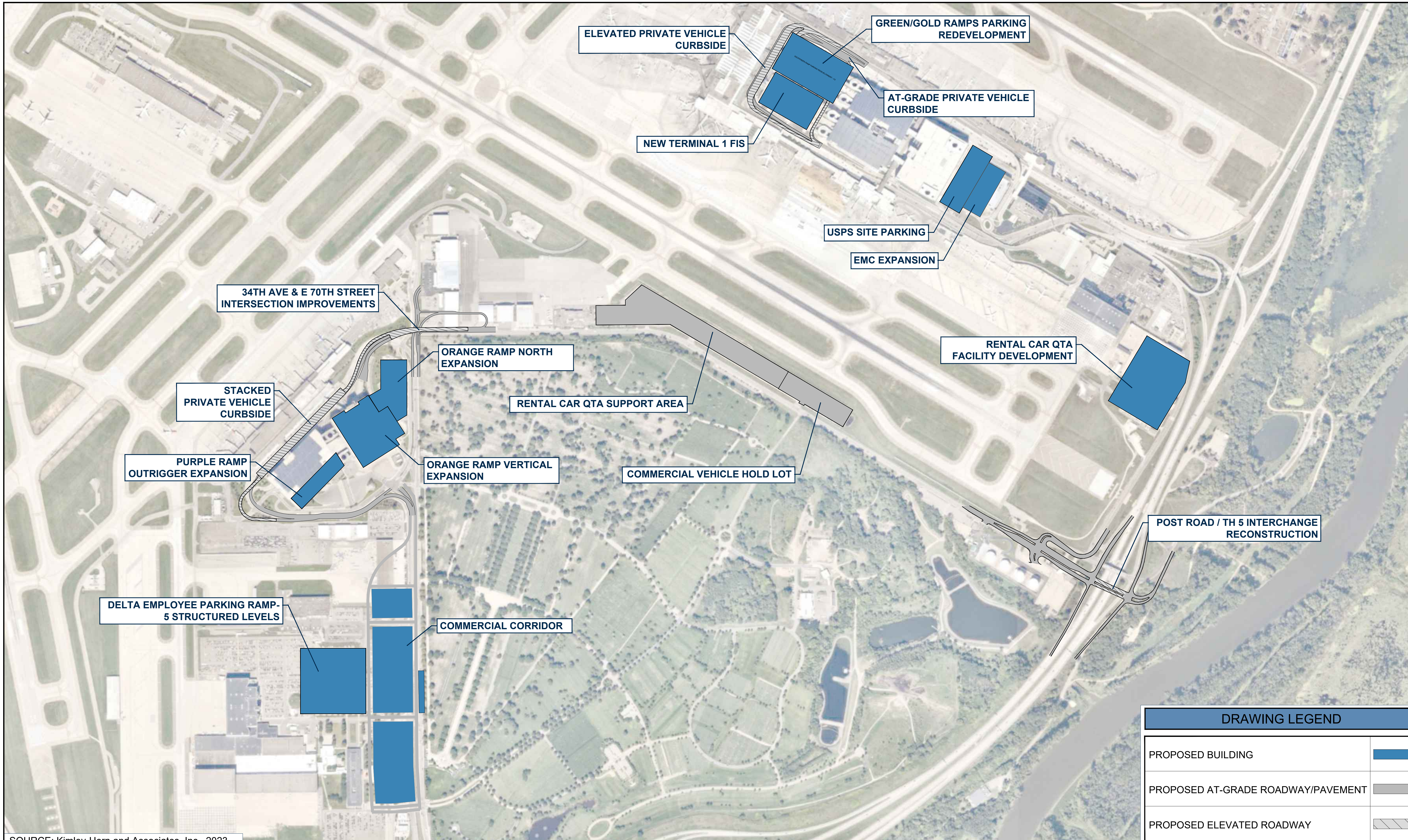
The general landside advantages of this alternative include:

- There is an opportunity to develop a new T1 FIS facility without demolishing the Green Ramp.
- The USPS site parking development offsets a portion of parking displaced by the Green and Gold Ramps demolition.
- A new rental car QTA facility provides an opportunity to redevelop the existing Red/Blue Ramps Level 1.
- Airport access is consolidated to both T1 and T2 from TH 5.
- The T2 curbside customer experience is enhanced.

The general landside challenges of this alternative include:

- There are limited opportunities to expand the T1 POV curbside.
- T2 parking is required to meet the T1 parking demand due to T1 site constraints.
- The T2 gate expansion impacts the existing rental car QTA facility, requiring relocation or consolidation in another location.
- Security and traffic associated with shuttling rental cars between the rental car ready/return area and the remote QTA facility at both T1 and T2.
- Increased T2 airline activity drives the need for significant access roadway enhancement.

- This alternative cannot meet the commercial vehicle hold lot and cell phone lot program requirements.
- Improvements at Post Road and TH 5 are constrained by existing airspace and require MnDOT coordination for improvements off of Airport property.



SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-37

Family 3 Landside Alternative

4.5 ALTERNATIVE EVALUATION

The MAC and Airport stakeholders evaluated the short-listed alternatives to identify a preferred development alternative. An evaluation exercise was completed for Alternatives 1A, 2A, and 3A based on six main categories[1] including passenger convenience, terminal, landside, airside, operation expenditures / capital expenditures, and "other."

4.5.1 Passenger Convenience Evaluation

The score for the passenger convenience category was based on two supporting categories: terminal walking distance / ease of use and landside walking distance / ease of use. Each supporting category was founded on a variety of ancillary topics:

- **Supporting Category 1 - Terminal walking distance / ease of use**
    - Proximity of gates to FIS facility, SSCPs, and terminal facility as a whole
    - Anticipated difficulty of terminal wayfinding based on navigability of horizontal and vertical circulation
- **Supporting Category 2 - Landside walking distance / ease of use**
    - Proximity of nearest terminal exit portal from curbside for both passenger and commercial vehicles
    - Proximity of parking spaces to nearest terminal exit portal considering level changes
    - Anticipated difficulty of regional and Airport complex roadway wayfinding

In comparison to its counterparts, Alternative 1A had the lowest score for passenger convenience, primarily due to longer landside walking distances and proximity of gates within the terminal facility. Alternative 2A scored slightly higher than Alternative 3A, primarily due to the proximity of gates to an FIS facility and SSCP, as well as curbside proximity.

4.5.2 Terminal Evaluation

The score for the terminal category, passenger convenience, was based on two supporting categories: terminal walking distance / ease of use and landside walking distance / ease of use. Each supporting category was founded on a variety of ancillary topics:

- **Gating Strategy**
    - Capability to fulfill airline operational strategies
    - Flexibility to accommodate changes in airline operations or new entrants
    - Consistency of flight lines
- **FIS Facilities**
    - Proximity of FIS facilities to gates, curbside, and security
    - LOS for passenger convenience processing from arrival gate to curb or connection at other gates
    - Capability for future expansion
    - Consolidation of FIS facilities

[1] The six main categories were selected based on the primary objectives identified for the LTP, as described in Chapter 1, Section 1.2.

In comparison to its counterparts, Alternative 1A had the lowest score for the terminal evaluation, primarily due to less contiguous operations from bifurcated terminal facilities. Alternative 2A ranked slightly higher than Alternative 3A, primarily due to proximity of gates to an FIS facility and SSCP, as well as curbside proximity.

4.5.3 Landside Evaluation

The score for the landside category was based on two supporting categories: roadway and curbside efficiency and parking. Each supporting category was founded on a variety of ancillary topics:

- **Roadway and Curbside Efficiency**
    - Passenger proximity to SSCPs and baggage claim
    - Ability to meet facility requirements
    - Balanced peak hour activity between terminals
- **Parking**
    - Proximity to nearest terminal entry/exit for passengers and meeters/greeters
    - Ability to meet terminal-specific facility requirements

In comparison to its counterparts, Alternative 1A had the highest score for landside, followed closely by Alternative 3A.

4.5.4 Airside Evaluation

The score for the airside category was based on two supporting categories: roadway and curbside efficiency and parking. Each supporting category was founded on a variety of ancillary topics:

- **Operational Efficiency**
    - Minimization of airside traffic flow congestion between taxiways
    - Minimization of apron conflicts in pushbacks, runup procedures, and VSR crossings
    - Maximization of flight service lines for carriers
- **Airfield Capacity**
    - Maximization of runway operations
    - Minimization of slot/gate constraints

In comparison to its counterparts, Alternative 1A had the lowest score for airside efficiency and capacity, primarily due to increased gate capacity in already congested airside areas. Alternative 2A scored slightly higher than Alternative 3A in airfield capacity due to cross-use of facilities between the two terminal aprons, and lower in efficiency because of the addition of gates in more congested airside areas.

4.5.5 Fast-Time Simulation

A fast-time airfield simulation was developed using Transoft's AirTOP software, to evaluate the alternative terminal and airfield projects. The PAL 3 schedule was applied to the future model to test the performance of the overall airfield under future conditions. Results were compared to results from a model using the future schedule and the existing airfield (a no-build alternative). The model tested five runway flow configurations and three weather conditions in both the future no-build and future Alternative 1A airfield and terminal configurations. The build alternative demonstrated significant positive benefit.

The end-around taxiway (EAT) showed significant reduction in delays associated with aircraft crossing Runway 12R/30L. Delay reductions are most significant under “South flow” and “Mixed A flow” conditions when aircraft leave Terminal 1 for departure on Runway 35. Similar benefits are realized during “North flow” for aircraft arriving Runway 17 for Terminal 1.

Another project with demonstrable benefit is to reconfigure Taxiways A and B near Concourse F. Providing two-way taxi flow significantly reduces conflicts between aircraft arriving to existing and extended concourse G and those taxing for departure on Runway 30L.

Other projects identified in Alternative 1A show benefits under some runway use configurations or during some weather conditions, which are sufficient to warrant further study following completion of the LTP.

4.5.6 Operational Expenditures / Capital Expenditures

The score for the operational expenditures (OPEX) and Capital Expenditures (CAPEX), was based on capital and operating costs for each alternative. Each of the supporting categories was founded on a variety of ancillary topics which are summarized as:

- **OPEX**
    - Complexity of logistics – how well the layout for each alternative allows for usage of facilities, equipment, and personnel.
    - Cross-use of facilities – the capability of an alternative’s facilities to be highly utilized through the balancing and spread of operations across the airport.
    - Efficiency – the ability to operate airport facilities in an efficient manner and allow for the seamless flow of passengers, bags, and aircraft.
- **CAPEX**
    - Assumed cost of construction for each alternative.
    - Ongoing costs of maintaining facilities within the Airport

In comparison to its counterparts, Alternative 2A had the highest score for OPEX and the lowest score for CAPEX, both due to the high interconnectivity between the two terminal complexes via a new APM tunnel. Alternative 1A had the lowest score for OPEX and the highest score for CAPEX, due to the size of the capital improvements that do not address the operational needs as well as the other two alternatives. Alternative 3A scored the highest overall, balancing the OPEX and CAPEX needs of the Airport.

4.5.7 Other

The other category looks at the strategic needs of the Airport, which include the MAC’s goals for the plan, as well as ease of implementation, maintaining or enhancing existing capabilities, and minimizing disruption of operations during implementation of the preferred alternative. The MAC goals for the LTP include:

- **MAC Goals**
  - Plan for future facilities that will meet projected passenger activity levels in a manner that maintains and enhances customer service, while facilitating a seamless experience
  - Produce a development plan that positions the MAC to meet future demand, enhance financial strength, leverage environmental stewardship, and infuse sustainable thinking
  - Conduct the planning process in a manner that includes meaningful stakeholder engagement

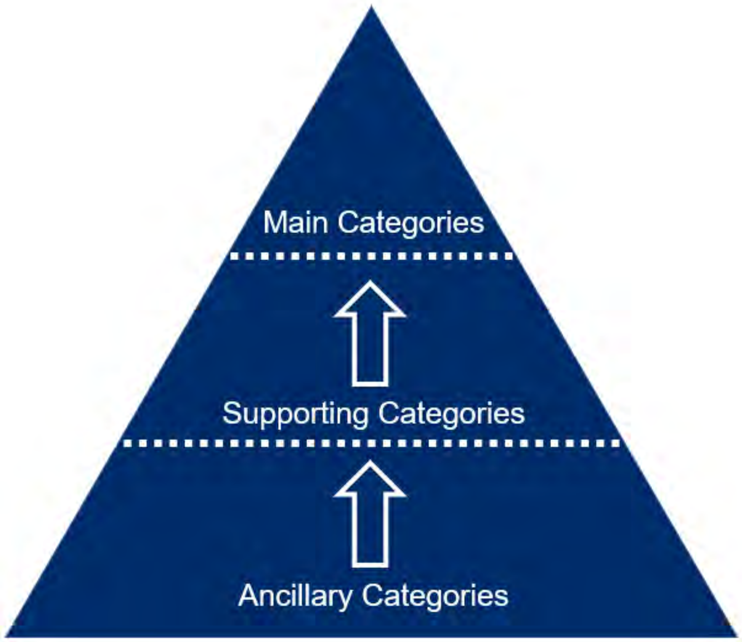
Exhibit 4-38 shows the evaluation matrix. Each main category was measured using a scoring system ranging from low to high, with low being least favorable and high being most favorable. A comprehensive score was assigned to each alternative, which assisted the MAC in selecting the most beneficial alternative for the future development of MSP. Alternative 3A received the highest cumulative score and was selected to be further studied and refined. This alternative would later transform into the preferred development alternative (reviewed in **Section 4.6**). While Alternative 3A did not receive the highest score for each main category, it performed consistently well in nearly all categories. Each category was based on the sum of two respective supporting categories, as shown on the evaluation matrix. Each supporting category was the product of multiple ancillary categories, which are reviewed throughout the remainder of this section. **Exhibit 4-39** presents the evaluation category hierarchy.

Exhibit 4-38: Evaluation Matrix

Evaluation Categories	Alt 1A	Alt 2A	Alt 3A
Passenger Convenience (15%)	**Low**	**High**	**Mid**
Terminal Walking distances/Ease of use	Low	High	Mid
Landside Walking distances/Ease of use	Low	High	Mid
Terminal (19%)	**Low**	**High**	**High**
Gating Strategy	Low	Mid	High
FIS Facilities	Mid	High	Mid
Landside (13%)	**High**	**Low**	**Mid**
Road/curb efficiency	High	Low	Mid
Parking	Mid	Low	Mid
Airside (13%)	**Low**	**Mid**	**High**
Operational Efficiency	Low	Mid	High
Airfield Capacity	Low	High	Mid
OPEX/CAPEX (20%)	**High**	**Low**	High
OPEX	Low	High	Mid
CAPEX	High	Low	Mid
Other (20%)	**Mid**	**Low**	**High**
Mission/Goals	Low	Mid	High
Implementation	High	Low	Mid
CUMULATIVE SCORE (100%)	**Mid**	**Low**	**High**

NOTES: Scores are low to high, with low being least favorable and high being most favorable. For details regarding the scoring system and evaluation process, contact the Metropolitan Airports Commission and/or Ricondo & Associates, Inc.
FIS – Federal Inspection Services; OPEX – Operation Expenditures; CAPEX – Capital Expenditures
SOURCE: Ricondo & Associates, Inc., December 2022.

Exhibit 4-39: Evaluation Category Hierarchy



SOURCE: Ricondo & Associates, Inc., December 2022.

The foundation of the scoring system began with a range from 1 to 5 for the ancillary categories, with 1 being least favorable and 5 being most favorable. In coordination with the MAC and other entities involved in the planning process, specific weights were applied to each supporting and ancillary category based on perceived importance. As shown on **Exhibit 4-39**, each main category was assigned a weight; these weights are the summation of the supporting categories' weights.

4.6 ALTERNATIVE 3A ALTERNATIVE LANDSIDE REFINEMENT

The consistently medium-to-high performance in the alternative matrix categories, Alternative 3A was considered in the LTP process for additional refinements in the landside category. Refinement of the landside alternatives was a response to the identification of the preferred terminal alternative of operations, the preferred terminal gate development locations, and preferred airside developments impacting existing landside facilities.

4.6.1 Terminal-Specific Requirements

Activity was determined for PAL 2 and PAL 3 at each terminal for both the spring and summer flight schedules. The spring activity was the basis for requirements at T2, whereas the summer was the basis for requirements at T1. In addition to the preferred alternative with airlines relocating to T2, a scenario where airlines do not relocate was also studied for T1 to create an envelope of potential future scenarios. **Table 4-1** presents the forecast percentage of activity at each terminal for the PALs based on the developed DDFSs.

Table 4-1: Terminal-Specific Origin and Destination Activity (Percent)

	Terminal Scenario	Terminal 1[1]	Terminal 2[1]
PAL 2 Spring	Airlines Relocate	62.5%	37.5%
PAL 2 Summer	Airlines Remain	85.1%	14.9%
	Airlines Relocate	63.5%	36.5%
PAL 3 Spring	Airlines Relocate	64.5%	35.5%
PAL 3 Summer	Airlines Remain	82.8%	17.2%
	Airlines Relocate	64.7%	35.3%

NOTES:
PAL – Planning Activity Level; Airlines Remain – Airlines from T2 occupy future gate expansion at T2; Airlines Relocate – Airlines from T1 relocate to T2 and occupy future gate expansion at T2.
1 Bolded values represent the design scenarios for the respective terminal.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

The DDFSs for each terminal scenario were analyzed to determine curbside requirements for PAL 3 to account for the additional activity anticipated based on the airline relocations. **Table 4-2** presents the terminal-specific curbside requirements. Refer to **Appendix C.1** for additional information on the methodology used.

Table 4-2: Terminal-Specific Curbside Requirements (Linear Feet)

		Terminal 1[1]		Terminal 2[1]	
	Terminal Scenario	Arrivals	Departures	Arrivals	Departures
PAL 3 Spring	Airlines Relocate	765’	890’	940’	840’
PAL 3 Summer	Airlines Remain	1,130’	1,130’	690’	515’
	Airlines Relocate	940’	1,080’	890’	715’

NOTES:
PAL – Planning Activity Level; Airlines Remain – Airlines from T2 occupy future gate expansion at T2; Airlines Relocate – Airlines from T1 relocate to T2 and occupy future gate expansion at T2.
1 Bolded values represent the design scenarios for the respective terminal.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Terminal-specific parking requirements were derived from the total Airport parking requirements presented in **Chapter 3**. It was assumed that 250 employees park at T1 and the rest are required to park at T2. As previously mentioned, the summer is the design season for T1 and the spring is the design season for T2. **Table 4-3** presents the parking requirements used to inform the refined landside alternatives.

Table 4-3: Terminal-Specific Parking Requirements (Stalls)

	Terminal Scenario	Terminal 1 [1]	Terminal 2 [1]	Total On-Airport Requirement
PAL 2 Spring	Airlines Relocate	15,545	**11,015**	26,560
PAL 2 Summer	Airlines Remain	**21,085**	5,475	
	Airlines Relocate	**15,800**	10,760	
PAL 3 Spring	Airlines Relocate	20,140	**13,060**	33,200
PAL 3 Summer	Airlines Remain	**25,775**	7,425	
	Airlines Relocate	**20,180**	13,020	

NOTES:
PAL – Planning Activity Level; Airlines Remain – Airlines from T2 occupy future gate expansion at T2; Airlines Relocate – Airlines from T1 relocate to T2 and occupy future gate expansion at T2.
1 Bolded values represent the design scenarios for the respective terminal.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

4.6.2 Refined Landside Alternative Constraints

MAC identified multiple constraints as part of separate studies that informed the refined alternatives. Critical development constraints include:

- *T1 EMC* – The facility expansion will occur in Concourse C. This is the result from a study completed as part of a separate Airport effort.
- *T2 Access Roadway* – The preferred alternative should maintain flexibility to access T2 landside facilities from either 34th Avenue or Post Road / East 70th Street.
- *T1 Electrical Substation* – The existing substation may require expansion. Development should not be planned in close proximity to the existing electrical substation.
- *Part 77 / US Standard for Terminal Instrument Procedures (TERPs) Surfaces* – Airspace restrictions must be considered for T1 landside facilities. The refined alternatives included a cursory review of airspace compliance; however, further study is required to verify feasibility.

4.6.3 Terminal 1

The refinement process for T1 focused on identifying the priority functions for the two primary development areas available at T1: the Green/Gold Ramp redevelopment site and the existing USPS site. The following program needs, and desirable program elements, were established through an analysis of the terminal-specific requirements and engagement with Airport stakeholders:

- Program Needs
    - Arrivals and Departures POV Curbside
    - FIS Facility
    - Public and Employee Parking
    - Rental Car QTA Facility
    - Commercial Vehicle Curbside (due to Green/Gold Ramp redevelopment)
- Desired Program Elements
    - MAC Offices
    - Commission Chambers
    - Solar Infrastructure
    - Additional Ticketing or Baggage Claim Functions
    - APM Station and/or APM Maintenance Space
    - Bike Trail Access

Based on the site attributes and the attributes that are required for each function, as described in **Section 4.4.1**, the program elements were designated a recommended site for development, as summarized in **Table 4-4**.

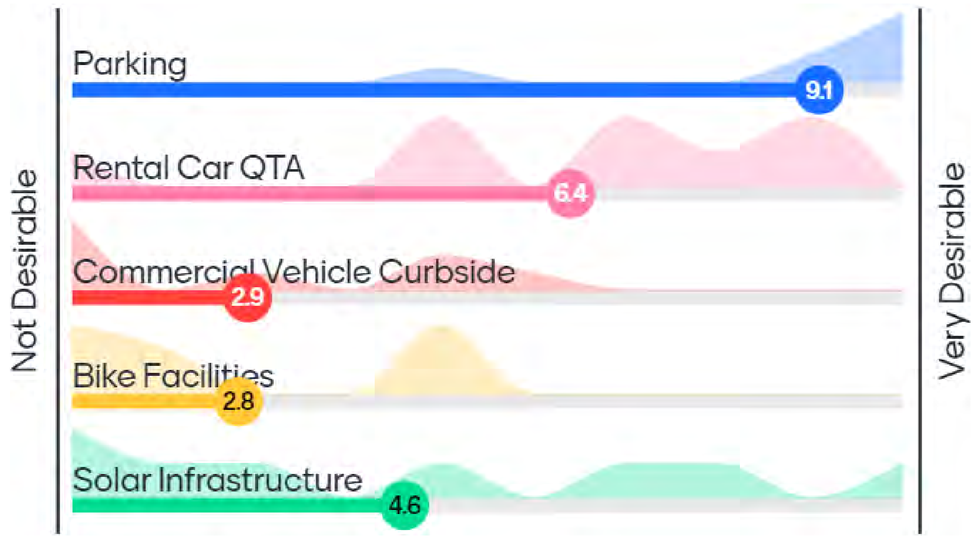
Table 4-4: Recommended Function Allocation

	Green/Gold Ramp Redevelopment Site	Red, Blue, and Silver Ramps	USPS Site
Program Needs	FIS	Commercial Vehicles	Rental Car QTA
	Arrivals and Departures Private Vehicle Curbside	Bike Trail Access	Parking
	Parking		
	Commercial Vehicles		
Potential Functions	Additional Ticketing/Baggage Claim		Solar Infrastructure
	Office Space		APM Space
	Commission Chambers		
	Plaza		
	Solar Infrastructure		
	APM Space		

NOTES:
USPS – US Postal Service; FIS – Federal Inspection Services; APM – Automated People Mover; QTA – Quick Turnaround
SOURCE: Kimley-Horn and Associates, Inc., 2022.

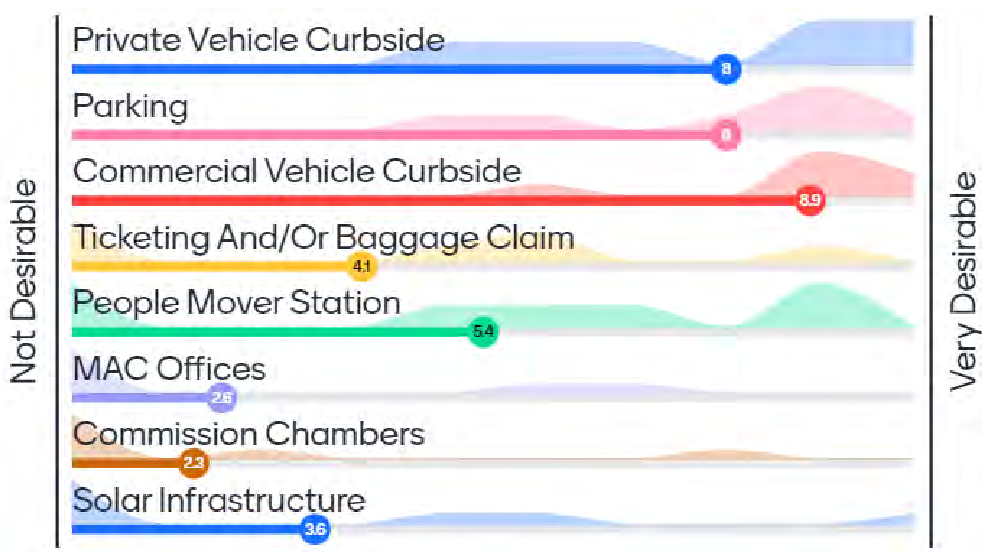
MAC stakeholders were polled to verify the recommended function allocations, which are outlined in **Table 4-4**. The results shown on **Exhibit 4-40** illustrate parking and rental car facilities are high priorities for the USPS site. Polling results related to the Green/Gold Ramp site, shown on **Exhibit 4-41**, indicate the POV curbside, parking, and commercial vehicle curbside are the most desirable uses for that space.

Exhibit 4-40: U.S. Postal Service Site Function Allocation – Poll Results



NOTE:
QTA – Quick Turnaround
SOURCES: Kimley-Horn and Associates, Inc., 2023; Mentimeter, 2023 (interactive presentation software).

Exhibit 4-41: Green/Gold Ramp Function Allocation – Poll Results

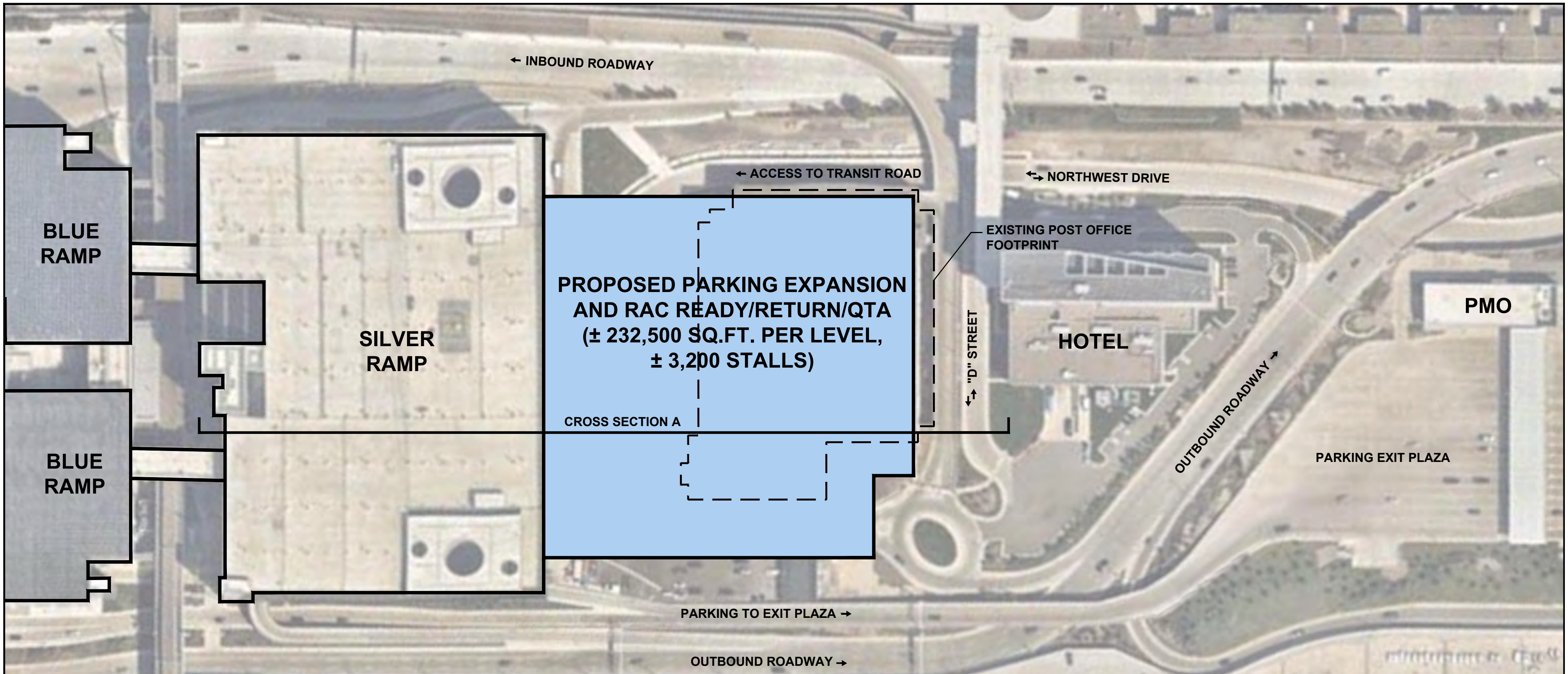


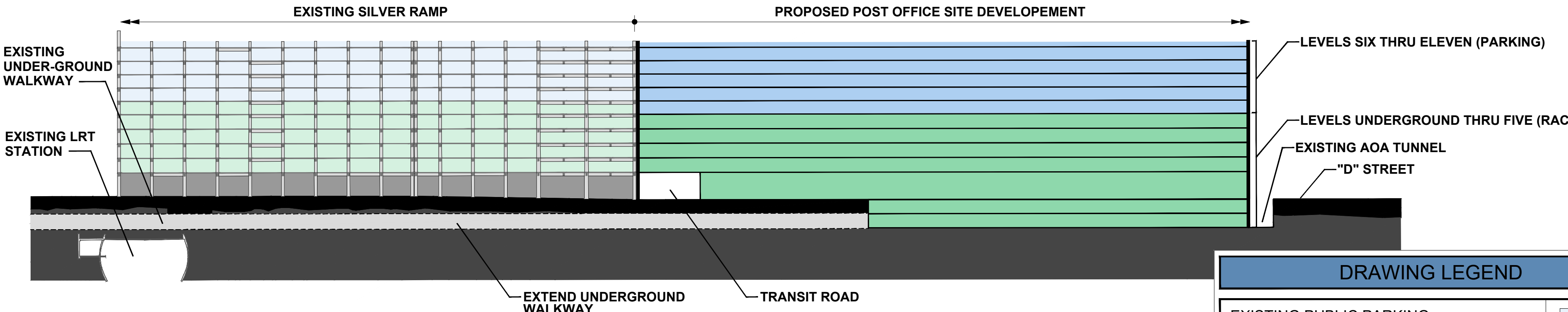
NOTE:
MAC – Metropolitan Airports Commission
SOURCES: Kimley-Horn and Associates, Inc., 2023; Mentimeter, 2023 (interactive presentation software).

4.6.3.1 U.S. Postal Service Site

Through stakeholder engagement, the USPS site was identified as a preferred location for rental car QTA operations and parking. Alternative rental car QTA sites serving T1 were deemed infeasible due to rental car operational requirements. Alternatives for the USPS site focused on maximizing public parking space and expanding rental car vehicle washing and EV fueling within a facility matching the height of the existing Silver Ramp. A multilevel QTA facility is proposed to meet the program requirements within the site footprint and to enhance rental car operations. Locating the QTA facility and parking in the USPS site allows integration with the existing RAC and parking operations, benefiting the operational efficiency of the landside area. **Exhibit 4-42** shows the proposed development footprint, as well as a cross section of the structure. Further planning/design refinement is required to validate the uses for the existing underground portions of the USPS facility that interface with the Airport Operations Area (AOA) tunnel.

The Silver Ramp programming and design included planning for a future eastern expansion into the USPS site. An existing underground tunnel can extend east to the USPS site (note: this requires storm sewer utility relocation). Perimeter columns on the east side of the Silver Ramp were designed to accept columns for an expanded facility. Rental car operations planning included accommodations for accessing a QTA facility east of the Silver Ramp.





CROSS SECTION A

NOT TO SCALE

DRAWING LEGEND	
EXISTING PUBLIC PARKING	
EXISTING RAC READY/RETURN	
EXISTING TRANSIT CENTER	
PROPOSED PUBLIC PARKING	
PROPOSED RAC AND QTA FUNCTIONS	

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-42

Post Office Site Redevelopment

4.6.3.2 Green/Gold Ramp Site

Within the Green/Gold Ramp redevelopment site, potential configurations of the functional elements were developed based on meeting program requirements (per **Table 4-2** and **Table 4-3**), minimizing curbside passenger vertical circulation, intuitive pedestrian and vehicular wayfinding, aligning with peer airports, and accommodating desired program elements.

Each alternative assumes pedestrian bridges are provided from Concourses C and G to the FIS facility located in the Green/Gold Ramp redevelopment site; pedestrian bridges are not detailed or described for clarity, as refinement beyond the scope of this planning study is required to validate feasibility and cost. Each alternative described in the following subsections was valued against the evaluation criteria presented in **Table 4-5**. Each element was rated on a scale of 1 to 5 (unsatisfactory to satisfactory).

Alternative 1.A – Two Stacked Curbsides

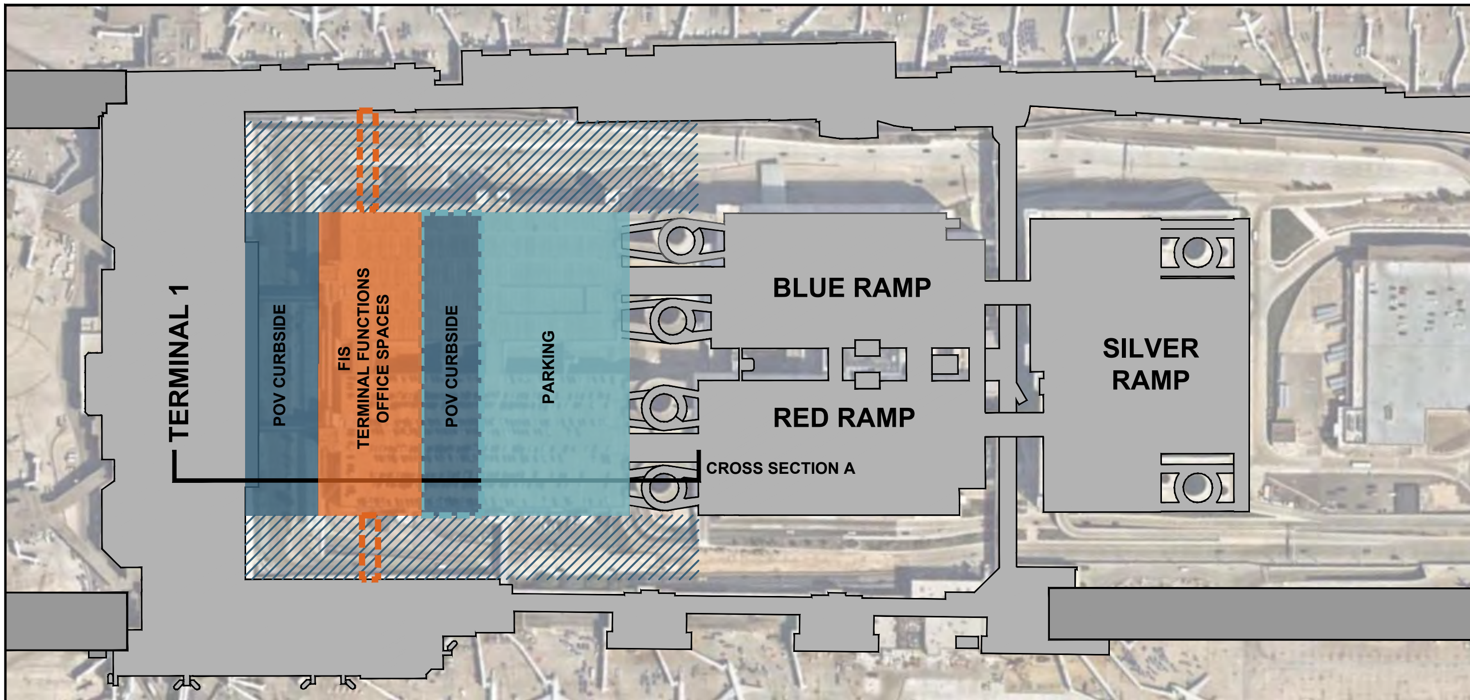
Alternative 1.A, illustrated on **Exhibit 4-43**, proposes two stacked curbsides separated by a building structure. The first two levels of the building are proposed to mimic the existing terminal, while upper levels can be used for other uses, such as the FIS facility and offices. The ticketing and baggage claim functions are included in the new building to provide an attraction for passengers to use the outer curbside facilities. A new parking development extends from the existing helices to the new building, extending over the curbside facilities, providing approximately 4,300 stalls. This alternative proposes maintaining the existing terminal-to-landside skyways and tunnel, as well as the Green/Gold Ramp vertical circulation core.

Alternative 1.B – Single-Level Curbside and a Stacked Curbside

Alternative 1.B, illustrated on **Exhibit 4-44**, proposes a single-level curbside nearest the existing terminal and a stacked curbside east of the existing vertical circulation core. An open-air plaza is proposed above the single-level curbside to provide connectivity with the new departures curb. The new building space for the FIS facility and the offices is located above the stacked curbside facility. Locating the FIS facility above vehicular functions presents a security concern. A new parking development extends from the existing helices to the new building, providing approximately 5,100 stalls.

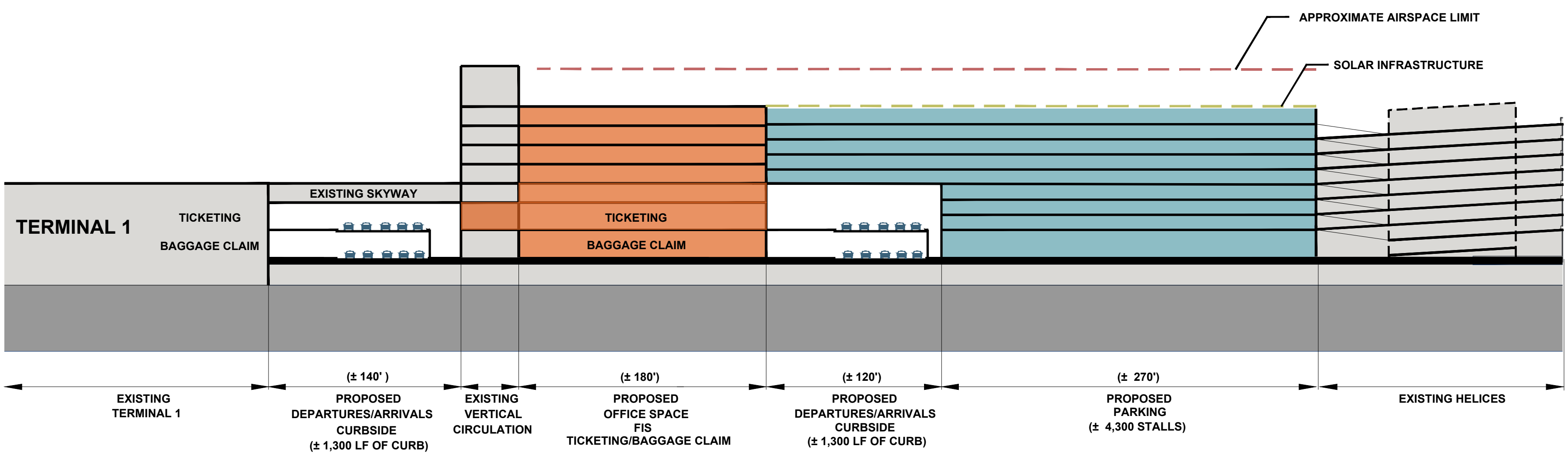
Alternative 1.C – Two Stacked Curbsides and a Vertical Circulation Space

Alternative 1.C, illustrated on **Exhibit 4-45**, proposes two stacked curbsides, offset from the terminal by a building extension to the east; a vertical circulation space is proposed to provide terminal access from the outer curbside. The footprint vacated by the existing POV curbside provides space for the FIS facility, a plaza, and offices. Locating the FIS facility adjacent to the existing terminal building could enhance baggage recheck for connecting passengers. A new parking development extends from the existing helices over both curbsides to the face of the existing vertical circulation core, providing approximately 6,250 stalls.



DRAWING LEGEND

EXISTING TERMINAL	
PROPOSED TERMINAL	
PROPOSED ROADWAY IMPROVEMENTS	
PROPOSED POV CURBSIDE	
PEDESTRIAN BUILDING	
PROPOSED PARKING	
BUILDING ABOVE	
PARKING ABOVE	



CROSS SECTION A

NOT TO SCALE

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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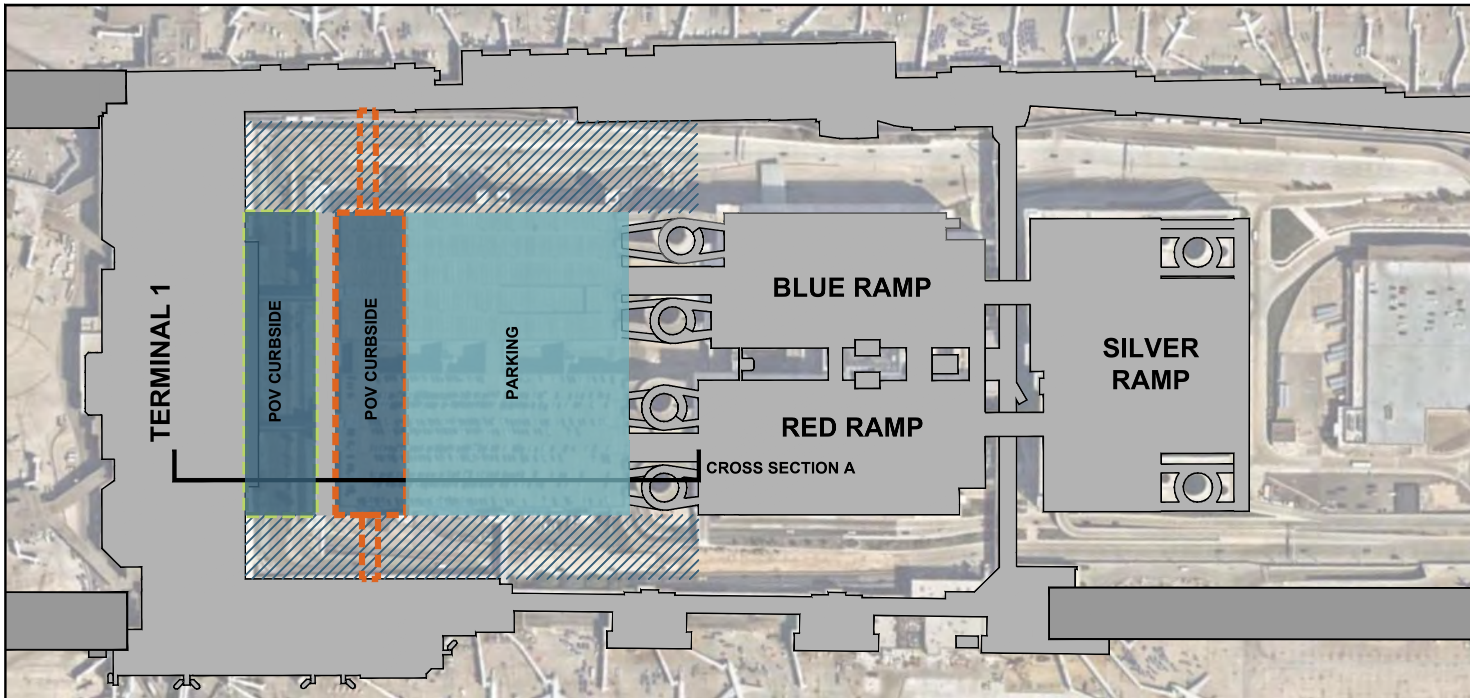
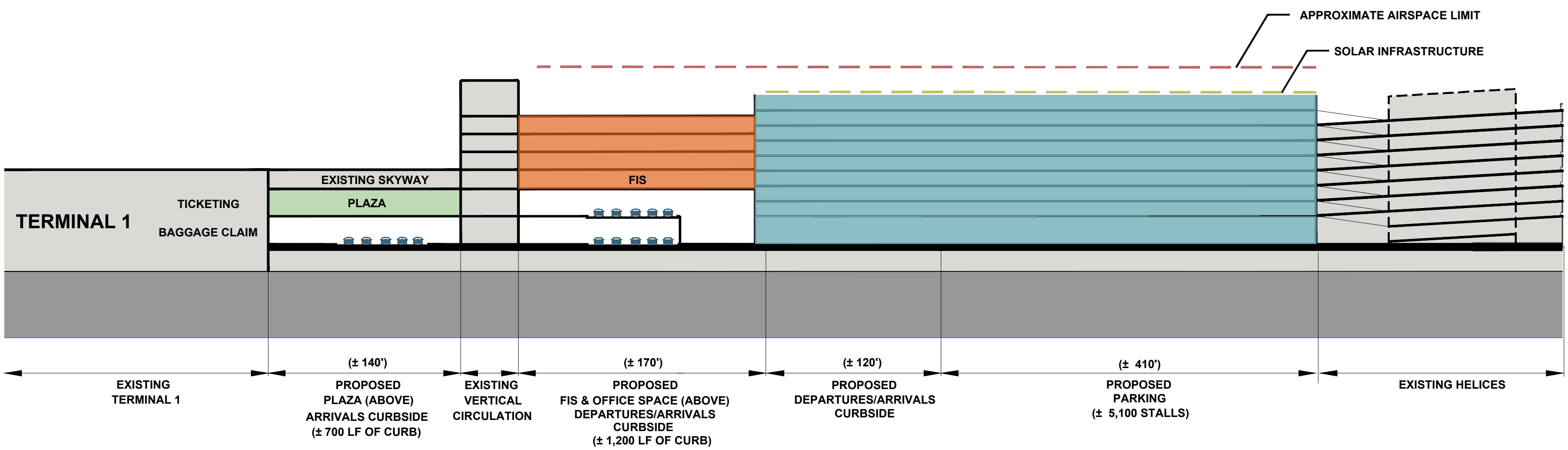
EXHIBIT 4-43

Landside Alternative 1.A



DRAWING LEGEND	
EXISTING TERMINAL	
PROPOSED TERMINAL	
PROPOSED ROADWAY IMPROVEMENTS	
PROPOSED POV CURBSIDE	
PEDESTRIAN BUILDING	
PROPOSED PARKING	
BUILDING ABOVE	
PLAZA ABOVE	



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NOT TO SCALE

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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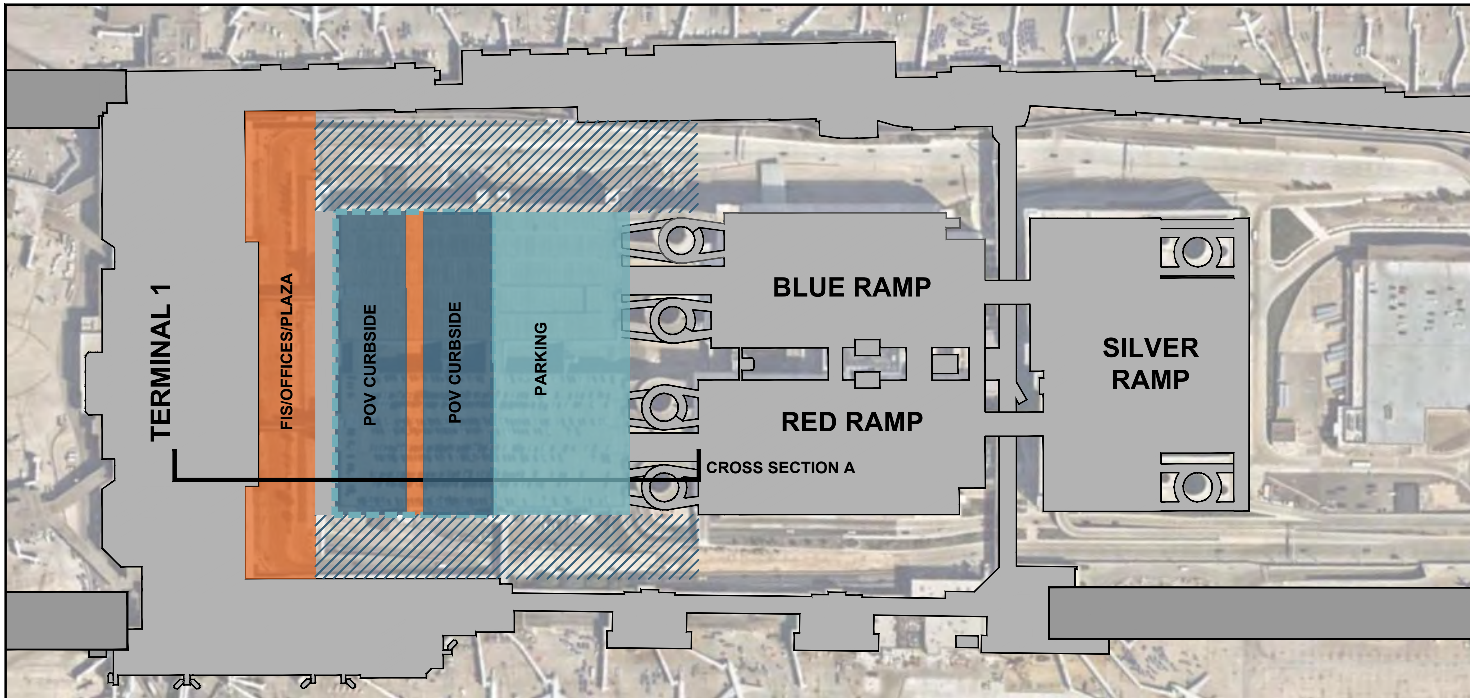
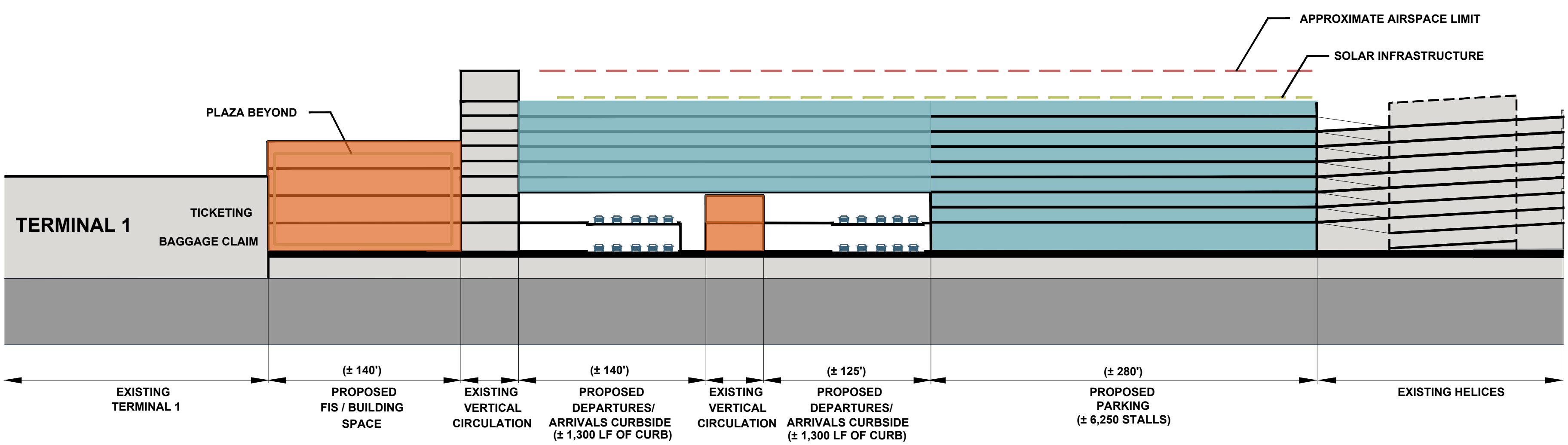
EXHIBIT 4-44

Landside Alternative 1.B



DRAWING LEGEND

EXISTING TERMINAL	
PROPOSED TERMINAL	
PROPOSED ROADWAY IMPROVEMENTS	
PROPOSED POV CURBSIDE	
PEDESTRIAN BUILDING	
PROPOSED PARKING	
PARKING ABOVE	



CROSS SECTION A

NOT TO SCALE

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-45

Landside Alternative 1.C

Alternative 1.D – Hybrid of Alternatives 1.A and 1.C with Extended Terminal Building

Alternative 1.D, illustrated on **Exhibit 4-46**, is a hybrid alternative between Alternatives 1.A and 1.C. Alternative 1.D extends the terminal building east for the FIS facility and office space in the area vacated by the existing POV curbside. Alternative 1.D also introduces a new building structure between the stacked curbsides for baggage claim functions. This alternative would require relocating all baggage claim functions and expanding ticketing functions to Level 1 of the existing terminal facility. Separating baggage claim and ticketing functions will allow traffic to be separated earlier along the inbound roadway to improve wayfinding. A new vertical circulation core, to the west of the existing location, allows for additional parking. This alternative provides approximately 5,690 parking stalls.

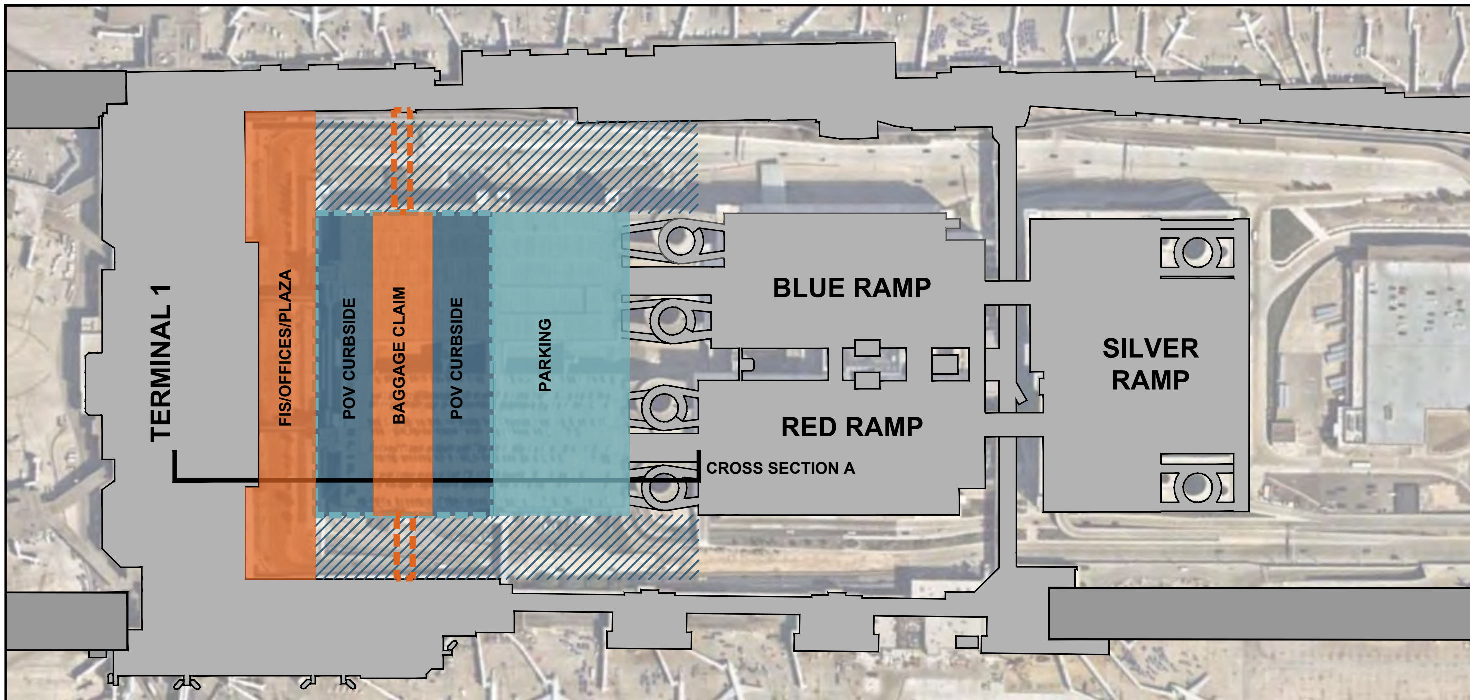
Alternative 1.E – Hybrid of Alternatives 1.A and 1.C with Wider Stacked Inner Curbside

Alternative 1.E, illustrated on **Exhibit 4-47**, is a hybrid alternative between Alternatives 1.A and 1.C. Alternative 1.E includes a wider stacked inner curbside to allow for a POV curbside and commercial vehicle curbside. Like the existing condition, the commercial vehicle curbside would have left-sided unloading/loading. A new building structure between the two stacked curbsides would house baggage claim functions, the FIS facility, offices, and vertical circulation. This alternative would require relocating all baggage claim functions and expanding ticketing functions to Level 1 of the existing terminal facility. This alternative provides approximately 4,005 parking stalls.

Table 4-5: Terminal 1 Green/Gold Ramp Redevelopment Evaluation Matrix

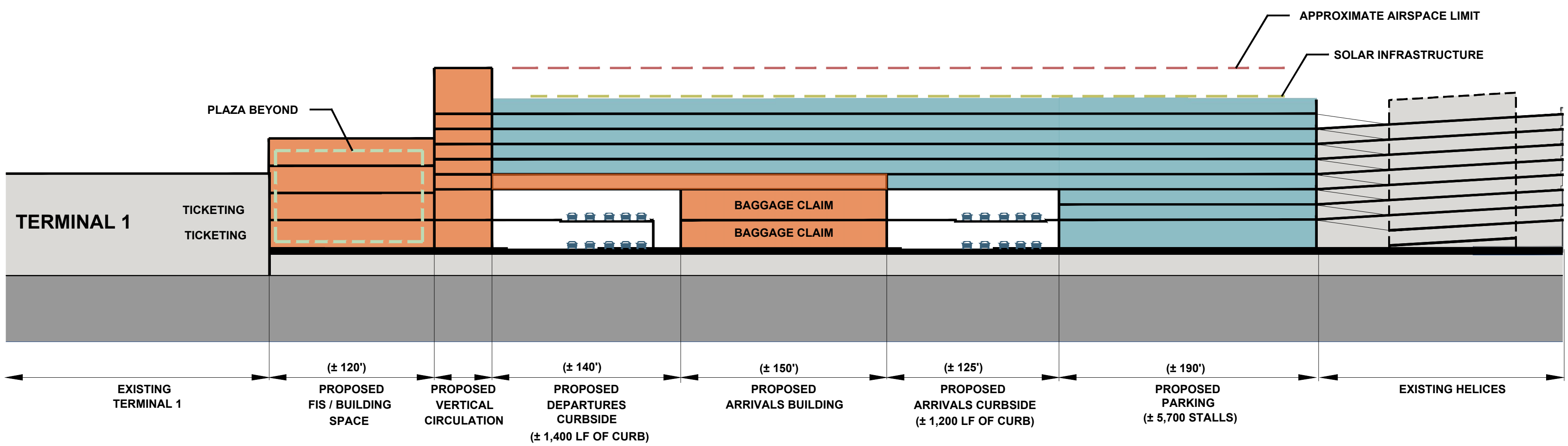
	Alternative 1.A	Alternative 1.B	Alternative 1.C	Alternative 1.D	Alternative 1.E
Meets Program Requirements	3	2	4	4	2
Minimize Curbside Passenger Vertical Circulation	4	4	4	4	4
Intuitive Pedestrian and Vehicular Wayfinding	4	3	3	4	3
Aligned with Peer Airports	4	2	3	3	3
Accommodate Desired Potential Functions	4	3	4	3	4
Total	**19**	**14**	**18**	**18**	**16**

NOTE:
Evaluation criteria are ranked on a scale of 1 to 5 (unsatisfactory to satisfactory). A higher value represents a more desirable alternative.
SOURCE: Kimley-Horn and Associates, Inc., 2022.



DRAWING LEGEND

EXISTING TERMINAL	
PROPOSED TERMINAL	
PROPOSED ROADWAY IMPROVEMENTS	
PROPOSED POV CURBSIDE	
PEDESTRIAN BUILDING	
PROPOSED PARKING	
BUILDING ABOVE	
PARKING ABOVE	



CROSS SECTION A

NOT TO SCALE

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-46

Landside Alternative 1.D

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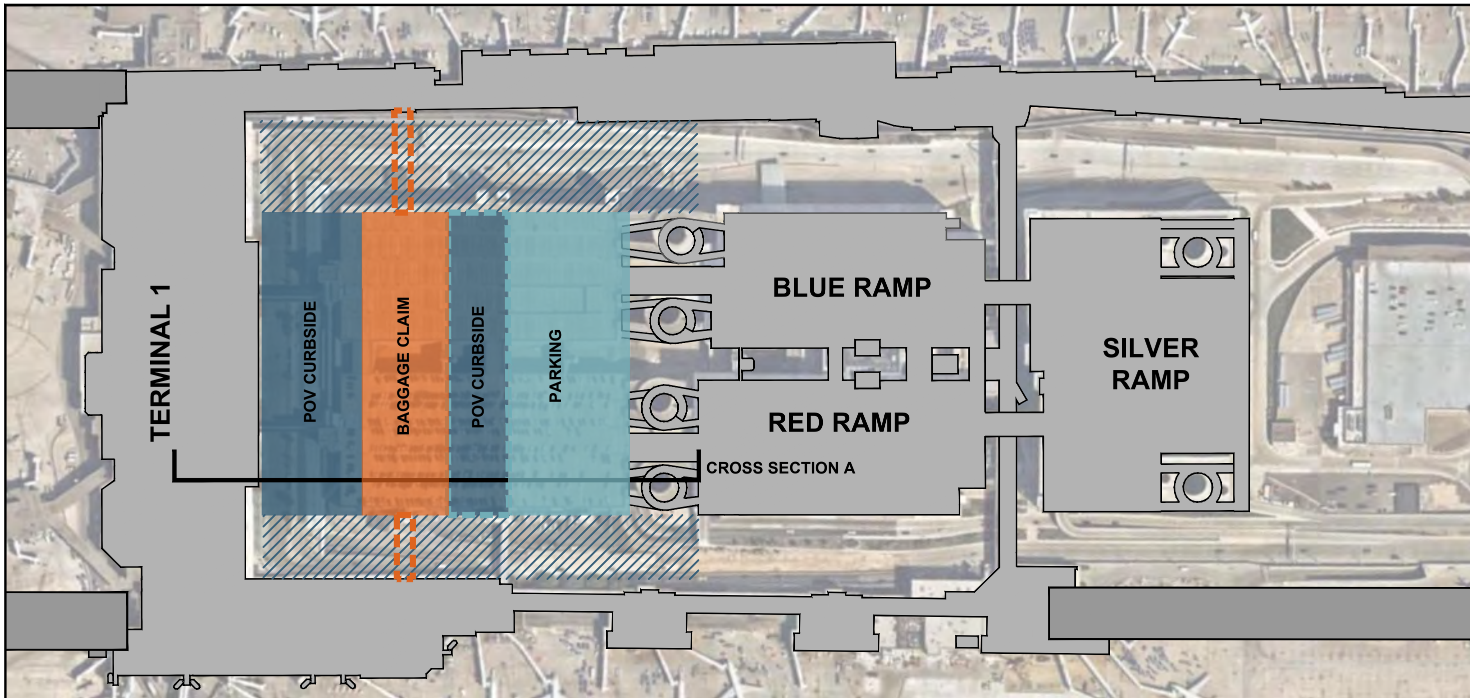
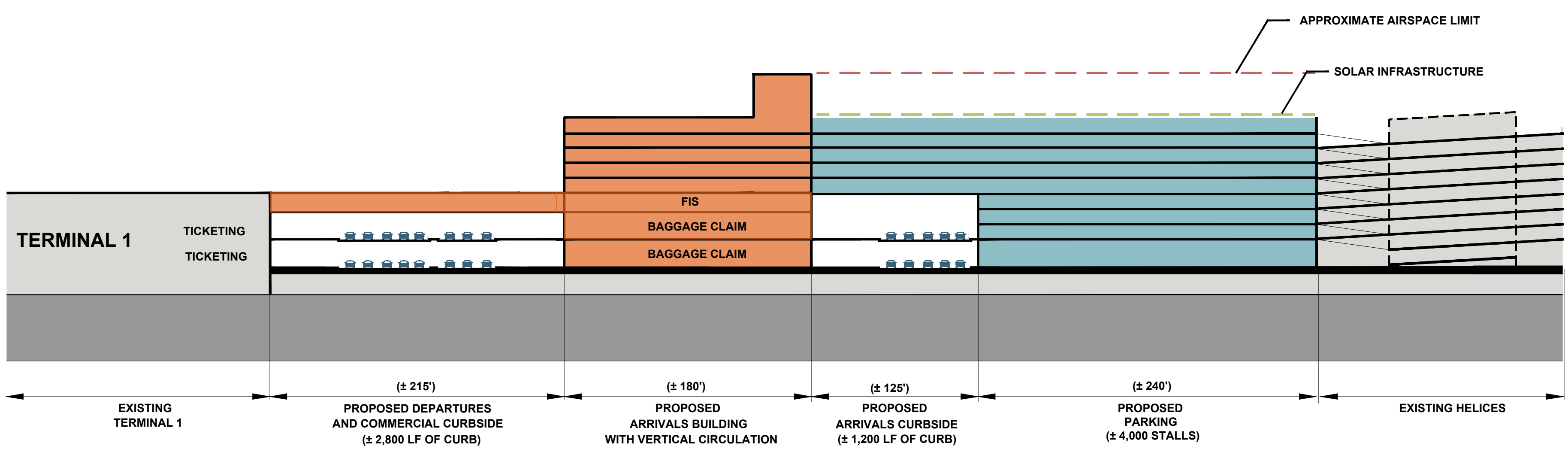


DRAWING LEGEND

EXISTING TERMINAL	
PROPOSED TERMINAL	
PROPOSED ROADWAY IMPROVEMENTS	
PROPOSED POV CURBSIDE	
PEDESTRIAN BUILDING	
PROPOSED PARKING	
BUILDING ABOVE	
PARKING ABOVE	



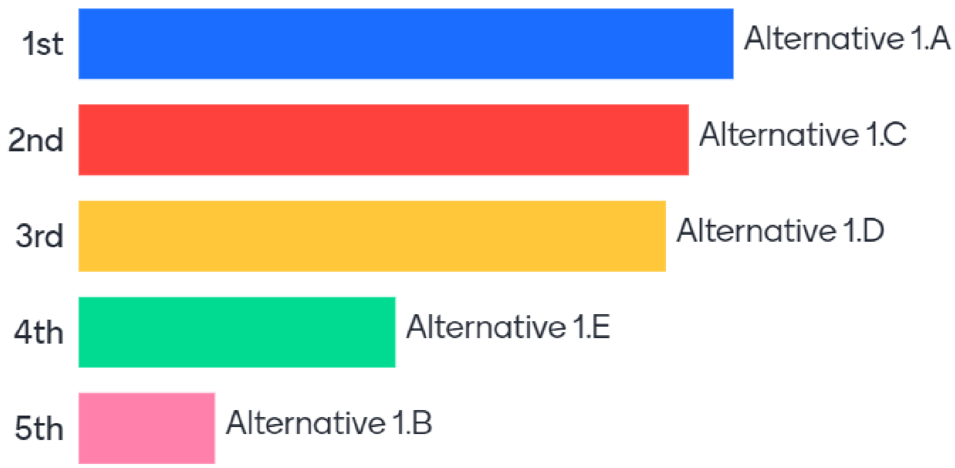
CROSS SECTION A

NOT TO SCALE

SOURCE: Kimley-Horn and Associates, Inc., 2023.

Various MAC stakeholders were asked to rank the alternatives from first (favorite) to fifth (least favorite). The weighted average ranking was used to determine the overall ranking, as presented on **Exhibit 4-48**.

Exhibit 4-48: Metropolitan Airports Commission Stakeholder Ranking – Terminal 1 Alternative



SOURCES: Kimley-Horn and Associates, Inc., 2023; Mentimeter, 2023 (interactive presentation software).

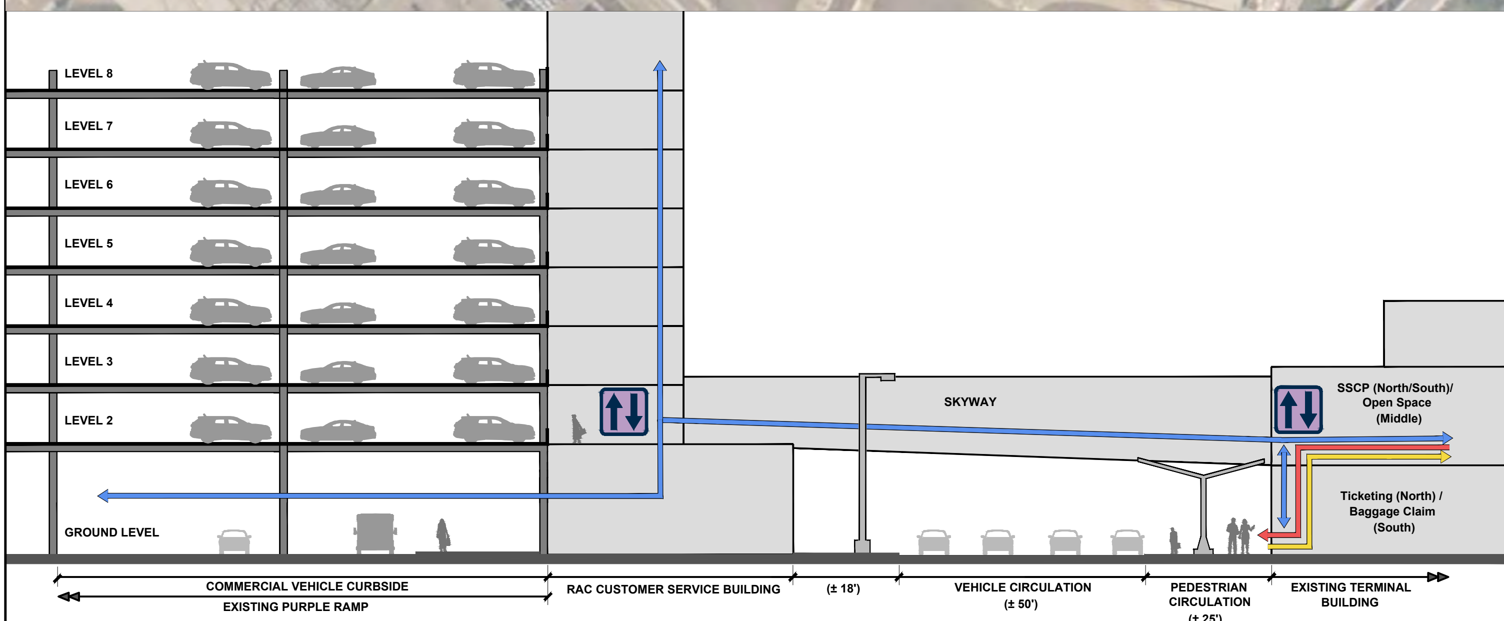
4.6.4 Terminal 2

4.6.4.1 Curbside

The proposed additional activity at T2 is expected to put a strain on the existing landside facilities. Like the alternatives process for T1, refined alternatives for the curbside at T2 were developed to address the projected deficits. The curbside alternatives aimed to meet the program requirements, while aligning terminal and landside functions. It was assumed that the terminal processor and parking ramps would remain in their existing location. Curbside alternatives were developed based on setting POV program requirements (per **Table 4-6**) minimizing curbside passenger vertical circulation, impacts to existing facilities, consistent curbside experience with T1, and aligning with peer airports. Each alternative described in the following subsections was valued against the evaluation criteria in **Table 4-6**. Each element was rated on a scale of 1 to 5 (unsatisfactory to satisfactory).

Alternative 2.A – Combined Single-Level Arrivals/Departures Roadway

Alternative 2.A, illustrated on **Exhibit 4-49**, explores maintaining the existing T2 curbside configuration, with arrivals and departures remaining at-grade. The existing curbside cannot be extended in a linear fashion and effectively align with the ticketing and baggage claim areas given the roadway geometry and terminal building constraints. Therefore, this alternative does not meet future curbside needs.



CROSS SECTION A

NOT TO SCALE

SOURCE: Kimley-Horn and Associates, Inc., 2023.

DRAWING LEGEND	
EXISTING BUILDING	
PROPOSED BUILDING	
PEDESTRIAN ROUTE FROM DEPARTURES CURB TO TERMINAL	
PEDESTRIAN ROUTE FROM TERMINAL TO ARRIVALS CURB	
PEDESTRIAN ROUTE BETWEEN PARKING/COMMERCIAL VEHICLES/RENTAL CARS AND TERMINAL	
PEDESTRIAN VERTICAL CIRCULATION	

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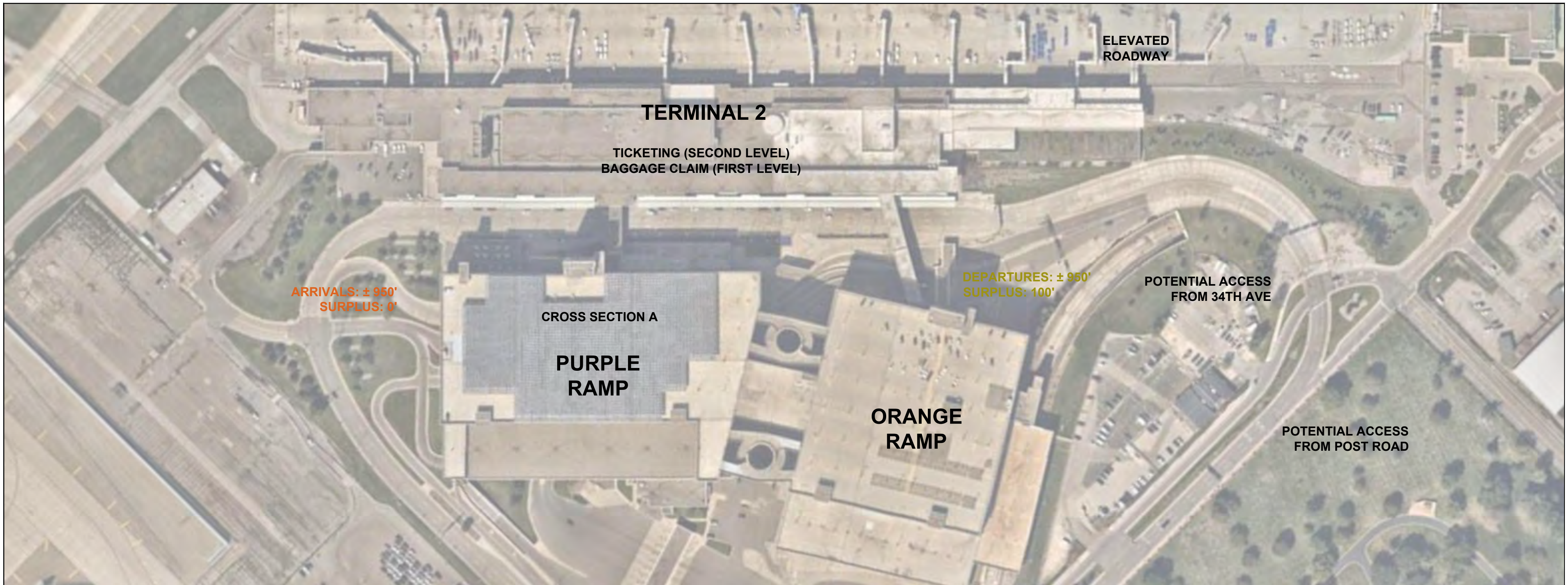
EXHIBIT 4-49

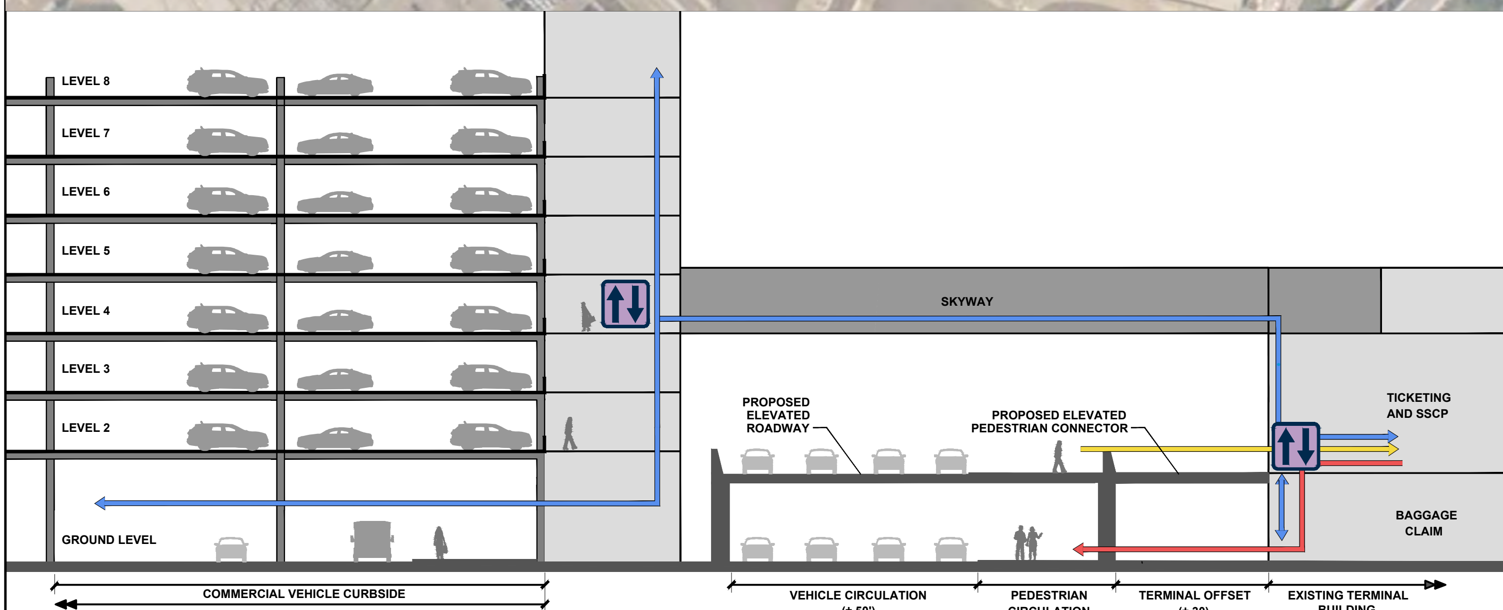
Landside Alternative 2.A

Alternative 2.B – Stacked Roadway with Elevated Departures

Alternative 2.B, illustrated on **Exhibit 4-50**, proposes constructing a stacked curbside with departures elevated and arrivals at-grade. Given the limited space between the terminal and the parking ramps, a two-level roadway is proposed to meet the program requirements. A stacked curbside provides approximately 950 linear feet of curb per level (1,900 linear feet total). Alternative 2.B shifts the curbside to the east to provide a minimum offset from the terminal building of 30 feet, as requested by the Airport Police Department (APD). In addition to the curbside construction, the following terminal enhancements are needed to align the terminal and landside functions:

- Move ticketing to Level 2.
- Expand baggage claim devices on Level 1.
- Expand the vertical elevator core.
- Reconstruct the existing skyways.
- Relocate the RAC CSB.





CROSS SECTION A

NOT TO SCALE

SOURCE: Kimley-Horn and Associates, Inc., 2023.

DRAWING LEGEND
EXISTING BUILDING
PROPOSED BUILDING
PROPOSED AT-GRADE ROADWAY
PROPOSED ELEVATED ROADWAY
PEDESTRIAN ROUTE FROM DEPARTURES CURB TO TERMINAL
PEDESTRIAN ROUTE FROM TERMINAL TO ARRIVALS CURB
PEDESTRIAN ROUTE BETWEEN PARKING/COMMERCIAL VEHICLES/RENTAL CARS AND TERMINAL
PEDESTRIAN VERTICAL CIRCULATION

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EXHIBIT 4-50

Landside Alternative 2.B

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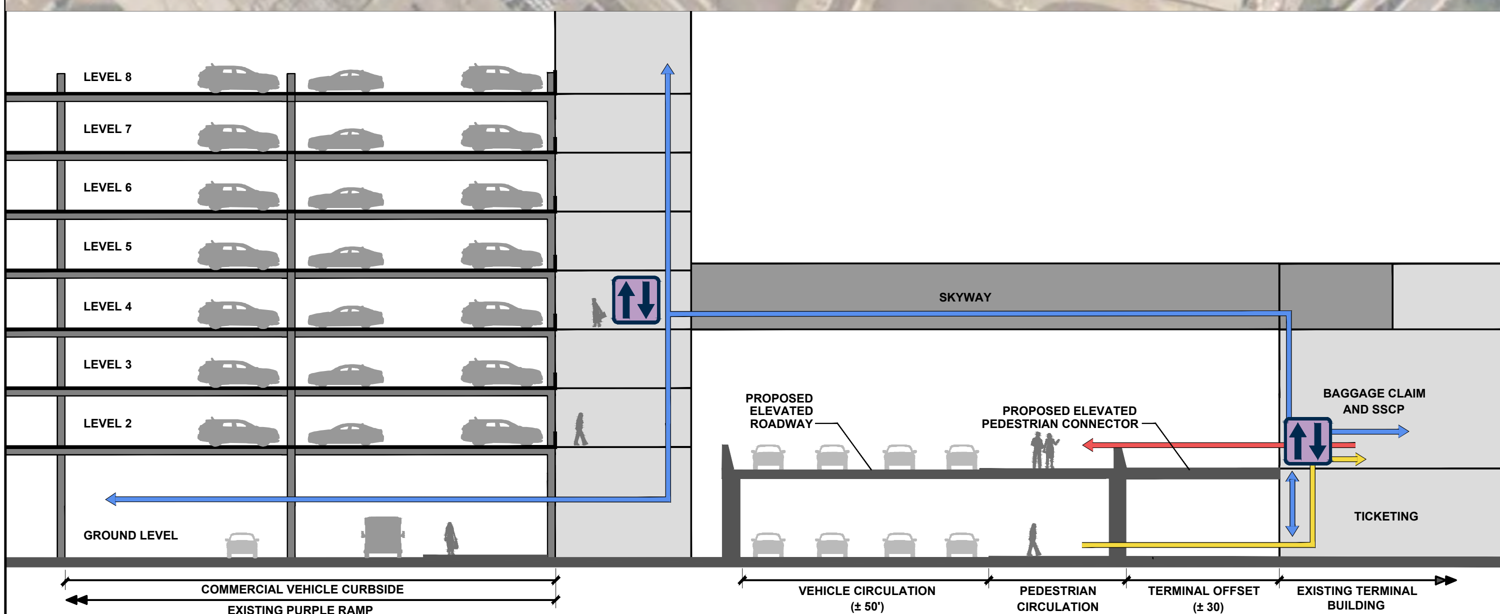
Alternative 2.C – Stacked Roadway with Elevated Arrivals

Like Alternative 2.B, Alternative 2.C proposes constructing a stacked curbside with departures at-grade and arrivals elevated. Alternative 2.C, illustrated on **Exhibit 4-51**, shifts the curbside to the east to provide a minimum offset from the terminal building of 30 feet, as requested by the APD. In addition to the curbside construction, the following terminal enhancements are needed to align the terminal and landside functions:

- Move baggage claim to Level 2.
- Expand ticketing on Level 1.
- Expand the vertical elevator core.
- Reconstruct the existing skyways.
- Relocate the RAC CSB.



CROSS SECTION A

NOT TO SCALE

SOURCE: Kimley-Horn and Associates, Inc., 2023.

DRAWING LEGEND

EXISTING BUILDING	
PROPOSED BUILDING	
PROPOSED AT-GRADE ROADWAY	
PROPOSED ELEVATED ROADWAY	
PEDESTRIAN ROUTE FROM DEPARTURES CURB TO TERMINAL	
PEDESTRIAN ROUTE FROM TERMINAL TO ARRIVALS CURB	
PEDESTRIAN ROUTE BETWEEN PARKING/COMMERCIAL VEHICLES/RENTAL CARS AND TERMINAL	
PEDESTRIAN VERTICAL CIRCULATION	

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LONG-TERM PLAN 2040

0 300' 600'

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EXHIBIT 4-51

Landside Alternative 2.C

Table 4-6: Terminal 2 Curbside Evaluation Matrix

	Alternative 2.A	Alternative 2.B	Alternative 2.C
Meets POV Curbside Program Requirements	1	5	5
Minimize POV Curbside Passenger with Checked Luggage Vertical Circulation	5	5	5
Impacts to Existing Facilities	5	3	2
Consistent Experience with Terminal 1	1	5	1
Aligned with Peer Airports	2	5	3
Total	**14**	**23**	**16**

NOTES:
Evaluation criteria are ranked on a scale of 1 to 5 (unsatisfactory to satisfactory). A higher value represents a more desirable alternative.
POV – Privately Owned Vehicle
SOURCE: Kimley-Horn and Associates, Inc., 2022.

4.6.4.2 Parking

The T2 parking ramps, Orange and Purple Ramps, were designed with the capability of expansion. **Table 4-7** presents the planned expansions and the number of stalls each expansion provides.

Table 4-7: Terminal 2 Existing Parking Ramp Expansions

Parking Expansion Area	Additional Stalls Provided
Purple Outrigger (Level 2 – Level 8)	1,275
Orange East Outrigger (Level 4 – Level 8)	750
Orange LRT Outrigger (Level 4 – Level 8)	360
Orange Vertical Expansion (Level 9 and Level 10)	1,250
Total	**3,635**

NOTE:
LRT – Light Rail Transit
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Based on the forecast increase in activity at T2, the additional stalls provided by the planned expansions are not sufficient to meet the requirements. New parking developments, in addition to the planned expansions of the existing parking structures, were evaluated to meet the total Airport parking demand. Parking alternatives were developed based on:

- Meets parking program requirements
- Walking distance to terminal processor
- Connectivity to existing ramps
- Impacts to existing facilities

Each alternative described in the following subsections was valued against the evaluation criteria in **Table 4-8**. Each criteria element was rated on a scale of 1 to 5 (unsatisfactory to satisfactory).

Table 4-8: Terminal 2 Parking Evaluation Matrix

	Alternative 2.D	Alternative 2.E	Alternative 2.F
Meets Parking Program Requirements	1	5	5
Walking Distance to Terminal Processor	5	3	3
Connectivity to Existing Ramps	5	1	3
Impacts to Existing Facilities	5	2	5
Total	**16**	**11**	**16**

NOTE:
Evaluation criteria are ranked on a scale of 1 to 5 (unsatisfactory to satisfactory). A higher value represents a more desirable alternative.
SOURCE: Kimley-Horn and Associates, Inc., 2022.

Alternative 2.D – Existing Structure Expansion

Alternative 2.D proposes only expanding the existing ramps to the extent possible. While this alternative does not require new land area to be dedicated for parking functions, the alternative does not meet program requirements.

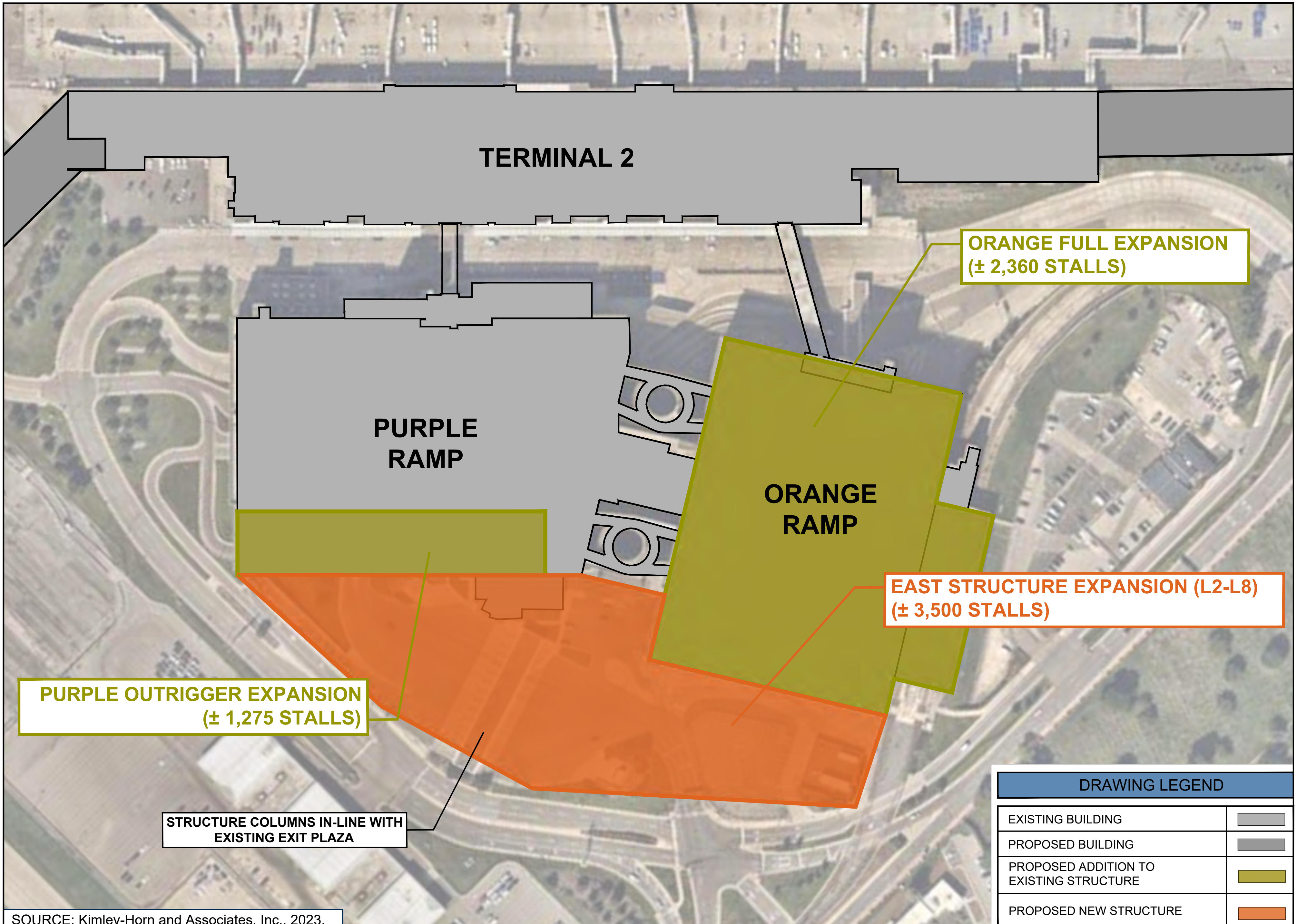
Alternative 2.E – East Parking Expansion

Alternative 2.E, illustrated on **Exhibit 4-52**, proposes a new parking structure to the east of the existing Purple and Orange Ramps, in addition to expanding the existing ramps to the extent possible. The new parking structure would be located above the existing exit plaza and connected to both the Orange and Purple Ramps. A structure spanning Levels 2 through 8 would provide approximately 3,500 stalls. Assuming the terminal processor remains in its current location, an east parking expansion would increase the average walking distance. Located above the existing exit plaza, the new structure would require the reconstruction of the exit plaza and temporary operations. However, the stakeholders expressed that locating the exit plaza underneath a structure is not preferable.

Alternative 2.F – North Parking Expansion

Alternative 2.F, illustrated on **Exhibit 4-53**, proposes a new parking structure to the north of the existing Orange Ramp, in addition to expanding the existing ramps to the extent possible. The new parking structure would be located on the north side of the light rail station, but it would connect via bridges to the Orange Ramp. A structure spanning Levels 2 through 10 would provide approximately 2,900 stalls. The ground level would only be accessible via 34th Avenue, so it would likely have an alternative function.

Alternative 2.F was selected as the preferred T2 parking development alternative. Though ranking the same as Alternative 2.F, Alternative 2.D does not meet the parking program requirements. Therefore, it was not considered in the selection of a preferred T2 parking development alternative.



SOURCE: Kimley-Horn and Associates, Inc., 2023.

DRAWING LEGEND

EXISTING BUILDING	
PROPOSED BUILDING	
PROPOSED ADDITION TO EXISTING STRUCTURE	
PROPOSED NEW STRUCTURE	

0 200' 400'

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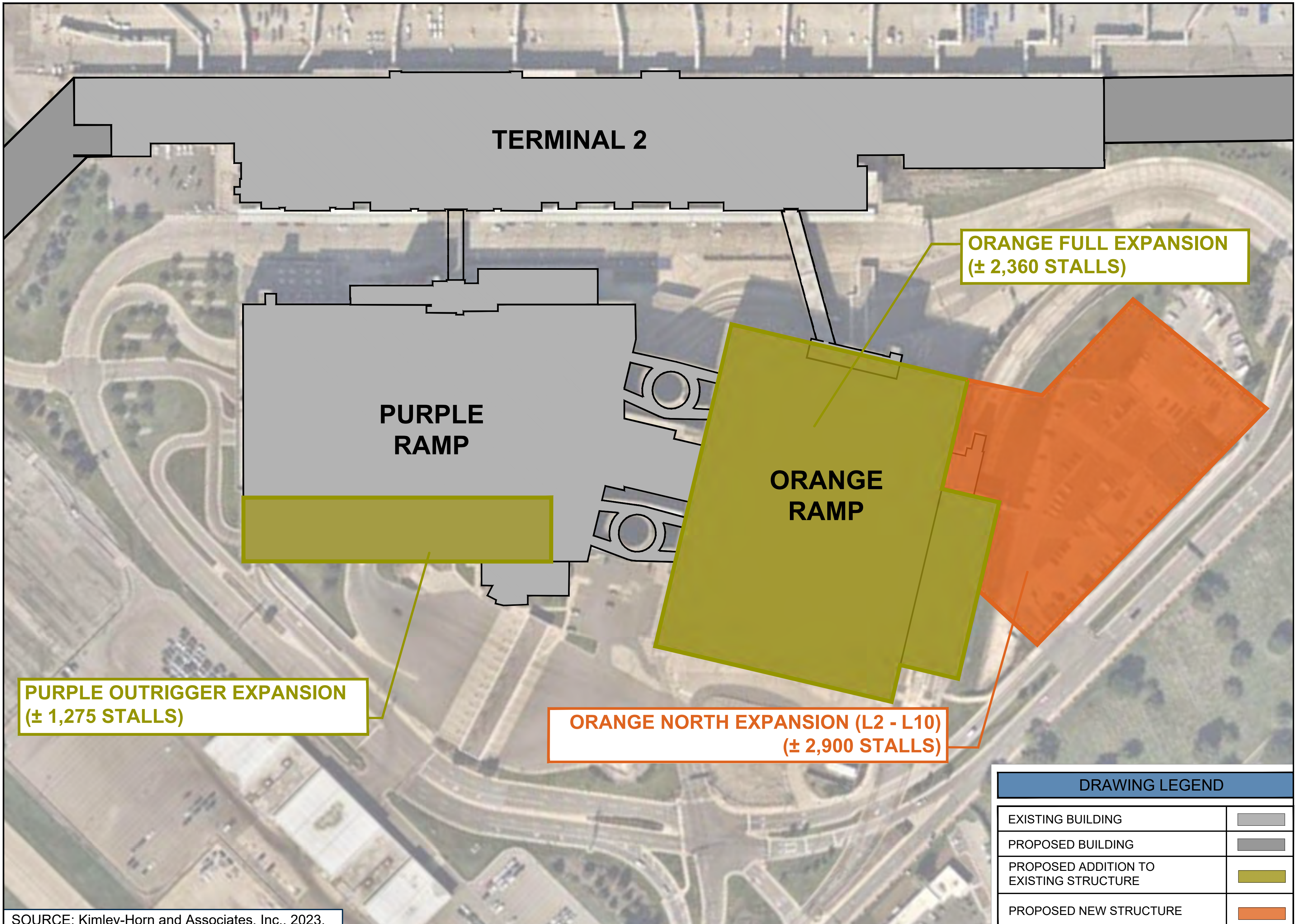
EXHIBIT 4-52
Landside Alternative 2.E



SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-53
Landside Alternative 2.F

4.6.5 Landside Refinement Summary

While a preferred landside alternative was not selected for T1, Alternative 1.A was rated the highest by the stakeholders. Therefore, additional plan-view graphics (see **Exhibits 4-54** through **4-60**) for each level at T1 were developed using Alternative 1.A. Similarly, additional plan-view graphics for T2 (see **Exhibits 4-61** through **4-67**) were developed for each level using the preferred Alternatives 2.B and 2.F. Both T1 and T2 layouts should be treated as potential layouts, where general concept and feel are meeting the requirements of the LTP objectives, but additional refinements and coordinating a preliminary design setting are still warranted beyond what the LTP can accomplish.

Table 4-9 presents the parking stall counts at the end of the planning horizon. With a total on-Airport parking requirement of 33,200 stalls by PAL 3, the proposed developments will accommodate the projected parking requirements.

Table 4-9: Proposed Parking Facilities

Facility	Spaces
Terminal 1	**18,050**
Blue Ramp (Levels 2–9)	3,400
Red Ramp (Levels 2–9)	3,759
Silver Ramp (Levels 6–11)	3,394
USPS Site Ramp (Levels 6–11)	3,200
Green/Gold Ramp Parking Redevelopment (Levels 1–9)	4,300
Quick Ride Ramp (Levels 1–2)	**1,704**
Terminal 2	**15,205**
Orange Ramp (Levels 1, M, 2–10)	7,028
Orange Ramp North Expansion (Levels 2–10)	2,900
Purple Ramp (Levels 2–8)	5,277
Total	**34,959**

NOTE:
USPS – U.S. Postal Service
SOURCE: Kimley-Horn and Associates, Inc., 2022.

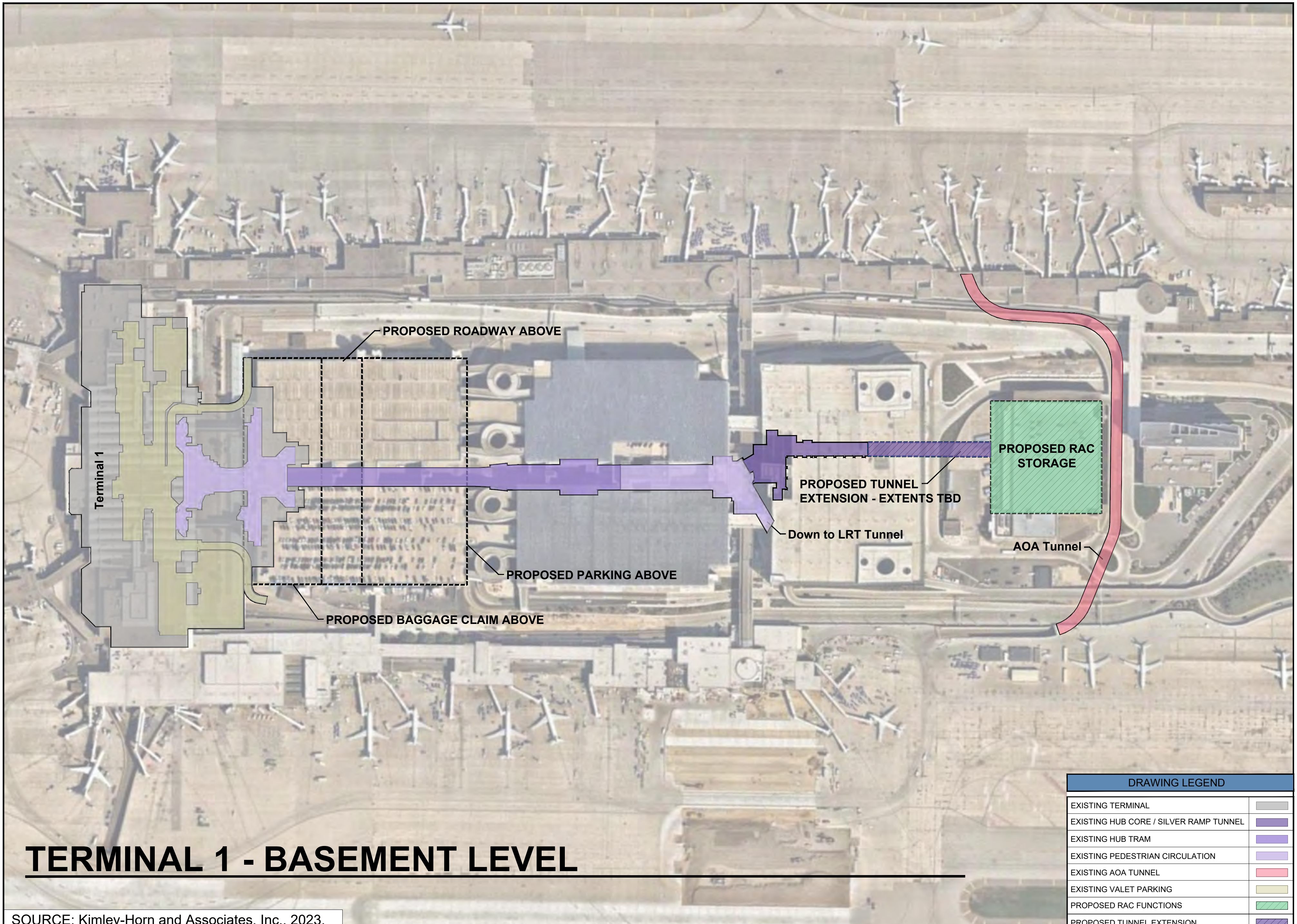

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EXHIBIT 4-54

Proposed Terminal 1 Development - Basement Level

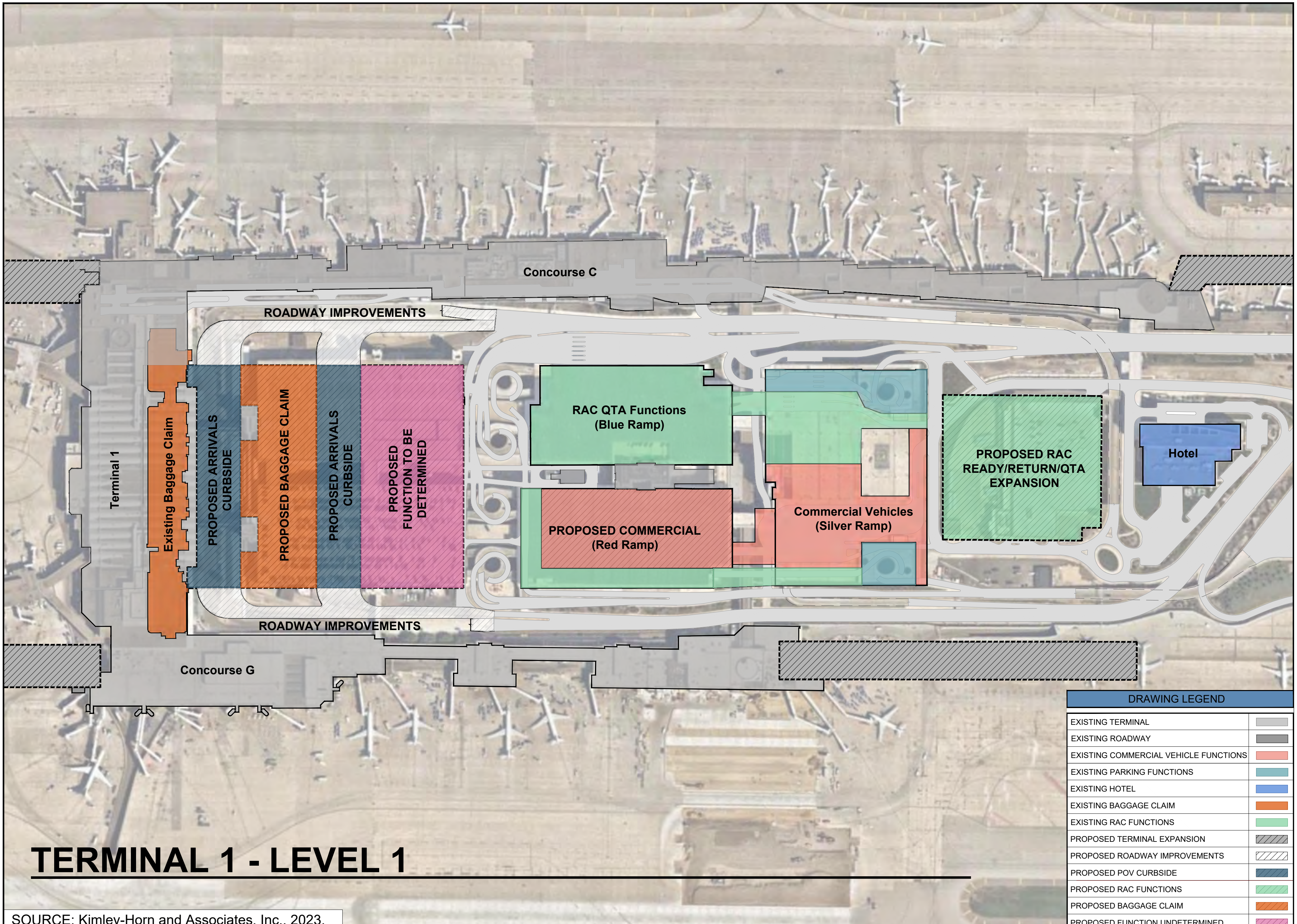

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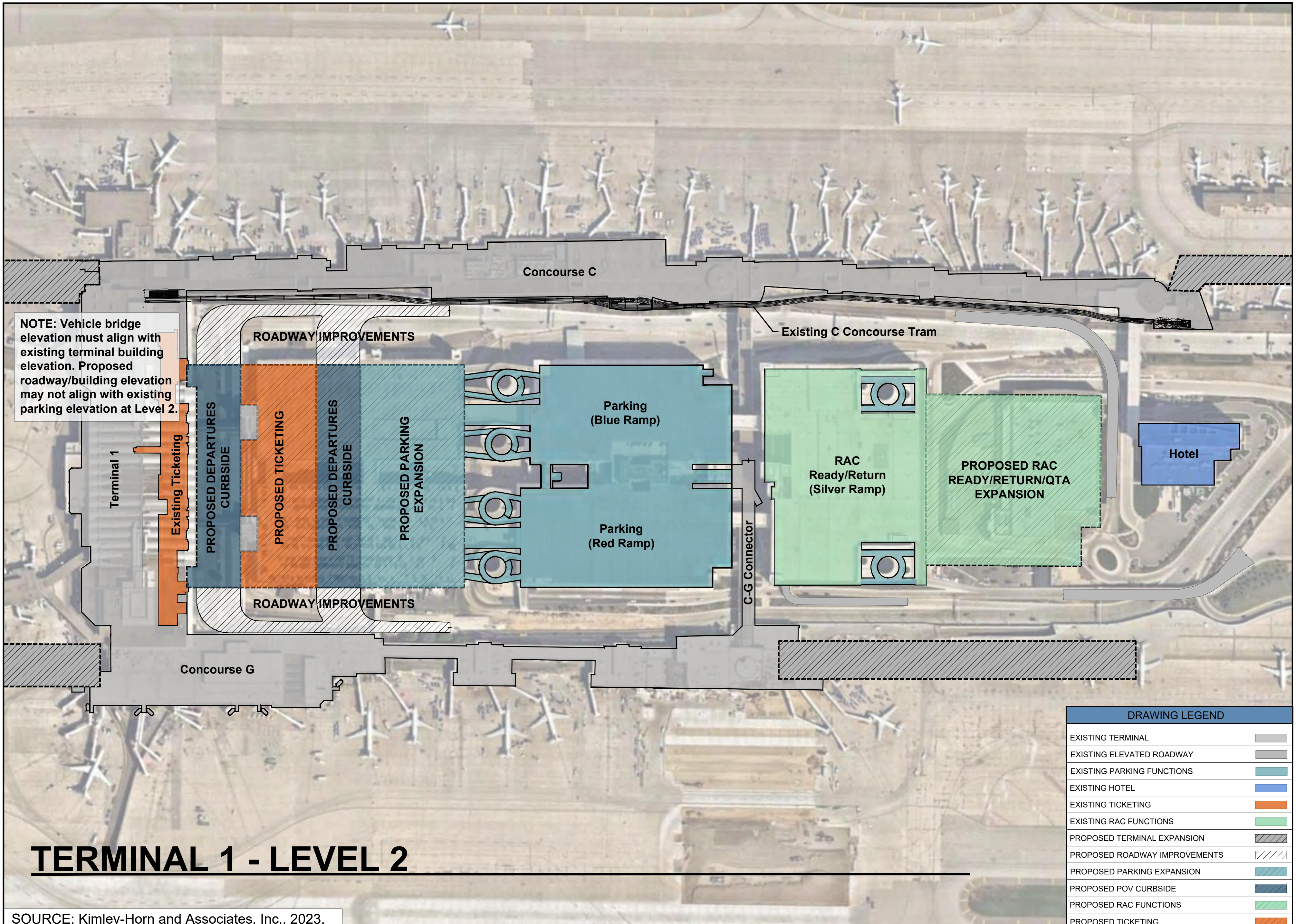
EXHIBIT 4-55

Proposed Terminal 1 Development - Level 1



SOURCE: Kimley-Horn and Associates, Inc., 2023.

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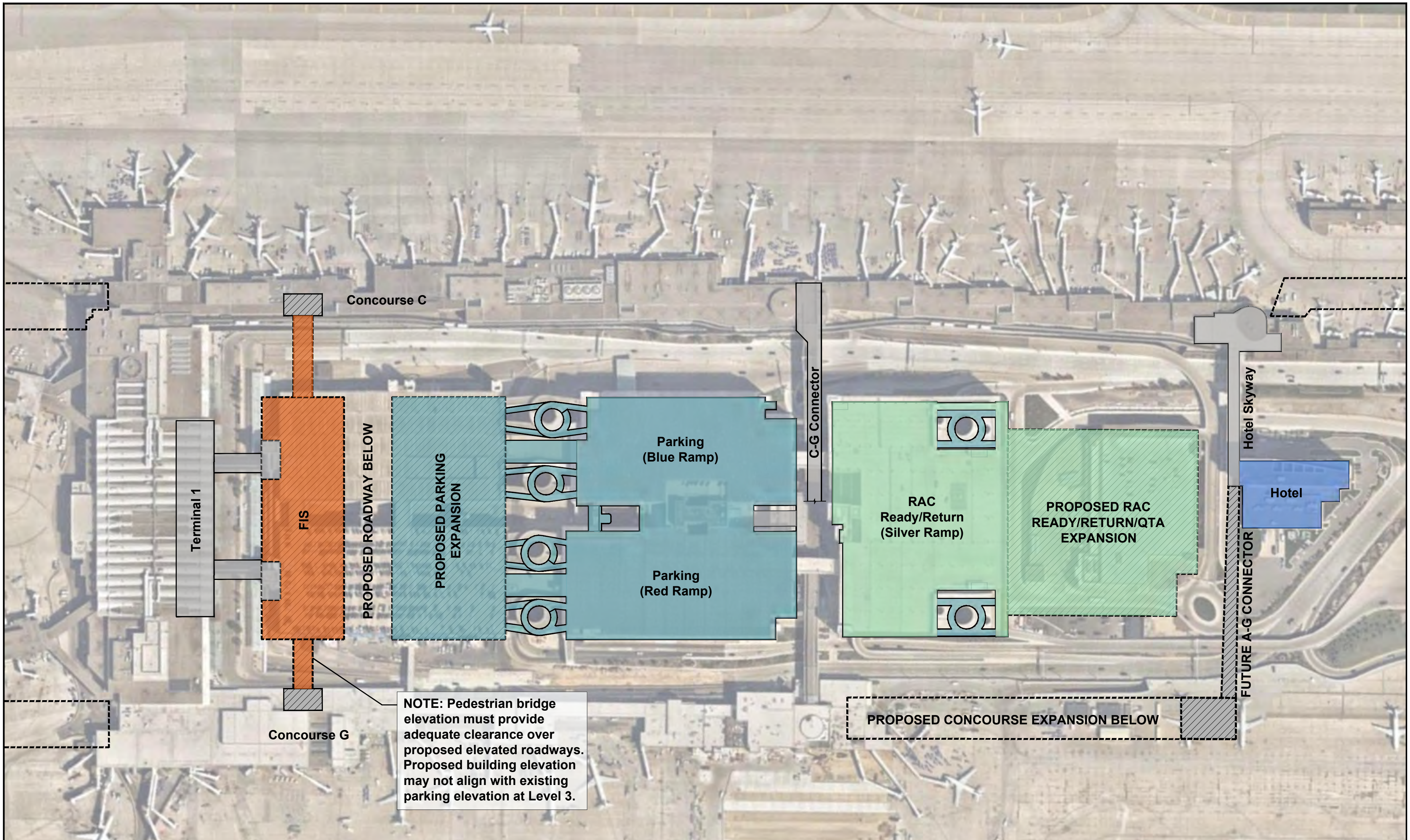
EXHIBIT 4-56

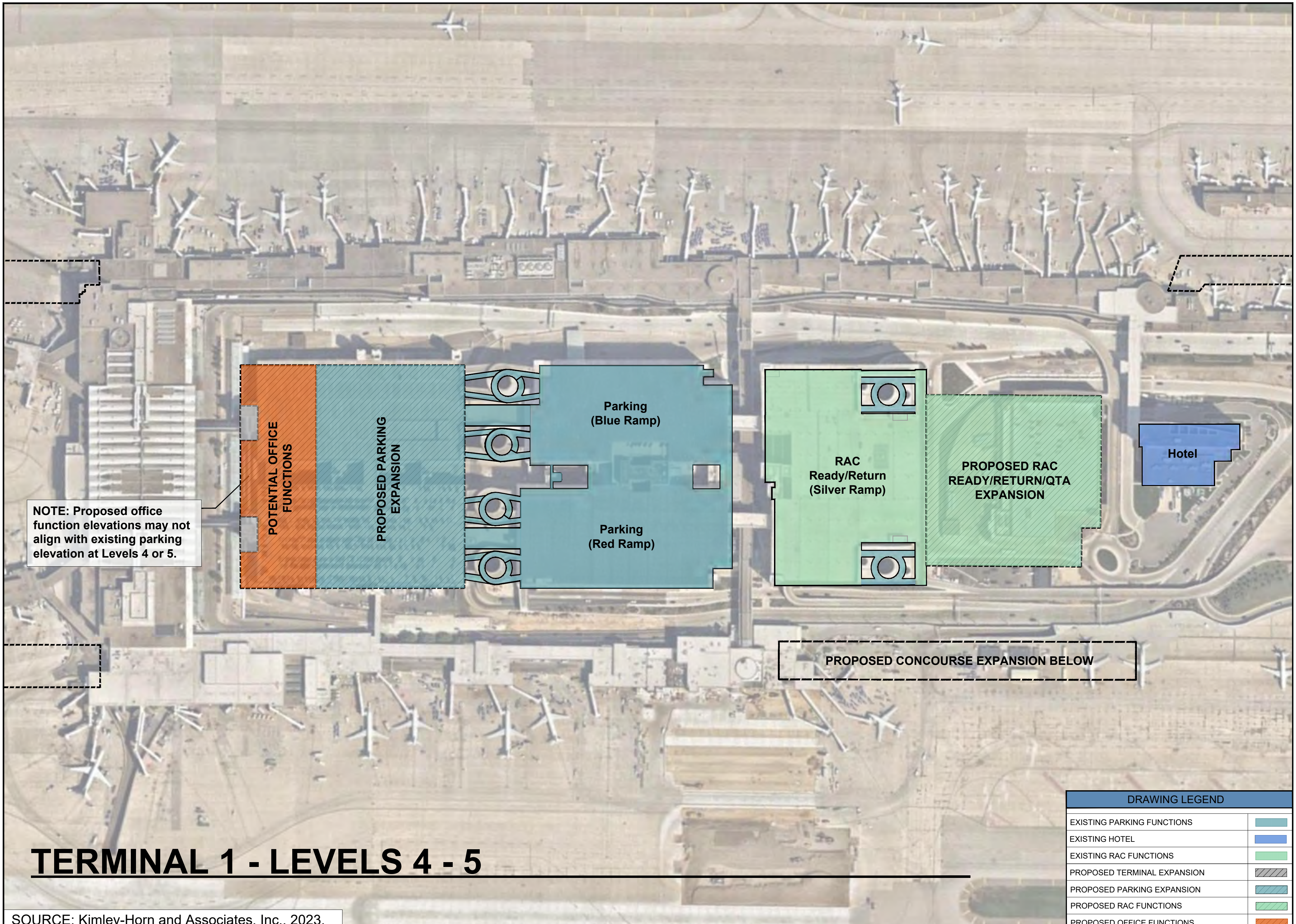
Proposed Terminal 1 Development - Level 2



TERMINAL 1 - LEVEL 3

DRAWING LEGEND	
EXISTING TERMINAL	
EXISTING PARKING FUNCTIONS	
EXISTING HOTEL	
EXISTING RAC FUNCTIONS	
PROPOSED TERMINAL EXPANSION	
PROPOSED PARKING EXPANSION	
PROPOSED RAC FUNCTIONS	
PROPOSED FIS	

SOURCE: Kimley-Horn and Associates, Inc., 2023.



SOURCE: Kimley-Horn and Associates, Inc., 2023.

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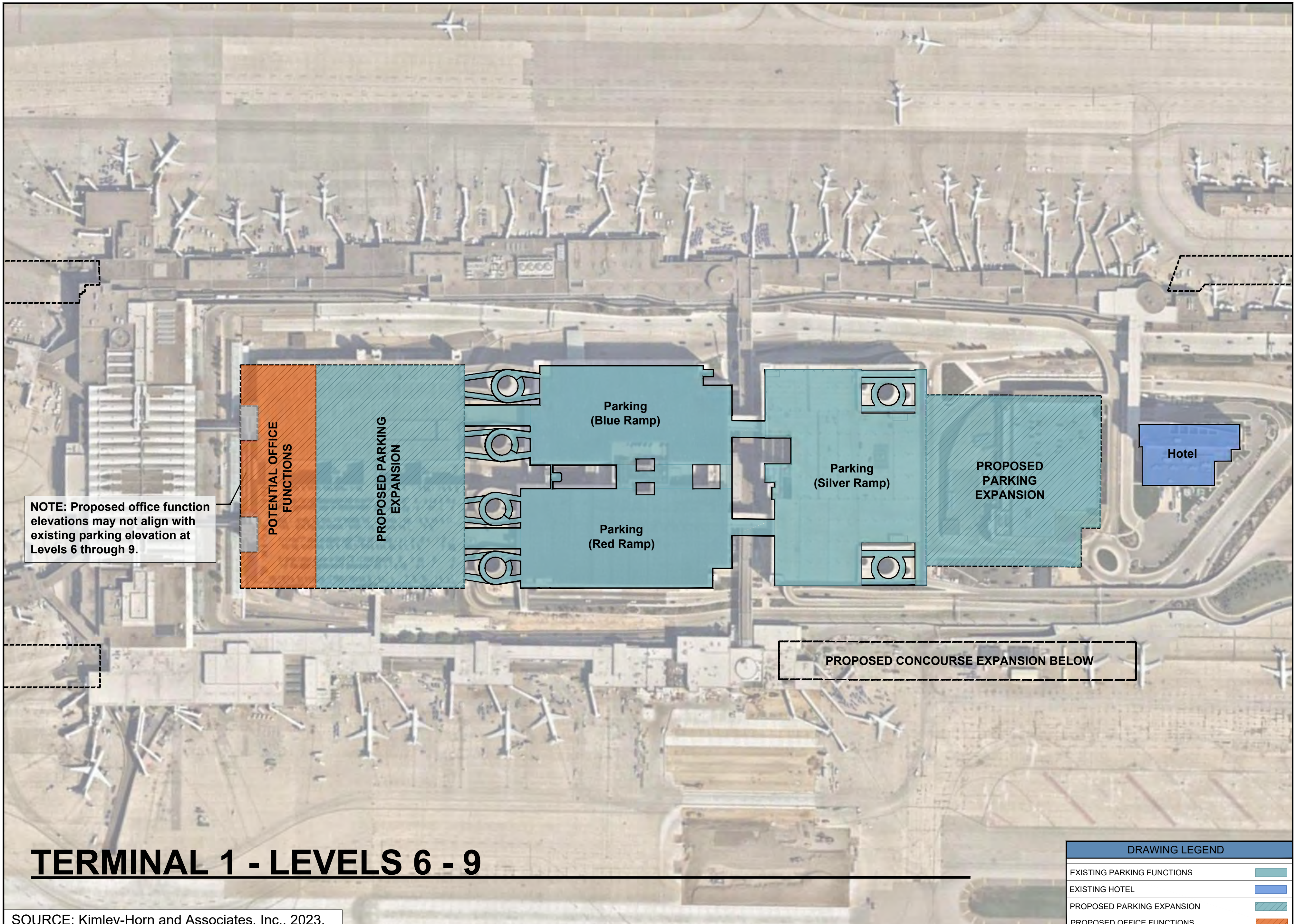
EXHIBIT 4-58

Proposed Terminal 1 Development - Levels 4-5



SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-59

Proposed Terminal 1 Development - Levels 6-9

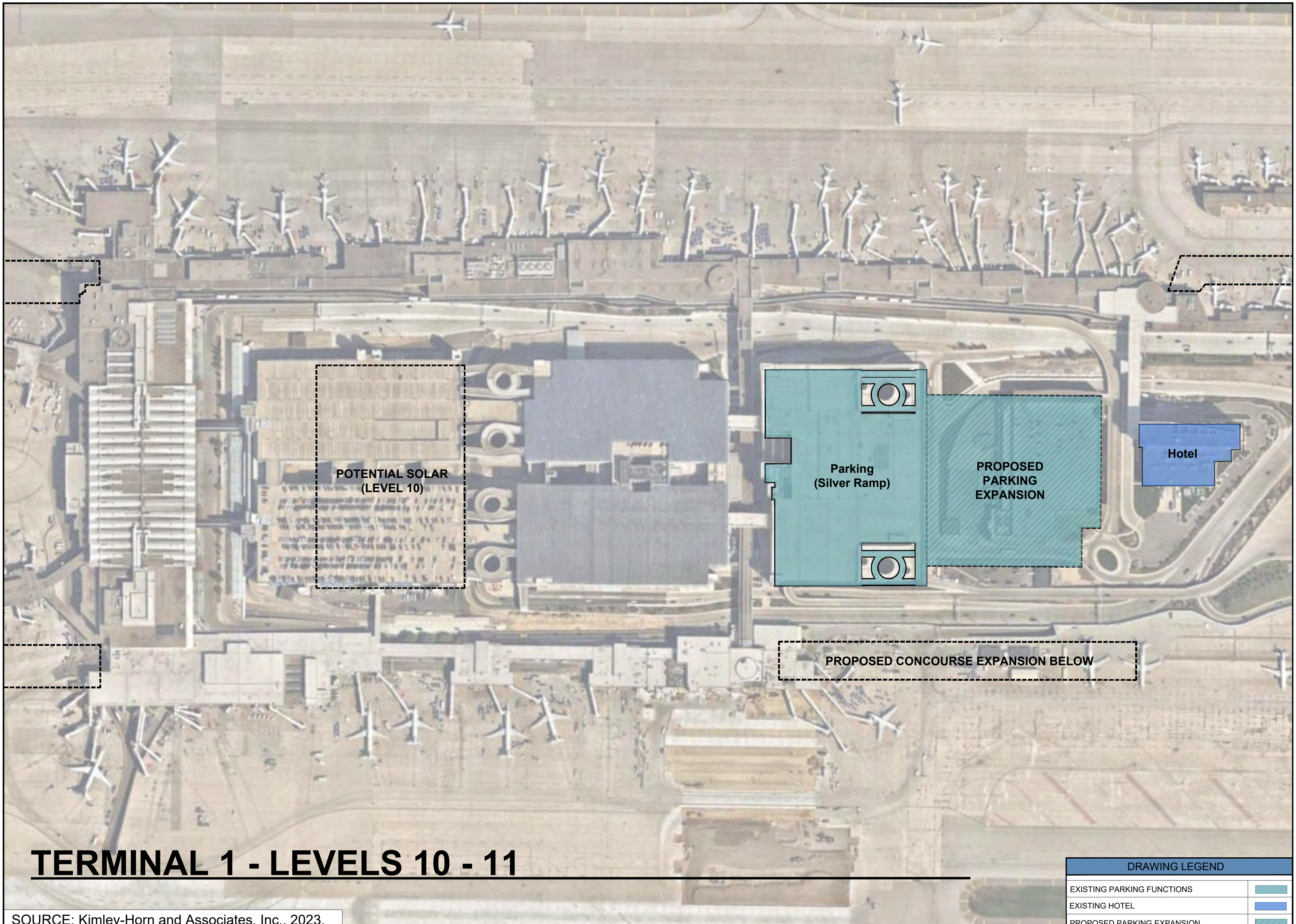

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EXHIBIT 4-60

Proposed Terminal 1 Development - Levels 10-11

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EXHIBIT 4-61

Proposed Terminal 2 Development - Level 1

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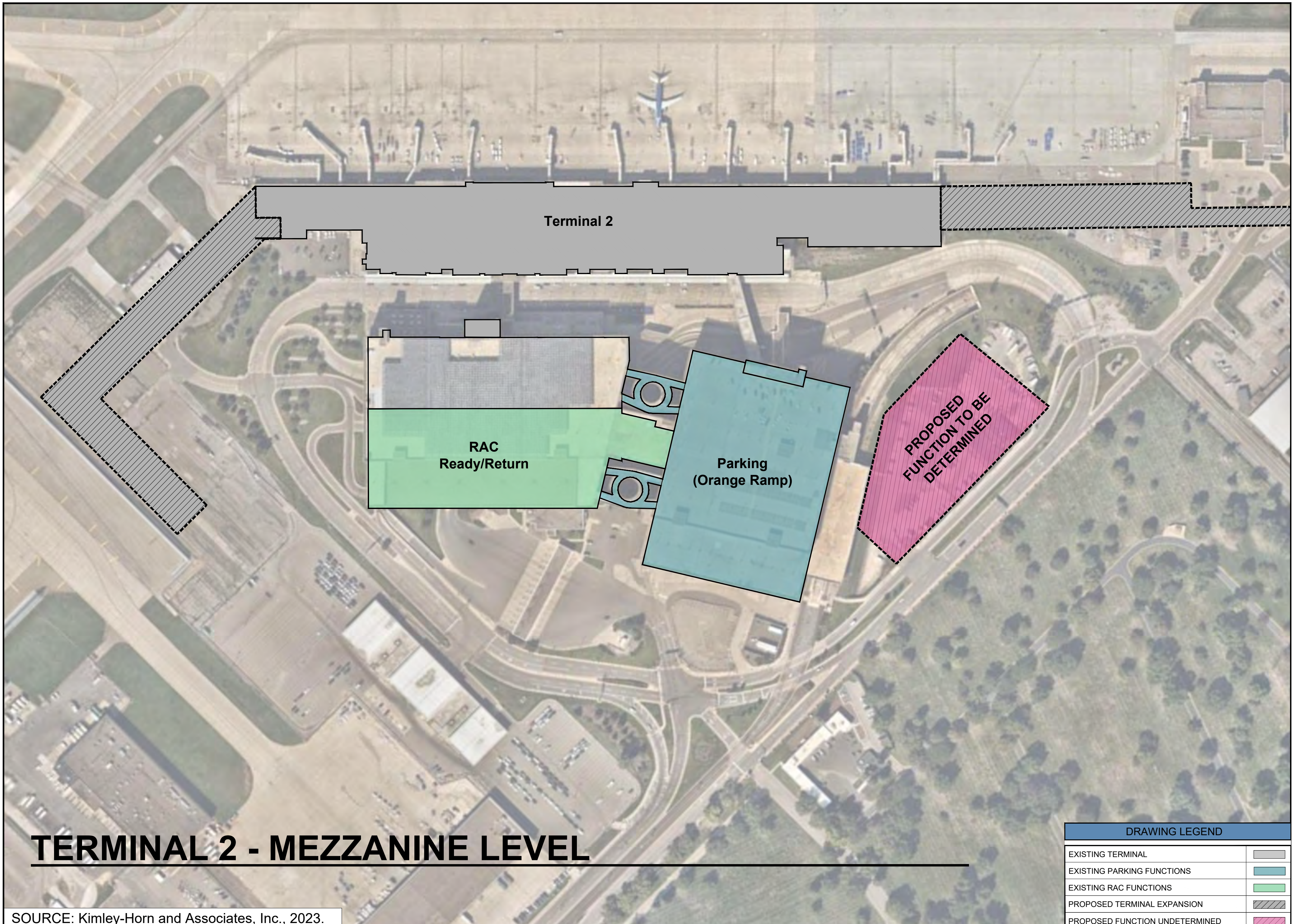

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-62

Proposed Terminal 2 Development - Mezzanine Level

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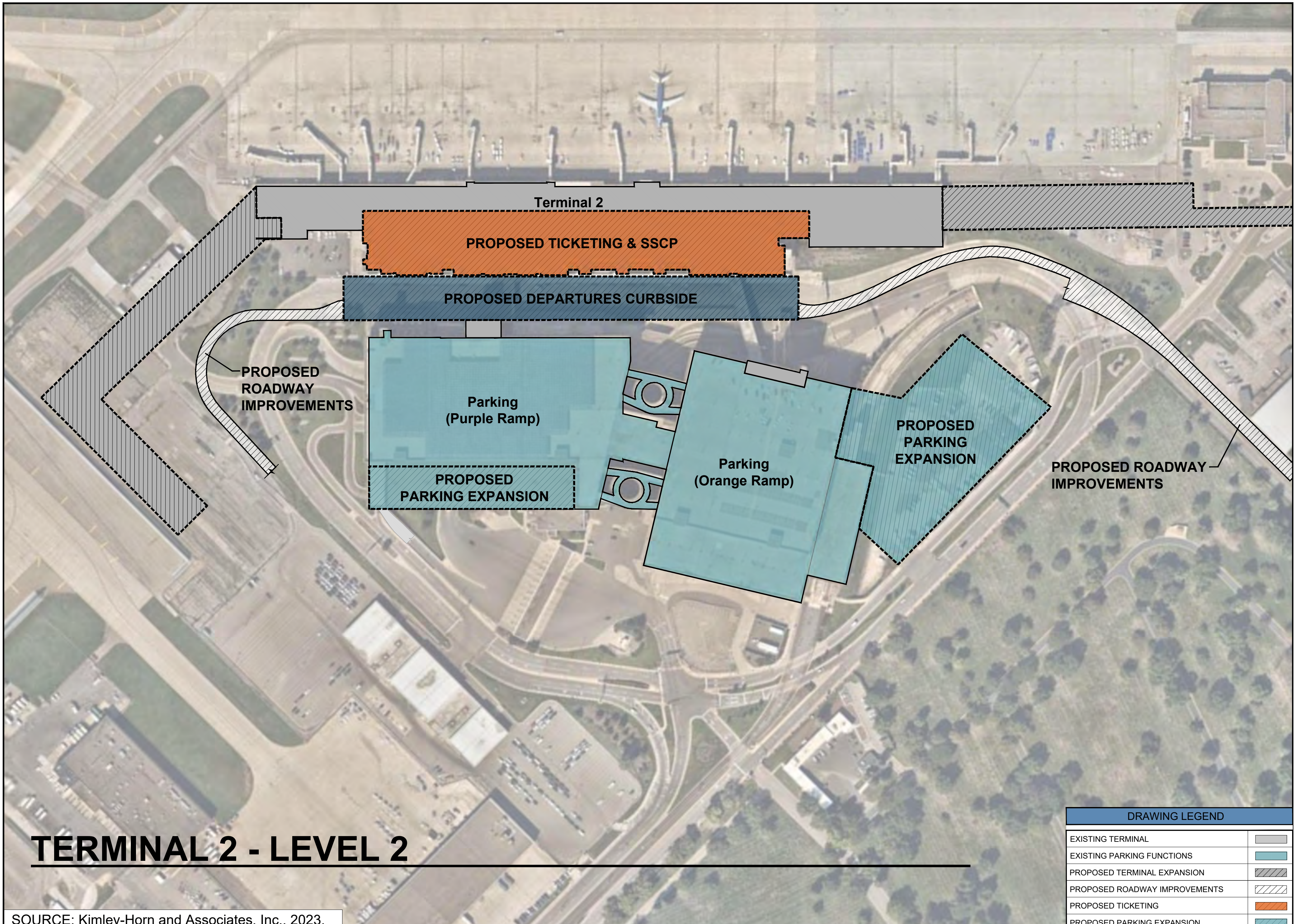

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-63

Proposed Terminal 2 Development - Level 2

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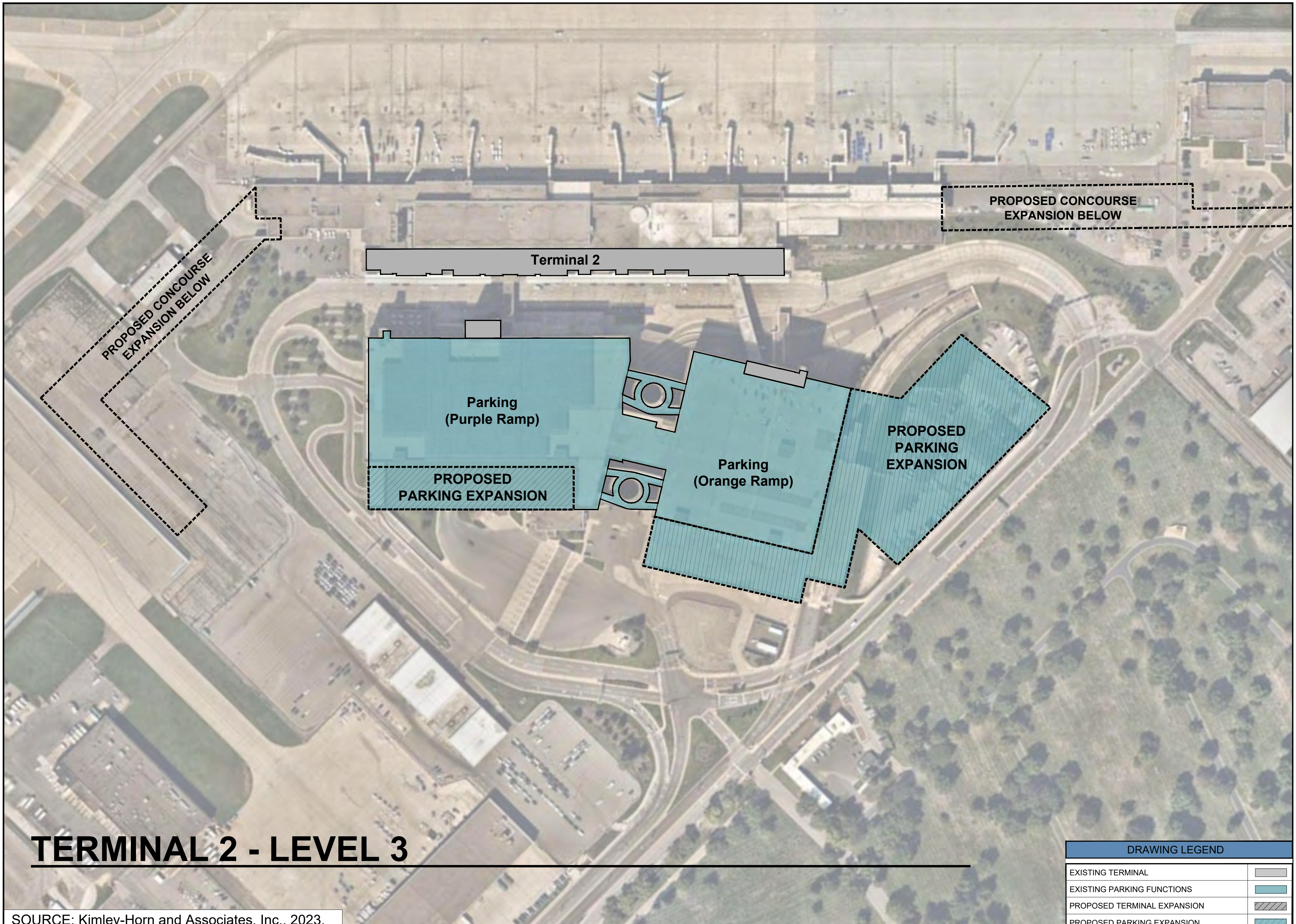

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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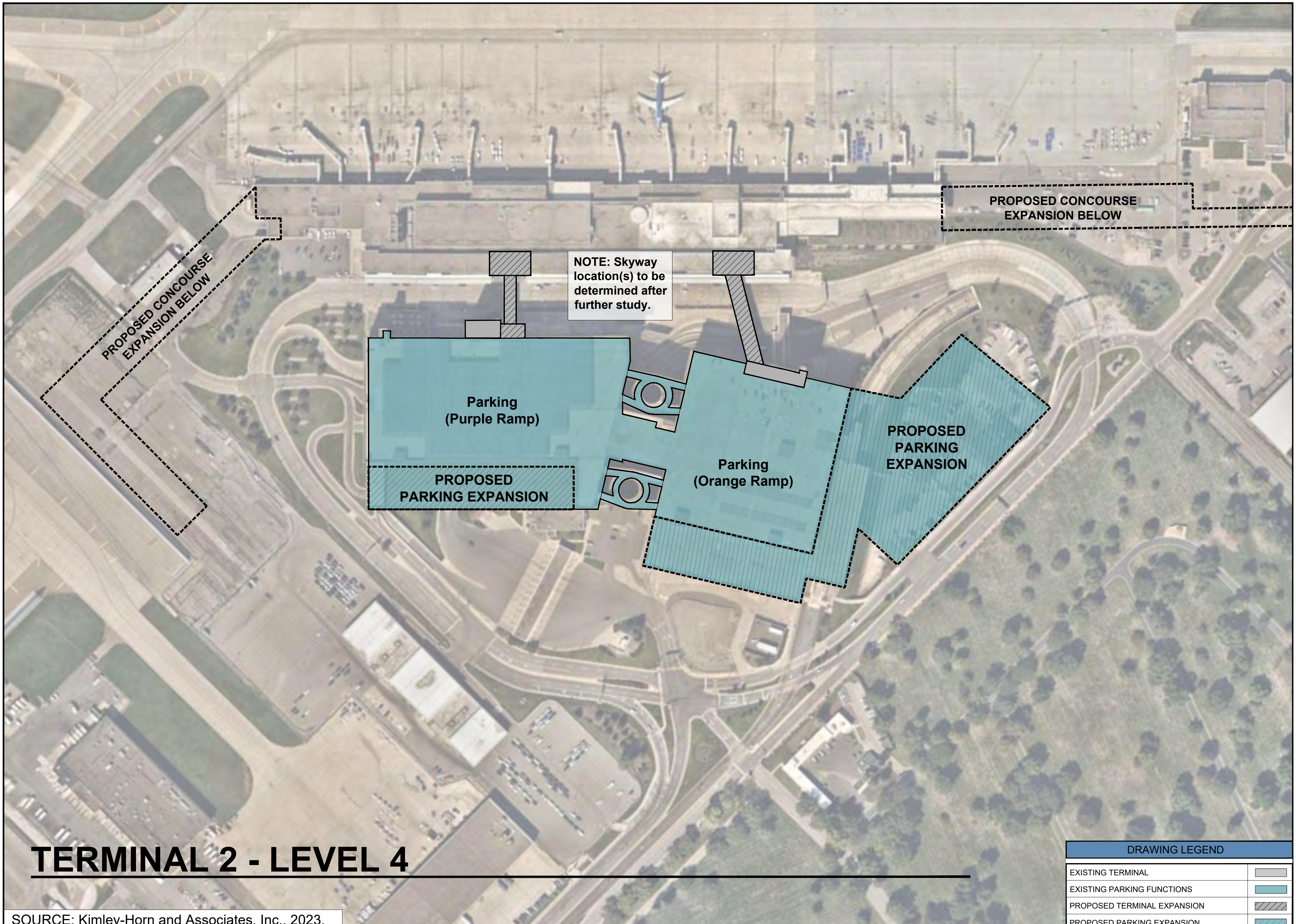
EXHIBIT 4-64

Proposed Terminal 2 Development - Level 3



SOURCE: Kimley-Horn and Associates, Inc., 2023.

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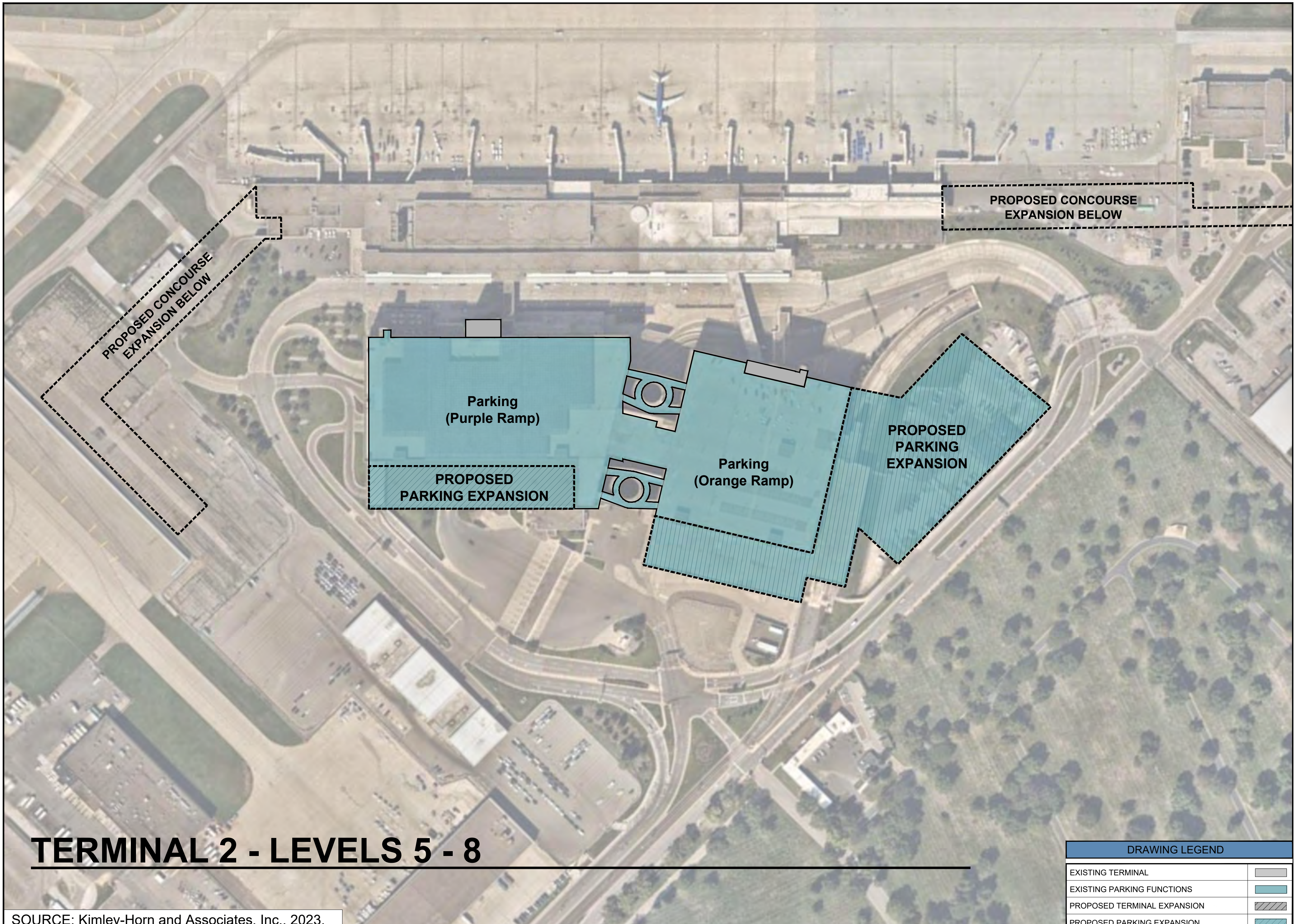
EXHIBIT 4-65
Proposed Terminal 2 Development - Level 4



TERMINAL 2 - LEVELS 5 - 8

DRAWING LEGEND
EXISTING TERMINAL
EXISTING PARKING FUNCTIONS
PROPOSED TERMINAL EXPANSION
PROPOSED PARKING EXPANSION

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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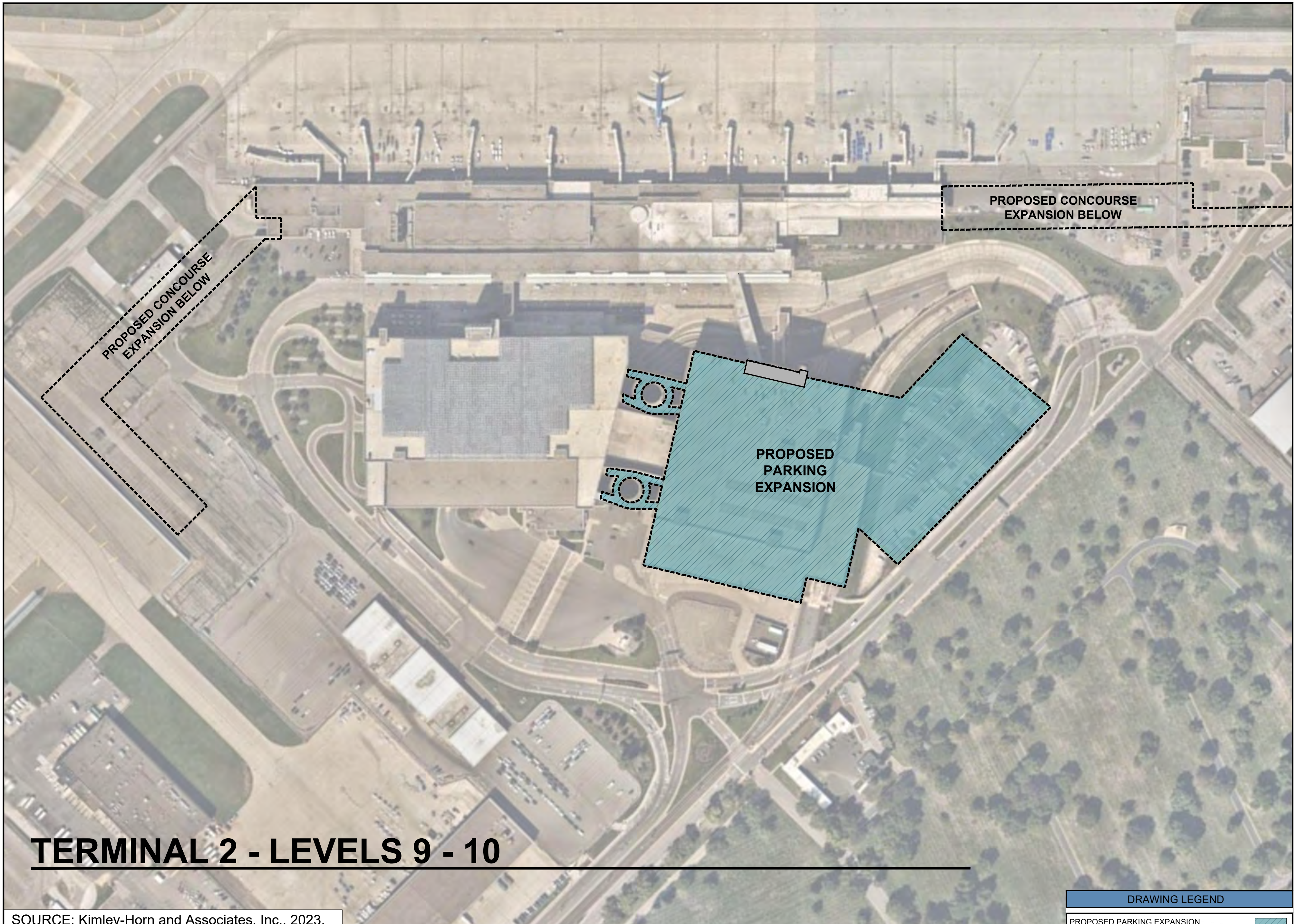

SOURCE: Kimley-Horn and Associates, Inc., 2023.

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EXHIBIT 4-67

Proposed Terminal 2 Development - Levels 9-10

4.7 PREFERRED ALTERNATIVE

The preferred alternative balances future airside, landside, and terminal needs while acknowledging the airport is geographically constrained. The alternative development process first focused on the terminal footprint, as landside elements would be directly tied to potential terminal expansion, which would in turn impact airside operations. The preliminary terminal layouts that were created focused on:

1. FIS function and location between T1 and T2; and
2. Gate expansion capabilities that would not overly burden airside functions. Expansion opportunities were considered on the basis of airline preferential gating (one airline using one contact gate) or common-use gating (multiple airlines operating out of one gate).

The three basic terminal alternatives were:

- Alternative 1A: Single FIS at T1; Preferential gating
- Alternative 2A: Single FIS at T2; Common-use gating
- Alternative 3A: FIS at both T1 and T2; Preferential gating

From there, airside and landside elements were incorporated into the terminal alternatives.

An extensive stakeholder engagement process was conducted to share and solicit feedback on the three alternatives. The project team conducted more than 15 meetings with airlines, tenants, agencies, MAC operational staff, MAC senior leadership, the LTP Stakeholder Advisory Panel (SAP), and members of the public. Stakeholder input was used to refine the concepts and inform decision-making for the preferred alternative.

Alternative 3.1A was selected as the preferred development alternative. This alternative incorporates multiple elements from each of the three preliminary consolidated alternatives and addresses the balance between airside, landside, and terminal functions. Preferred Alternative 3.1A, shown on **Exhibit 4-68**, assumes FIS function remains at both T1 and T2 and balances the need for both preferential gating at T1 and a strategy to continue implementing common-use gating at T2.

This alternative addresses the concerns of airport congestion in the landside, terminal, and airside through a series of projects. Landside projects at both terminals – as well as the surrounding feeder roadways – were developed to reduce traffic congestion around the airport and at curbside areas. Parking will be expanded to accommodate the forecasted demand and acknowledge the need for reconstructing end-of-life T1 parking facilities (Green/Gold).

Terminal projects are also intended to address increased demand for narrowbody aircraft parking (ADG III) while maintaining an optimal level of service for passengers.

Airfield modifications were identified to improve efficiency in aircraft ground maneuvering, specifically in areas where current design standards have been prohibitive, and to reduce runway crossings for aircraft accessing Runway 17-35. Projects include reconfiguring taxiways, expanding deicing and RON aircraft aprons, and relocating and expanding some support facilities.

A phased high-level implementation strategy was developed to categorize near-term, mid-term, and long-term projects. Phasing was determined by need and targeted demand.

Near-term projects are primarily focused on increasing capability of existing facilities while creating areas for development staging.

Mid-term projects are focused on increasing the capability of the Airport to accommodate projected demand.

Long-term projects provide additional expansion for demand and increasing operational flexibility through inter-terminal connectivity.

The division between Near-, Mid-, and Long-Term term development plans was established to characterize development that has a higher likelihood of justification and implementation within the 2040 planning cycle. However, it is important to recognize that the division in these windows of development is approximate and dynamic and will be subject to change as the MAC begins to implement the LTP. Needs and opportunities may evolve, and many supporting projects would also be needed to fully implement this program.

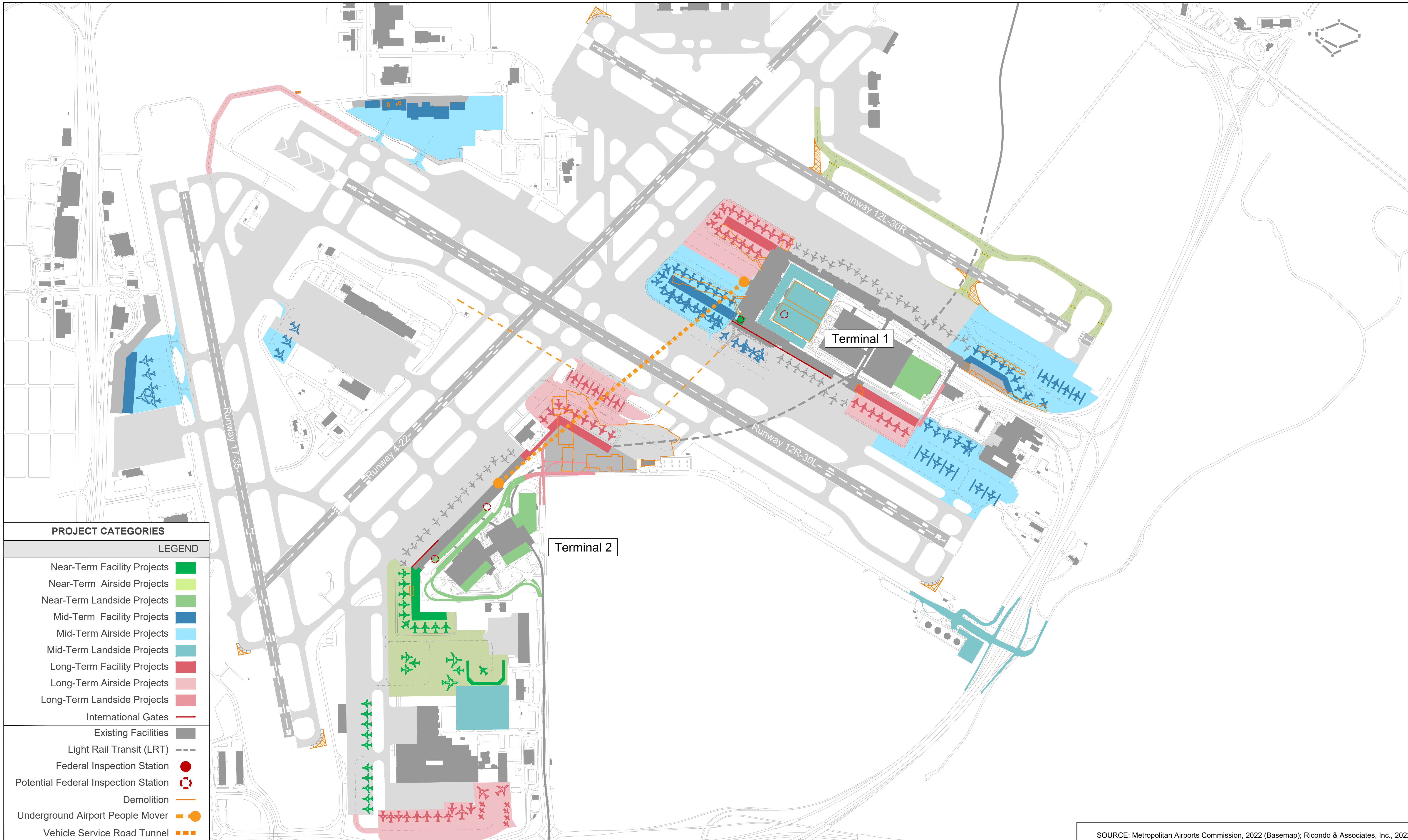

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EXHIBIT 4-68
Preferred Development Alternative 3.1A

4.7.1 Near-Term Preferred Development Alternative 3.1A

The near-term preferred development alternative features several key developmental alterations to the terminal area complex, as listed in **Table 4-10** and shown on **Exhibit 4-69**. The following subsections review the near-term projects in detail.

Table 4-10: Near-Term Projects

Project #	Project Description
1-1	Existing T1 FIS Facility Enhancements
1-2	T2 South Terminal Expansion
1-3	Taxiway Edge Geometry
1-4	Runway 12L-30R Partial Parallel Taxiway and Taxiway P3 Reconfiguration
1-5	Ground Runup Enclosure (GRE) Relocation and RON Apron Construction
1-6	U.S. Postal Service (USPS) Site Redevelopment
1-7	Orange Ramp North Expansion and Outrigger Expansions
1-8	Orange and Purple Ramps Vertical Expansion
1-9	T2 Curb Frontage Improvements

NOTES:
T1 – Terminal 1; FIS – Federal Inspection Services; GRE – Ground Runup Enclosure; RON – Remain Overnight
SOURCE: Ricondo & Associates, Inc., December 2022.

4.7.1.1 Project 1-1: T1 Federal Inspection Services Facility Enhancements

The T1 FIS facility enhancement project within the existing Concourse G facility will allow for support of additional international gates. The project involves the addition of approximately 2,600 square feet of passenger screening and queuing area. Space adjacent to the existing FIS facility will need to be relocated to accommodate the enhancements. A new sterile circulation corridor will be added to connect additional international gates. The sterile circulation should not impact the existing facilities.

The T1 FIS facility enhancement project does not have any enabling projects. **Exhibit 4-70** shows the location of the T1 FIS facility expansion project.

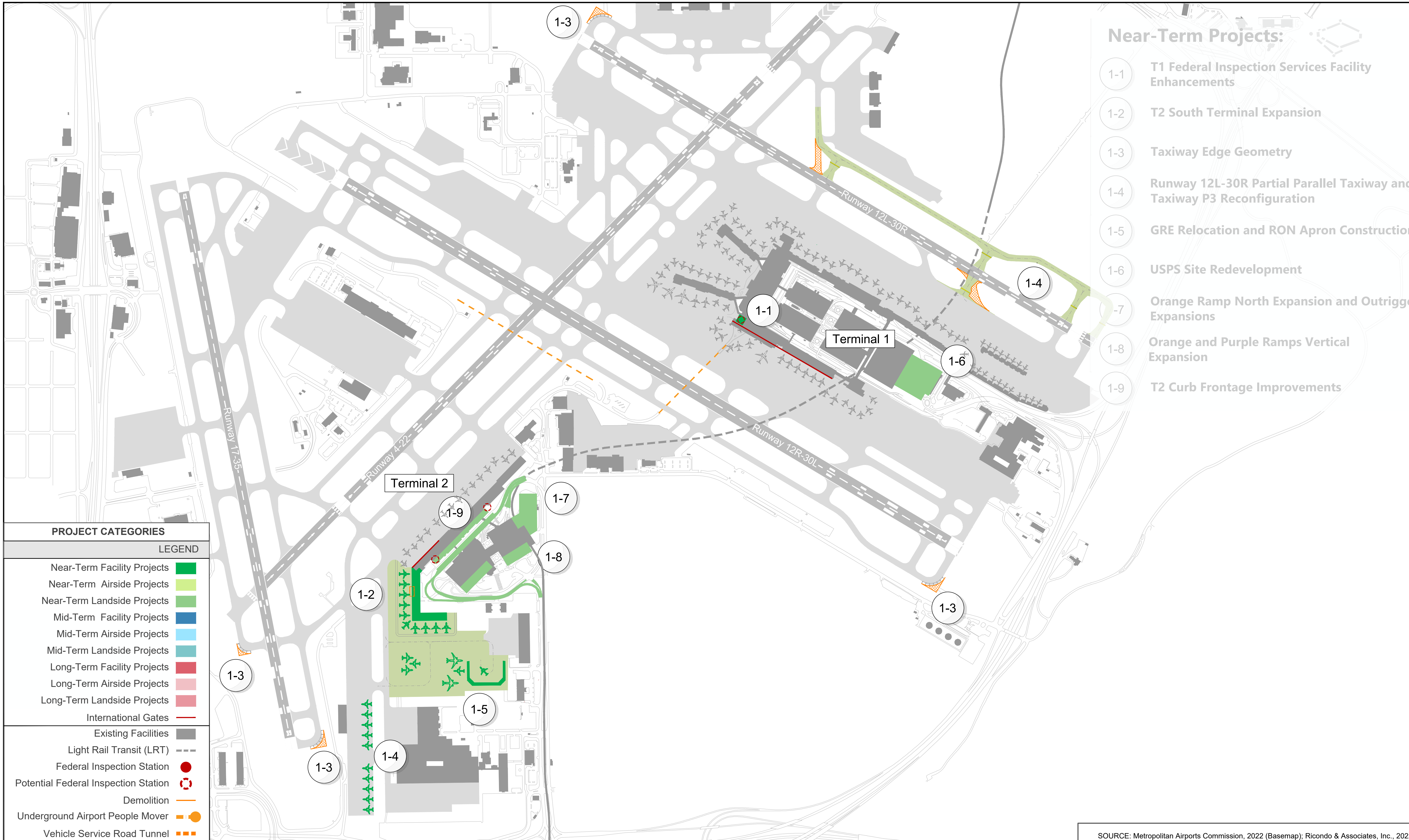

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EXHIBIT 4-69
Near-Term Preferred Development Alternative 3.1A

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EXHIBIT 4-70
Existing Terminal 1 FIS Enhancement

4.7.1.2 Project 1-2: T2 South Terminal Expansion

The south concourse expansion is a two-level single-loaded concourse consisting of 11 ADG III contact gates. The phasing of the south concourse expansion occurs in the near-term in order to provide surplus gates for staging future terminal projects. The additional gates will minimize gate relocations during future terminal construction projects. This project was brought forward in previous LTP efforts and was approved in the 2013 EA.

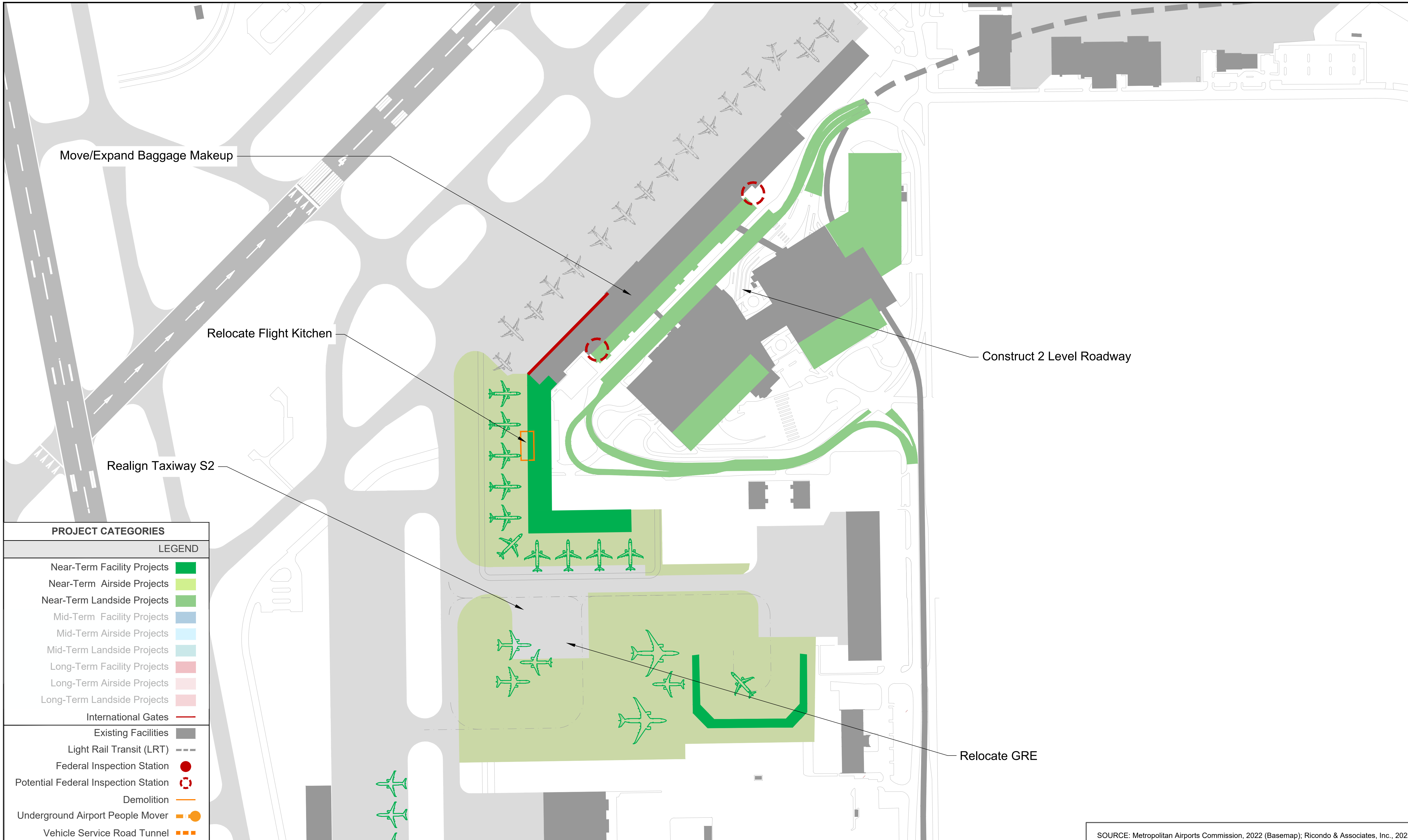
The future building is approximately 220,000 square feet. Level 2 contains holdrooms, public circulation, concessions, restrooms, and access to the contact gates. Level 1 contains Airport support, airline support, mechanical and storage. The adjacent future apron is approximately 440,000 square feet of pavement that will be used for aircraft parking and GSE circulation and storage. The concourse extends south from the existing T2 and then continues west, encroaching on the existing QTA facility. In addition, the concourse expansion impacts a flight kitchen south of the existing T2.

The south concourse expansion requires the realignment of Taxiway S2, which subsequently affects the existing GRE. The south concourse expansion project would be constructed in conjunction with the GRE relocation and RON apron construction, as discussed for Project 1-5.

The enabling projects for the development of the expansion include:

- Relocate the flight kitchen.
- Relocate the GRE (see **Section 4.6.1.5**).
- Relocate the QTA facility.
- Realign Taxiway S2 (see **Section 4.6.1.5**).
- Move/add baggage makeup in T2.

Exhibit 4-71 shows the new T2 South expansion in detail.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Ricondo & Associates, Inc., 2022.

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EXHIBIT 4-71
New T2 South Expansion

4.7.1.3 Project 1-3: Taxiway Edge Geometry

The taxiway edge geometry project will remove the existing 90-degree edge of pavement corners at the ends of Taxiway R and Taxiway R10, Taxiway W and Taxiway W1, Taxiway K and Taxiway K1, and Taxiway L and Taxiway L1. Approximately 40,000 square feet of pavement will be removed and replaced with loam and seed to create a rounded edge of pavement. Revising the edge of pavement from a 90-degree corner to a rounded corner increases visibility of the taxiway and distinguishes it from the runway for pilots on approach, reducing the chances of a wrong-surface landing. The taxiway edge geometry improvements do not have any enabling projects.

4.7.1.4 Project 1-4: Runway 12L-30R Partial Parallel Taxiway and Taxiway P3 Reconfiguration

Existing Taxiways P and Q are wingspan restricted for simultaneous use by ADG III aircraft. When aircraft larger than ADG III occupy Taxiway P, Taxiway Q must remain sterile. A partial parallel taxiway north of Runway 12L-30R will allow unrestricted ADG IV and V aircraft access to or from the Runway 30R approach end with full design conformity and improve airfield efficiency.

4.7.1.5 Project 1-5: Ground Runup Enclosure (GRE) Relocation and Remain-Overnight Apron Construction

The south expansion of T2 requires the existing GRE to be relocated. The GRE will be relocated approximately 1,200 feet to the east, and approximately 1 million square feet of new apron pavement will be constructed for the relocated GRE and new RON parking positions. The GRE relocation and RON apron construction project requires that the existing flight kitchen building be vacated and demolished.

4.7.1.6 Project 1-6: U.S. Postal Service Site Redevelopment

The USPS site redevelopment is an enabling project in the near-term. This project provides replacement public parking to accommodate parking displaced during Green/Gold Ramp demolition in the mid-term. The USPS site redevelopment project will construct a new rental car QTA facility and public parking structure on the footprint of the existing USPS site. The proposed QTA facility will occupy multiple levels to meet the T1 demand. The remaining 10 levels of the structured-level cast-in-place post-tensioned concrete structure will be used for public parking operations. The new structure should provide connectivity to the existing ready/return functions on Levels 2 through 5 of the Silver Ramp and the parking functions on Levels 6 through 11. The cross section of the proposed structure is provided in **Exhibit 4-42**.

The enabling projects for the redevelopment of the USPS site include buying out the USPS lease, demolishing the existing USPS industrial buildings and CSB, and demolishing two levels of the concrete parking structure (located above the USPS building).

4.7.1.7 Project 1-7: Orange Ramp North Expansion and Outrigger Expansions

The Orange Ramp north expansion comprises a structured-level cast-in-place post-tensioned concrete parking structure located to the north of the existing Orange Ramp. The nine-level structure will connect directly to the existing Orange Ramp via pedestrian and vehicular bridges on each level. The exact functions that will reside in the new structure have not been determined; however, parking functions will occupy the majority of the new structure. EV charging infrastructure should be incorporated into the parking ramp. The parking expansion at T2, in addition to the USPS site redevelopment, will bolster the Airport's parking capacity to enable the demolition of the Green/Gold Ramp.

This project will also include vertical outrigger expansions for the Orange Ramp, which consist of:

- Five levels of cast-in-place post-tensioned concrete parking structure for the Orange Ramp LRT outrigger expansion
- Five levels of cast-in-place post-tensioned concrete parking structure for the Orange Ramp east outrigger expansion

The Orange Ramp north expansion is recommended before other Orange Ramp vertical expansions due to radar shadow issues on the existing Orange Ramp site. The radar issues must be rectified to the satisfaction of the FAA before vertical expansion is feasible. The Orange Ramp north expansion project does not have any significant enabling projects. Existing construction staging operations require relocation prior to site development. However, due to the project's proximity to the existing LRT and T2 station, extensive coordination with Metro Transit will be required.

4.7.1.8 Project 1-8: Orange and Purple Ramps Vertical Expansion

The Orange and Purple Ramps at T2 can expand vertically on the existing ramp footprint. The vertical expansions for Project 3-9 include:

- Two levels of cast-in-place post-tensioned concrete parking structure for the entire Orange Ramp footprint
- Seven levels of cast-in-place post-tensioned concrete parking structure for the Purple Ramp outrigger expansion

This project will also include raising the helices between the Purple and Orange Ramps to Level 10 to provide access to the new Orange Ramp levels. Enabling projects for the vertical expansions include:

- Modify the Orange Ramp structure to provide additional bearing pressure and axial capacity for the columns.
- Relocate an aircraft NAVAID on the airside to prevent signal disruptions.

The enabling projects include the relocation of the ASR or upgrade/relocation to ASR 11.

4.7.1.9 Project 1-9: T2 Curb Frontage Improvements

The project includes the need to make physical improvements to vehicle operations in front of T2, specifically addressing curb front congestion. Terminal 2 will reconfigure the second level of the existing terminal to accommodate a new two-level roadway along the curb front of the building. The modifications include infill of some areas open to below on the second level to allow for curbside access from the second level of the roadway, reconstruction of the pedestrian tunnel to the Orange Ramp, and reconfiguration of the second level fascia to allow ingress/egress through that level. The reconfiguration will allow for optimal use of both the upper and lower curbsides for originating and destination passengers, alleviating the increased traffic on the existing single-level curbside. There are no enabling projects for the building modifications.

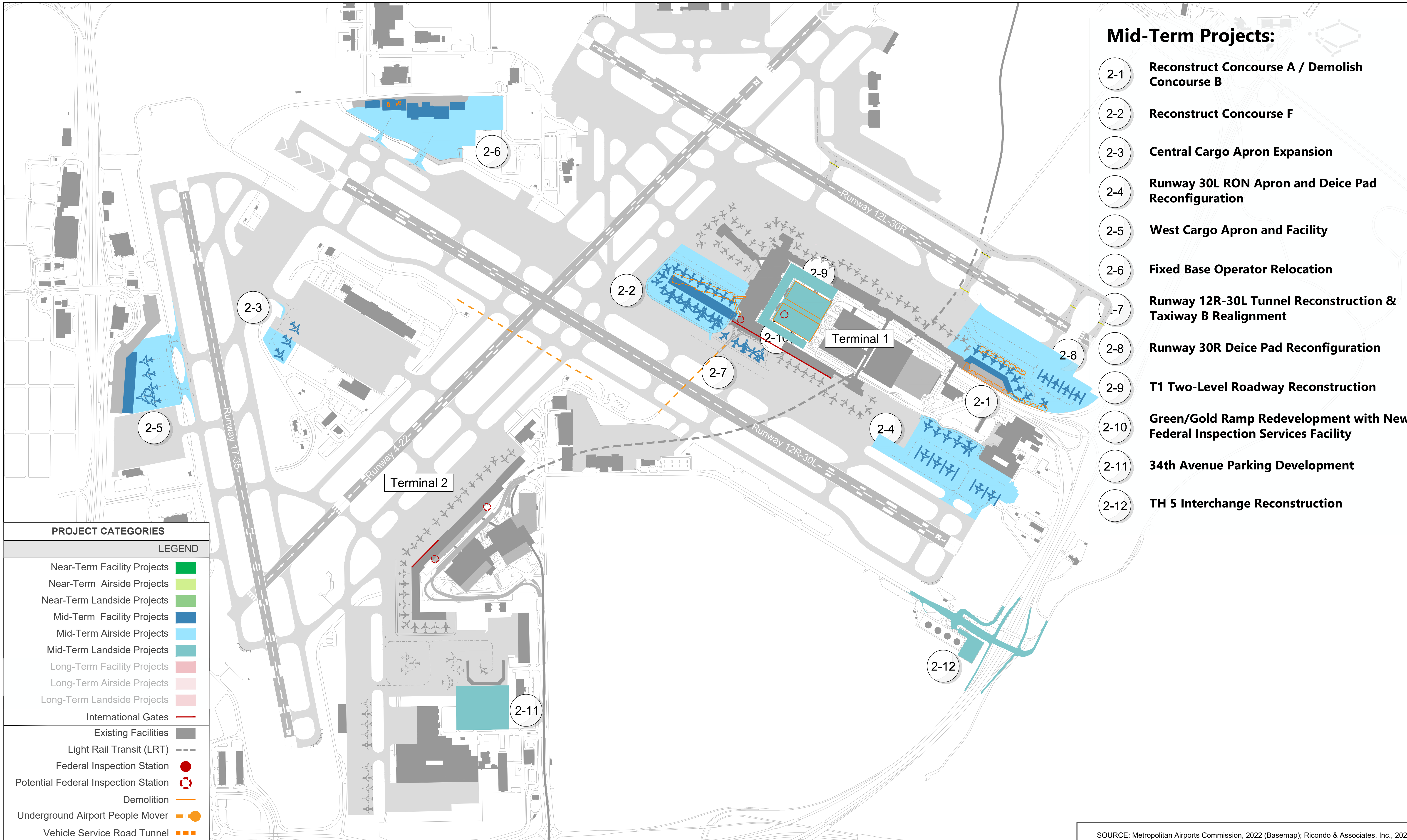
4.7.2 Mid-Term Preferred Development Alternative 3.1A

The mid-term preferred development alternative features several key developmental alterations to the terminal area complex, as listed in **Table 4-11** and shown on **Exhibit 4-72**. The following subsections review the mid-term projects in detail.

Table 4-11: Mid-Term Projects

Project #	Project Description
2-1	Reconstruct Concourse A, Demolish Concourse B
2-2	Reconstruct Concourse F
2-3	Central Cargo Apron Expansion
2-4	Runway 30L Remain Overnight (RON) Apron and Deice Pad Reconfiguration
2-5	West Cargo Apron and Facility
2-6	Fixed Base Operator (FBO) Relocation
2-7	Runway 12R-30L Tunnel Reconstruction and Taxiway B Realignment
2-8	Runway 30R Deice Pad Reconfiguration
2-9	Terminal 1 Two-Level Roadway Reconstruction
2-10	Green/Gold Ramp Redevelopment with New Federal Inspection Service (FIS) Facility
2-11	34th Avenue Parking Development
2-12	TH 5 Interchange Reconstruction

NOTES:
RON – Remain Overnight; FBO – Fixed Base Operator; FIS – Federal Inspection Services; SSCP – Security Screening Checkpoint
SOURCE: Ricondo & Associates, Inc., December 2022.



Mid-Term Projects:

- 2-1 Reconstruct Concourse A / Demolish Concourse B
- 2-2 Reconstruct Concourse F
- 2-3 Central Cargo Apron Expansion
- 2-4 Runway 30L RON Apron and Deice Pad Reconfiguration
- 2-5 West Cargo Apron and Facility
- 2-6 Fixed Base Operator Relocation
- 2-7 Runway 12R-30L Tunnel Reconstruction & Taxiway B Realignment
- 2-8 Runway 30R Deice Pad Reconfiguration
- 2-9 T1 Two-Level Roadway Reconstruction
- 2-10 Green/Gold Ramp Redevelopment with New Federal Inspection Services Facility
- 2-11 34th Avenue Parking Development
- 2-12 TH 5 Interchange Reconstruction

PROJECT CATEGORIES

LEGEND

- Near-Term Facility Projects
- Near-Term Airside Projects
- Near-Term Landside Projects
- Mid-Term Facility Projects
- Mid-Term Airside Projects
- Mid-Term Landside Projects
- Long-Term Facility Projects
- Long-Term Airside Projects
- Long-Term Landside Projects
- International Gates
- Existing Facilities
- Light Rail Transit (LRT)
- Federal Inspection Station
- Potential Federal Inspection Station
- Demolition
- Underground Airport People Mover
- Vehicle Service Road Tunnel

SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Ricondo & Associates, Inc., 2022.

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EXHIBIT 4-72
Mid-Term Preferred Development Alternative 3.1A

4.7.2.1 Project 2-1: Reconstruct Concourse A; Demolish Concourse B

The reconstructed Concourse A requires the demolition/redevelopment of the existing Concourse A and Concourse B facilities. Concourse B is a satellite concourse that will be replaced with apron pavement infill and dual ADG III taxilanes to improve aircraft flows around the new concourse and deice pad. The adjacent deice pad will be reconfigured, as discussed in Project 2-8. Concourse A will be redeveloped as a single-loaded ADG III–capable facility.

The future building is approximately 140,000 square feet. Level 2 contains holdrooms, public circulation, concessions, restrooms, and access to the contact gates. Level 1 contains Airport support, airline support, mechanical and storage. The adjacent future pavement will be used for aircraft parking, GSE circulation, and storage.

The configuration of the reconstructed Concourse A facility provides additional landside development opportunities south of the future concourse.

The enabling projects for the development of the new Concourse A include:

- Demolish/redevelop Concourse A.
- Demolish Concourse B.
- Reconfigure the deice pad (see **Section 4.7.2.8**).

Exhibit 4-73 shows the Reconstructed Concourse A project in detail.

4.7.2.2 Project 2-2: Reconstruct Concourse F

The reconstructed Concourse F is a three-level double-loaded concourse consisting of 19 ADG III contact gates. The new Concourse F provides 4 ADG V multiple aircraft ramp system (MARS) gates that could potentially serve international flights. However, the primary focus of these ADG V aircraft gates would be the seasonal domestic routes in which airlines up gauge their aircraft size.

The reconstructed Concourse F requires the demolition of the existing Concourse F facility, which will be replaced with apron pavement infill. The configuration of the new concourse will align with the existing Concourse G flight line, creating a contiguous structure to improve aircraft gate alignment and additional aircraft maneuvering capability around the terminal area.

The future building is approximately 250,000 square feet. Level 3 contains a sterile corridor connected to the T1 FIS facilities. This sterile corridor will be used by the four MARS gates. Level 2 contains holdrooms, public circulation, concessions, restrooms, and access to the contact gates. Level 1 contains Airport support, airline support, mechanical and storage. The adjacent future pavement will be used for aircraft parking, GSE circulation, and storage.

A single ADG III taxilane will be provided north of the reconstructed Concourse F to serve both the new concourse and the existing Concourse E. The reconstructed Concourse E construction, discussed for Project 3-3, allows the space between future Concourse F and future Concourse E to accommodate triple ADG III taxilanes. **Exhibit 4-74** shows the new Concourse F project in detail.

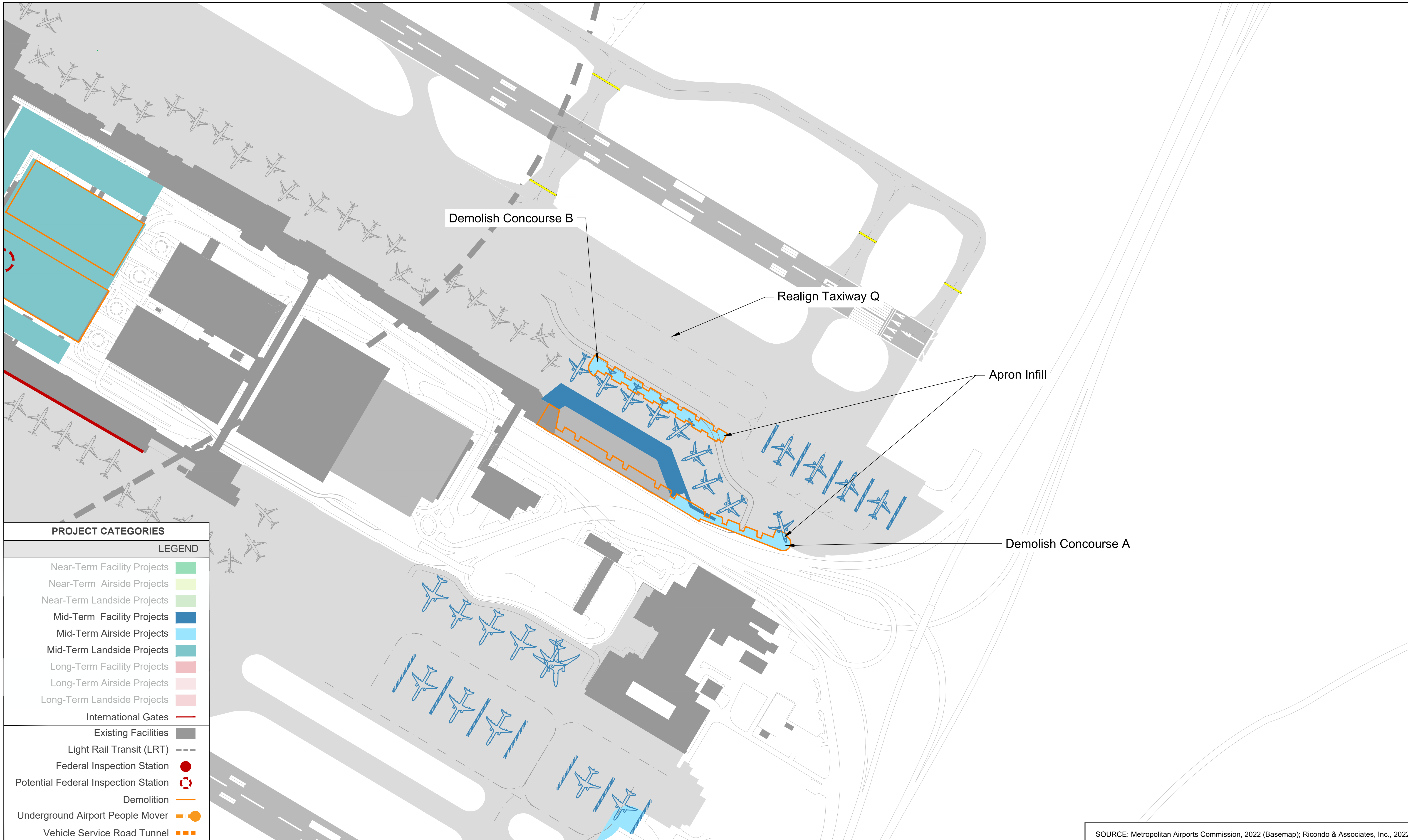

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EXHIBIT 4-73
Reconstruct Concourse A/Demolish Concourse B

4.7.2.3 Project 2-3: Central Cargo Apron Expansion

The Central Cargo Apron, specifically the UPS apron, will be expanded to allow for the addition of two parking stalls for UPS. The apron expansion is approximately 133,000 square feet, located on the western end of the existing UPS apron. The Central Cargo Apron expansion project has no enabling projects.

4.7.2.4 Project 2-4: Runway 30L Remain-Overnight (RON) Apron and Deice Pad Reconfiguration

The Runway 30L deice pad will be reconfigured to accommodate larger aircraft on the deice pad. Approximately 17,000 square feet of apron pavement will be added. With the addition of this pavement and reconfiguration of the surface markings, up to five ADG III aircraft will be able to operate on the deice pad at a time. The Concourse H expansion will require reconfiguration of the RON parking positions north of the Runway 30L deice pad. No new pavement is required for this, and surface markings will be reconfigured to allow for one ADG III position, three ADG IV positions, and a final position capable of parking either an ADG IV or ADG V aircraft. The Runway 30L RON apron and deice pad reconfiguration project has no enabling projects.

4.7.2.5 Project 2-5: West Cargo Apron and Facility

The West Cargo Apron and facility project will construct a new airfield apron, cargo warehouse and sort facility, and landside trailer docking and parking lot on the existing abandoned site north of the shared Amazon / DHL apron. The new apron and facilities will meet the anticipated cargo requirements for Amazon. Approximately 621,000 square feet of new airfield apron will be constructed, which will provide parking for up to three ADG IV aircraft and one shared parking stall for either an ADG IV or ADG V aircraft. The cargo warehouse and sort facility is approximately 124,000 square feet. Approximately 285,000 square feet of landside pavement will be constructed to accommodate cargo haul vehicle docking and employee parking. The West Cargo Apron and facility project has no enabling projects.

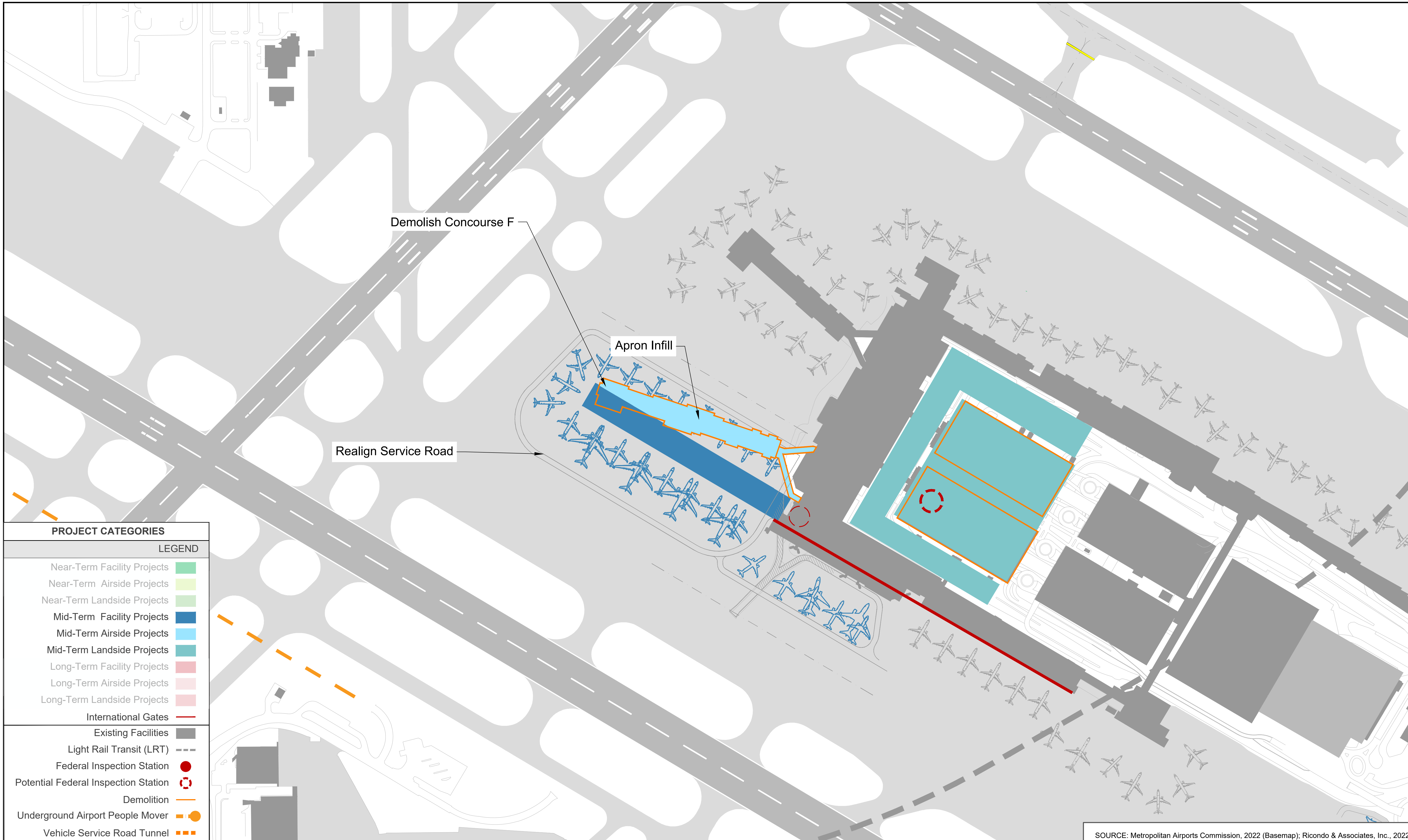

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EXHIBIT 4-74
Reconstruct Concourse F

4.7.2.6 Project 2-6: Fixed Base Operator (FBO) Relocation

To accommodate the north expansion of T2, the existing FBO terminal and hangars will be relocated to the north side of the airfield, adjacent to Taxiway B. The relocated FBO apron includes a 20,000-square-foot terminal building, approximately 175,000 square feet of hangar space, approximately 956,000 square feet of new apron pavement, and approximately 129,000 square feet of landside parking. Two connections will be provided to Taxiway B, and aircraft up to ADG V will be able to access the FBO apron.

There are two enabling projects and one revision to a programmed project under design that are required for the FBO relocation. The FAA RTR/RCAG equipment and supporting facilities will need to be relocated, as well as the existing fire training facility. The preferred FBO relocation alternative also requires a revision to the proposed security center development site by relocating the parking lot access point from 32nd Avenue South from the existing driveway to the west of the old Navy building.

4.7.2.7 Project 2-7: Runway 12R-30L Tunnel Reconstruction and Taxiway B Realignment

The Runway 12R-30L tunnel reconstruction and Taxiway B realignment project will increase airfield capacity and efficiency by extending the existing VSR tunnel approximately 160 feet. The tunnel extension will allow for the alignment of Taxiway B as it crosses over the tunnel to be parallel to Taxiway A. This will remove an existing bottleneck at this location that limits the taxiing of aircraft to only one aircraft at a time on either Taxiway A or Taxiway B as they cross over the tunnel. The realignment of Taxiway B will allow simultaneous aircraft to taxi over the tunnel on Taxiway A and Taxiway B. The VSR will also need to be reconstructed to meet existing grade as it approaches Concourse F. This project is anticipated to occur concurrently with the reconstruction of Concourse F.

As an enabling project, existing gating on Concourse G will need to be revised to accommodate the reconfiguration of the VSR.

4.7.2.8 Project 2-8: Runway 30R Deice Pad Reconfiguration

The Runway 30R deice pad reconfiguration will increase the capacity of the deice pad by allowing up to four ADG III aircraft to be deiced at a time on the deice pad. The existing deice pad markings will need to be reconfigured to accommodate ADG III aircraft. Dedicated GSE and deice equipment staging areas will also be provided. No additional apron pavement is required for the deice pad reconfiguration.

As an enabling project, the existing Concourse B building will need to be demolished to allow ADG III aircraft to have access to the deice pad, since the existing taxilane accessing the deice pad is restricted to aircraft with less than an 81.5-foot wingspan.

4.7.2.9 Project 2-9: T1 Two-Level Roadway Reconstruction

The existing elevated departures and at-grade arrivals roadways will be reconstructed as the upper-level roadway structure reaches its end of life. Further study and stakeholder coordination are required to determine a preferred layout for the T1 roadways. However, the new roadways will likely be in a similar configuration to the existing roadways, but they will be offset farther from the terminal to provide a clearance requested by the APD. The inbound and outbound roadways will also be reconstructed to be compatible with the proposed changes as part of the Green/Gold Ramp redevelopment. The new elevated roadway is also anticipated to include a canopy cover. The Green/Gold Ramp redevelopment is an enabling project to provide curbside facilities during the demolition and reconstruction of the existing curbside roadways.

4.7.2.10 Project 2-10: Green/Gold Ramp Redevelopment with New Federal Inspection Services (FIS) Facility

The Green/Gold Ramp will be demolished as the ramps are anticipated to reach their end of useful life during the planning horizon. The new structure will consist of a multi-use parking facility including parking, a centralized FIS facility, and MAC administrative space. The LTP recommends a preliminary design and alternative refinement project be completed ahead of this project to validate a preferred layout as well as goals, objectives, and timeline of the reconstruction. The redevelopment of the site will be directly dependent on the demolition of the existing Green/Gold Ramp.

The enabling projects for the demolition include the USPS site parking development and the T2 parking expansion, described in Section 4.7.1.6 and 4.7.1.7, respectively. The Green/Gold Ramp site requires close coordination with the Airport APM system programming, which will occur as a separate study. The Green/Gold Ramp site will interface with the existing Hub Tram tunnels connecting Red/Blue/Silver Ramps to T1.

4.7.2.11 Project 2-11: 34th Avenue Parking Development

The construction of a 5,000-stall cast-in-place post-tensioned concrete parking structure is proposed along 34th Avenue. The structure will serve as an employee parking facility for Delta employees. A new entrance and exit driveway will need to be constructed for access. The construction of the new ramp will require the demolition of an existing 35,000-square-foot industrial building. The 34th Avenue parking development has no enabling projects, though it is connected to the proposed RON aircraft parking area adjacent to Highway 494 in the long-term project list.

4.7.2.12 Project 2-12: TH 5 Interchange Reconstruction

A new intersection for TH 5 and Post Road is proposed to improve capacity and intersection LOS. Improvements to the intersection could include modifications to make Post Road / East 72nd Street the primary entrance to T2. Construction of the new interchange will require constructing a new bridge over TH 5, realigning Post Road and Northwest Drive, and reconfiguring the intersection. The geometry of the intersection included in the MSP 2040 LTP is based on the work completed as part of the 2010 EA. Further study and coordination with MnDOT are required for program timing and to validate the proposed interchange meets the needs of both MnDOT and MAC.

The interchange reconstruction also involves the construction of a commercial vehicle staging lot, just south of the former Super America site. There are no enabling projects at the Airport for the TH 5 interchange reconstruction. Enabling projects for the development would be developed by MnDOT.

4.7.3 Long-Term Preferred Development Alternative 3.1A

The long-term preferred development alternative features several key developmental alterations to the terminal area complex, as listed in **Table 4-12** and shown on **Exhibit 4-75**. The following subsections review the long-term projects in detail.

Table 4-12: Long-Term Projects

Project #	Project Description
3-1	New T2 North Expansion
3-2	Concourse G South Expansion
3-3	Reconstruct Concourse E
3-4	T1–T2 Automated People Mover (APM) Tunnel Construction
3-5	Runway 4-22 Tunnel Reconfiguration and Deice Pad Construction
3-6	South Remain Overnight (RON) Apron Construction
3-7	Runway 12R End-Around Taxiway (EAT) Construction
3-8	34th Avenue and E 70th Street Reconstruction

NOTES:
T1 – Terminal 1; T2 – Terminal 2; APM – Automated People Mover; RON – Remain Overnight
SOURCE: Ricondo & Associates, Inc., December 2022.

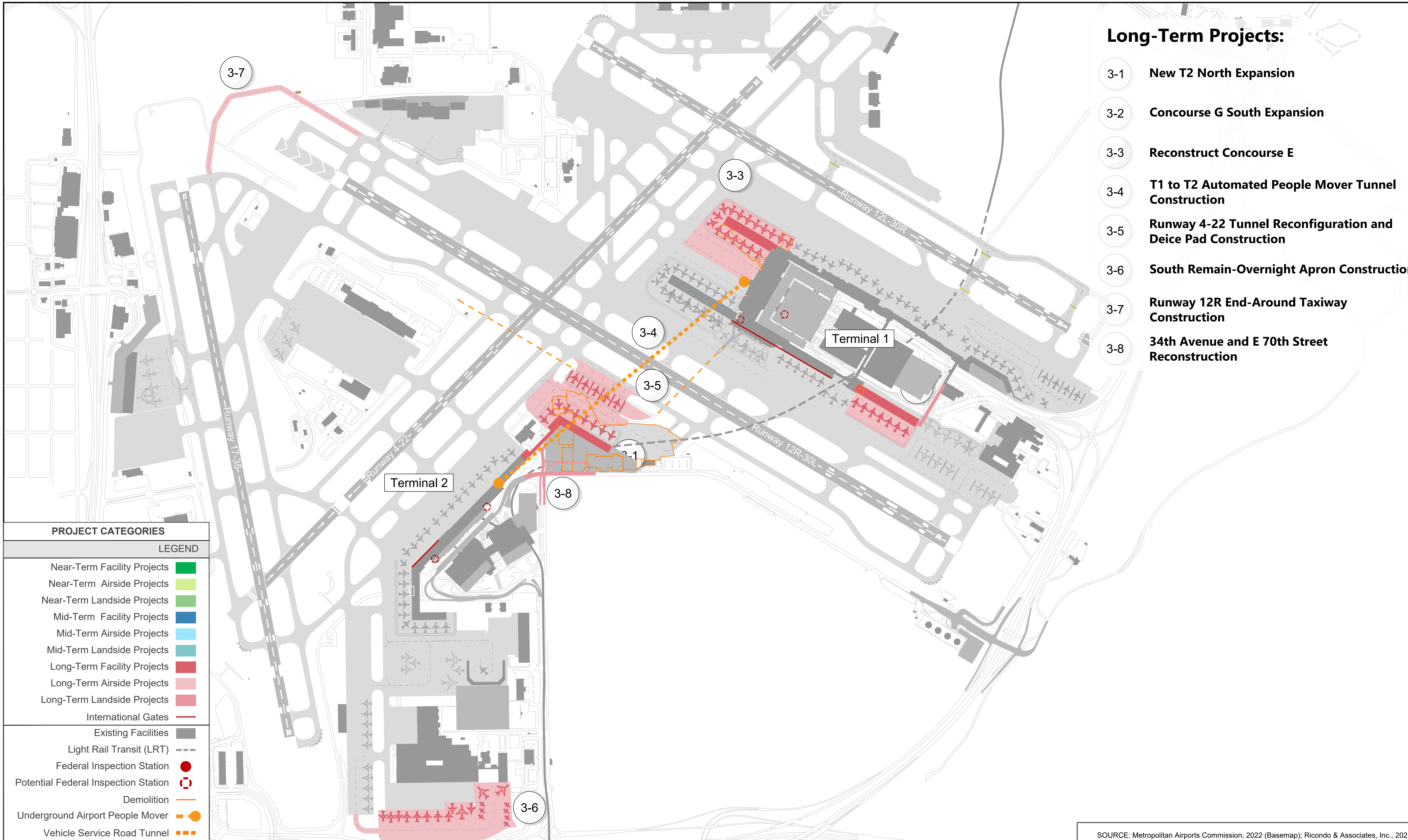

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EXHIBIT 4-75

Long-Term Preferred Development Alternative 3.1A

4.7.3.1 Project 3-1: New T2 North Expansion

The new T2 North expansion is a two-level single-loaded concourse consisting of nine ADG III contact gates. The phasing of the new concourse expansion occurs in the long-term due to the impact on the existing FBO facilities, which would need to be relocated prior to the north expansion of the concourse.

The new T2 North expansion requires the demolition of the existing FBO campus, which will be relocated in the mid-term phase, as discussed in Project 2-6. The configuration of the new concourse expansion extends northeast from the existing concourse, before extending southeast onto the existing FBO area. There is a passenger bridge connecting from the existing concourse to the future north expansion, spanning over the existing entry road to the ARFF facility. While the existing ARFF facility remains unimpacted by this project, a reconfiguration of the entry road will be necessary.

The future building is approximately 275,000 square feet. Level 2 contains holdrooms, public circulation, concessions, restrooms, and access to the contact gates. Level 1 contains Airport support, airline support, mechanical and storage. The adjacent future pavement will be used for aircraft parking, GSE circulation, and storage. The new North Concourse H apron will be served by a single ADG III taxilane, and it will have airfield access to Taxiway D and Taxiway W.

In conjunction with the new T2 North expansion, a new deice pad will be constructed north of the concourse expansion project. The deice pad and accompanying tunnel reconfiguration are discussed in detail for Project 3-6.

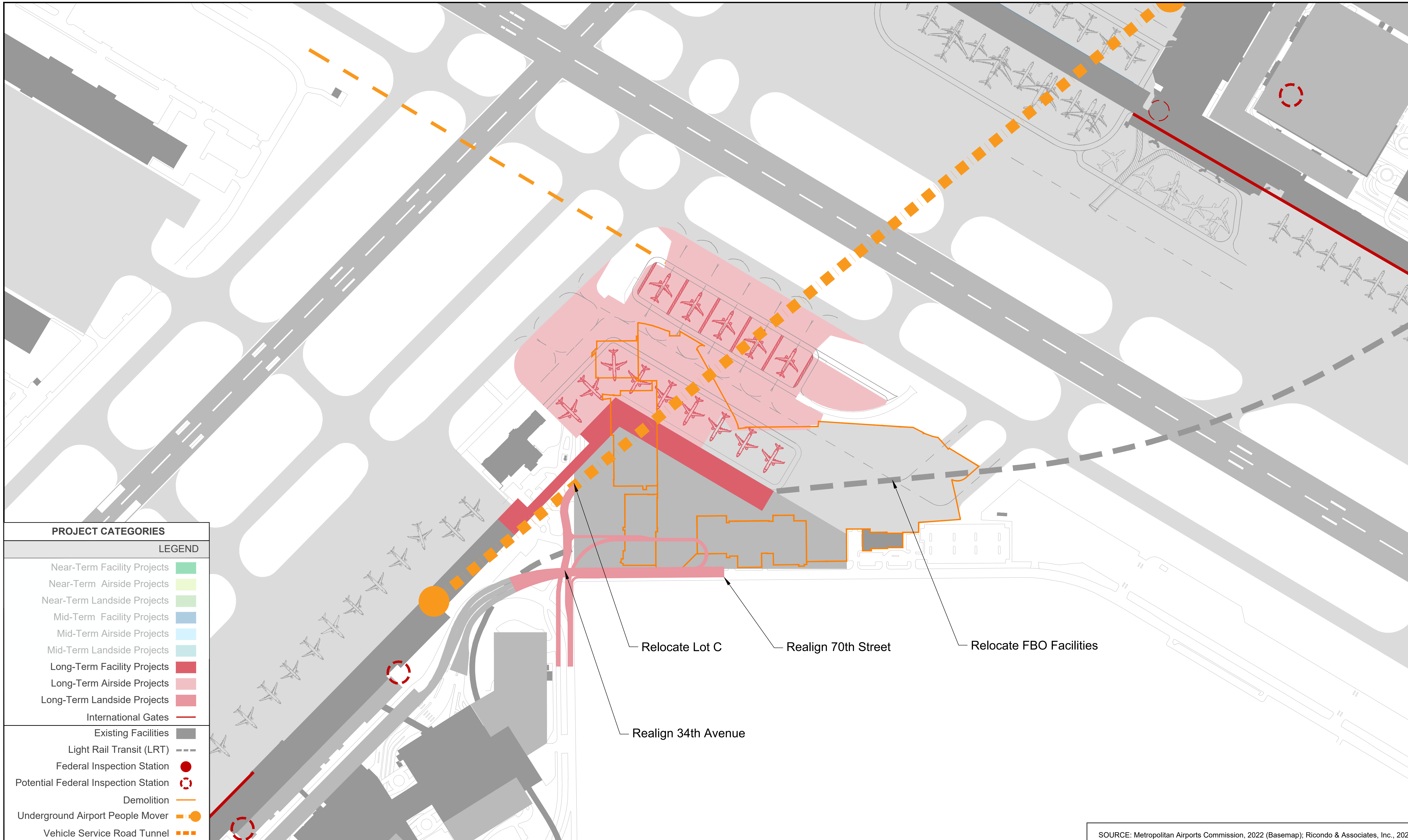
The enabling projects for the development of the new T2 North expansion include:

- Demolish the FBO campus.
- Realign the ARFF facility entry road (see **Section 4.7.3.10**).
- Realign 70th Street (see **Section 4.7.3.10**).

Exhibit 4-76 shows the new T2 North expansion project in detail.

4.7.3.2 Project 3-2: Concourse G South Expansion

The Concourse G expansion is a two-level single-loaded concourse consisting of seven ADG III contact gates. The phasing of the new concourse expansion occurs in the long-term to address the increasing demand of contact gates for aircraft operations. The concourse expansion project would require the demolition of four existing contact gates (G19, G20, G21, G22), which are clustered on the end of the existing Concourse G.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Ricondo & Associates, Inc., 2022.

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EXHIBIT 4-76
New T2 North Expansion

The configuration of the concourse expansion extends southeast from the existing Concourse G, ending with a new passenger bridge connection north to the existing InterContinental Hotel bridge. This new passenger bridge would tie into the existing passenger bridge that connects the hotel to Concourse A, creating a direct secure connection from Concourse G to Concourse A. The connector is approximately 30,000 square feet and extends over two existing roadways: Glumack Drive and Foshay Drive.

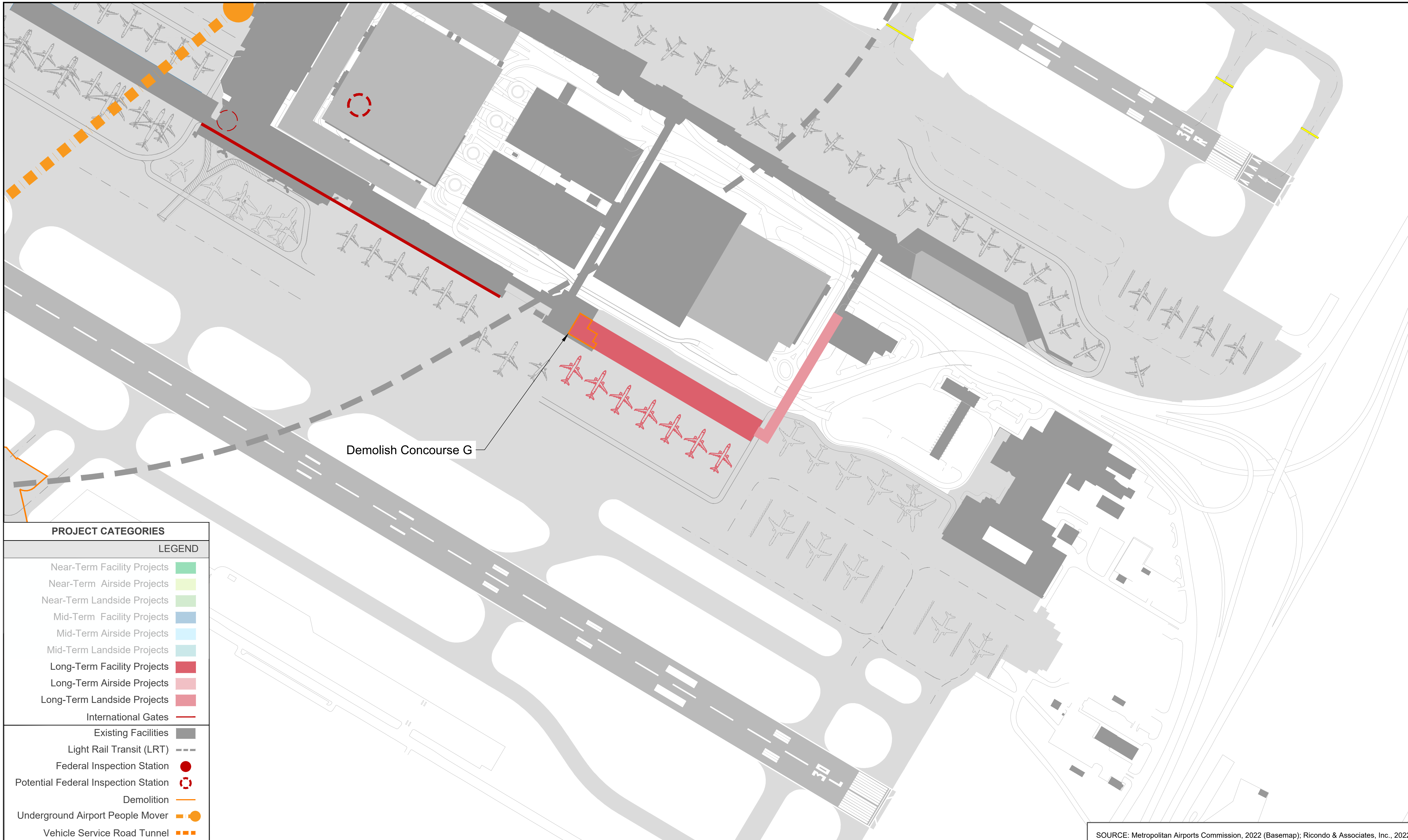
The future concourse building is approximately 210,000 square feet. Level 2 contains holdrooms, public circulation, concessions, restrooms, and access to the contact gates. Level 1 contains Airport support, airline support, mechanical and storage. The adjacent future pavement will be used for aircraft parking, GSE circulation, and storage. The Concourse G expansion will be adjacent to the future Runway 30L deice pad and RON apron, as discussed for Project 2-4. The following enabling project is required for the development of the Concourse G expansion: demolish the end of Concourse G. **Exhibit 4-77** shows the Concourse G expansion project in detail.

4.7.3.3 Project 3-3: Reconstruct Concourse E

The new Concourse E project is a two-level double-loaded concourse consisting of 15 ADG III contact gates. The new Concourse D project is a two-level single-loaded concourse consisting of 2 ADG III gates. There is a likelihood reconstructing Concourse E will result in absorption of existing Concourse D and will likely trigger the need to rename the concourses in T1.

The reconstructed Concourse E requires the demolition of the existing Concourses E and D facilities, which will be replaced with apron pavement infill. The configuration of the new concourse will align with the existing Concourse C flight line, creating a contiguous structure to improve aircraft gate alignment. This new concourse alignment creates additional airfield space between Concourse E and Concourse F, accommodating three ADG III taxilanes.

The future Concourse E building is approximately 185,000 square feet. Level 2 contains holdrooms, public circulation, concessions, restrooms, and access to the contact gates. Level 1 contains Airport support, airline support, mechanical and storage. The adjacent future pavement will be used for aircraft parking, GSE circulation, and storage. The future airfield between Concourse E and Concourse F allows for the improvement of aircraft maneuverability with three ADG III taxilanes, replacing the existing single ADG III taxilane currently serving this area. **Exhibit 4-78** shows the new Concourse E project in detail.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Ricondo & Associates, Inc., 2022.

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EXHIBIT 4-77
Concourse G South Expansion

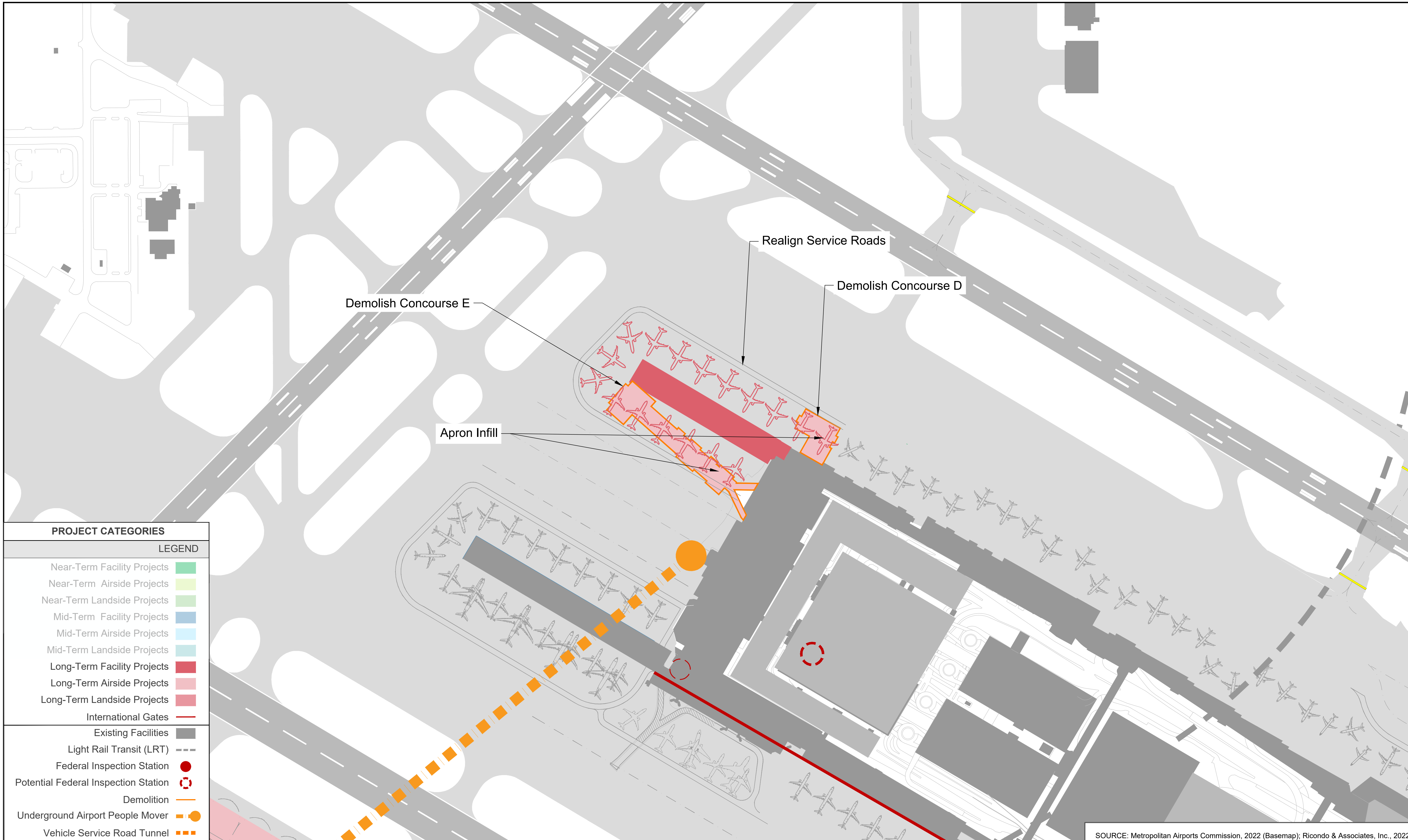

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EXHIBIT 4-78

Reconstruct Concourse E

4.7.3.4 Project 3-4: T1 to T2 Automated People Mover (APM) Tunnel Construction

A new APM tunnel from the headhouse of T1 will connect to the new north concourse on T2. The tunnel is approximately 3,200 feet long and should accommodate two stops, one for each terminal. The stops should include passenger boarding areas, vertical circulation to the boarding level, and switchbacks for the trains. The tunnel will allow for airside connectivity for passengers between the two terminals and increases the flexibility of the terminal for interconnected operations. There are no enabling projects for the tunnel construction. Construction under Runway 12R – 30L would coincide with scheduled runway and apron rehabilitation projects.

4.7.3.5 Project 3-5: Runway 4-22 Tunnel Reconfiguration and Deice Pad Construction

The Runway 4-22 tunnel reconfiguration and deice pad project will increase the deicing capabilities of MSP by adding an additional five ADG III deice positions north of the T2 north expansion, adjacent to Taxiway W. The deice positions may also be utilized as RON parking in non-deicing conditions. The existing Runway 4-22 VSR tunnel will be extended approximately 820 feet, and the deice pad will be constructed over the extended tunnel. The Runway 4-22 VSR will connect to the Runway 12R-30L VSR. Dedicated GSE and deice equipment staging will be constructed adjacent to the deice pad. Approximately 436,000 square feet of apron will be constructed as part of this project. Enabling projects for the Runway 4-22 tunnel reconfiguration and deice pad construction project include the relocation of the VSR as part of the T2 north expansion, relocation of the FBO apron to the north side of the airfield, and relocation of an existing fueling facility at this location.

4.7.3.6 Project 3-6: South Remain-Overnight (RON) Apron Construction

The south RON apron construction project will increase the Airport's available RON parking. The exact number of additional RON spaces is dependent on the size of aircraft parked and the parking configuration (dependent or independent) on the RON apron. As shown for the preferred alternative, parking for up to 7 ADG II aircraft, 10 ADG III aircraft, and 3 ADG IV aircraft is provided. The RON apron will be approximately 1 million square feet. As an enabling project for the south RON apron construction project, relocation of the existing Delta employee parking lots to another surface lot or new parking structure is required.

4.7.3.7 Project 3-7: Runway 12R End-Around Taxiway (EAT) Construction

The Runway 12R End-Around Taxiway (EAT) construction project will build a new taxiway around the approach end of Runway 12R, connecting Taxiway B to Taxiway K. The EAT will increase airfield capacity and safety by eliminating the crossing of Runway 12R-30L by aircraft landing or departing on Runway 17-35. The EAT will be approximately 3,100 feet long and will require the construction of approximately 232,000 square feet of taxiway pavement. The EAT will be restricted to ADG IV aircraft with tail heights less than 45 feet (i.e., Boeing 757-200) so that tails do not penetrate the Runway 30L departure surface. Construction of the EAT also includes reconstruction and tunneling of the airfield perimeter road in two locations where it crosses the EAT. The EAT passes through the existing ALSF-2 of Runway 12R, which will be partially reconfigured as an enabling project for the EAT construction.

4.7.3.8 Project 3-8: 34th Avenue and E 70th Street Reconstruction

An elevated roadway from Post Road will pass over the existing intersection to improve throughput, while maintaining access to the existing ARFF facility. A flyover from 34th Avenue will provide a recirculation option to the terminal. The enabling projects for this project include Projects 1-9 and 2-12.

Chapter 5. Environmental Considerations

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Chapter 5 Environmental Considerations

This chapter presents an overview of the environmental considerations for development of the 2040 MSP Long-Term Plan (LTP). These considerations include the effects that development may have on noise, air quality, and water quality within the region surrounding the Airport. The analysis for noise conditions was developed using an Aviation Environmental Design Tool (AEDT) and is based on updated forecasts discussed in **Chapter 2**. The remaining environmental considerations are based on Chapter 5 of Appendix A, which presents the 2030 LTCP update for aviation demand, and Appendix B, which presents the 2020 Improvements Final EA/EAW.

The Metropolitan Airports Commission (MAC) has a longstanding commitment to creating a sustainable future. The MAC furthered this commitment in 2020 by setting the following 2030 goals:

- Reduce MSP's greenhouse gas emissions by 80%.
- Reduce MSP's water usage per passenger by 15%.
- Divert 75% of MSP's waste away from landfills.
- Achieve a MAC employee engagement sustainability score of 85.

The MAC and airport stakeholders are working toward reaching these goals through a variety of means, such as reducing energy and CO2 emissions, achieving Level 2 in the Airport Carbon Accreditation program, diverting airport waste, reducing water consumption, and planning for climate resiliency.

5.1 BACKGROUND

The **Appendix A** analysis was based on the 2008 aviation forecast, with demand extending to 2030. The baseline condition for **Appendix B** was based on 2010 data, with aviation demand extending to 2020. The total aircraft operations calculated for the 2040 LTP is lower in 2040 than what was determined for 2030 in **Appendix A** and 2025 in **Appendix B**. As presented on **Exhibit 2-39** in Chapter 2 of this report, total operations for 2040, in relation to the revised baseline forecast, are anticipated to be approximately 517,000 operations. Total operations forecast for 2030 in **Appendix A** were approximately 630,800. This is approximately 113,800 more operations 10 years earlier based on data derived in 2008. Total operations forecast for 2025 in **Appendix B** were approximately 526,000. This is approximately 9,000 more operations 15 years earlier based on data derived in 2010.

The 2040 LTP forecast operations in 2040 were noticeably less than the operations forecast in prior studies, consequently the environmental results from these studies are applicable in relation to the LTP 2040 peak demand. In addition, the alternatives that were assessed in prior studies require similar alterations to the preferred development alternative presented in **Chapter 4**; therefore, the extent of the study area is still appropriate. The environmental consequences within the study areas, defined in **Appendix B**, were completed in accordance with FAA Orders 1050.1E, *Environmental Impacts: Policies and Procedures*, and 5050.4B, *National Environmental Policy Act* (*NEPA) Implementing Instructions for Airport Actions*, and the FHWA NEPA regulations. An environmental consequences summary can be found in **Appendix B**.

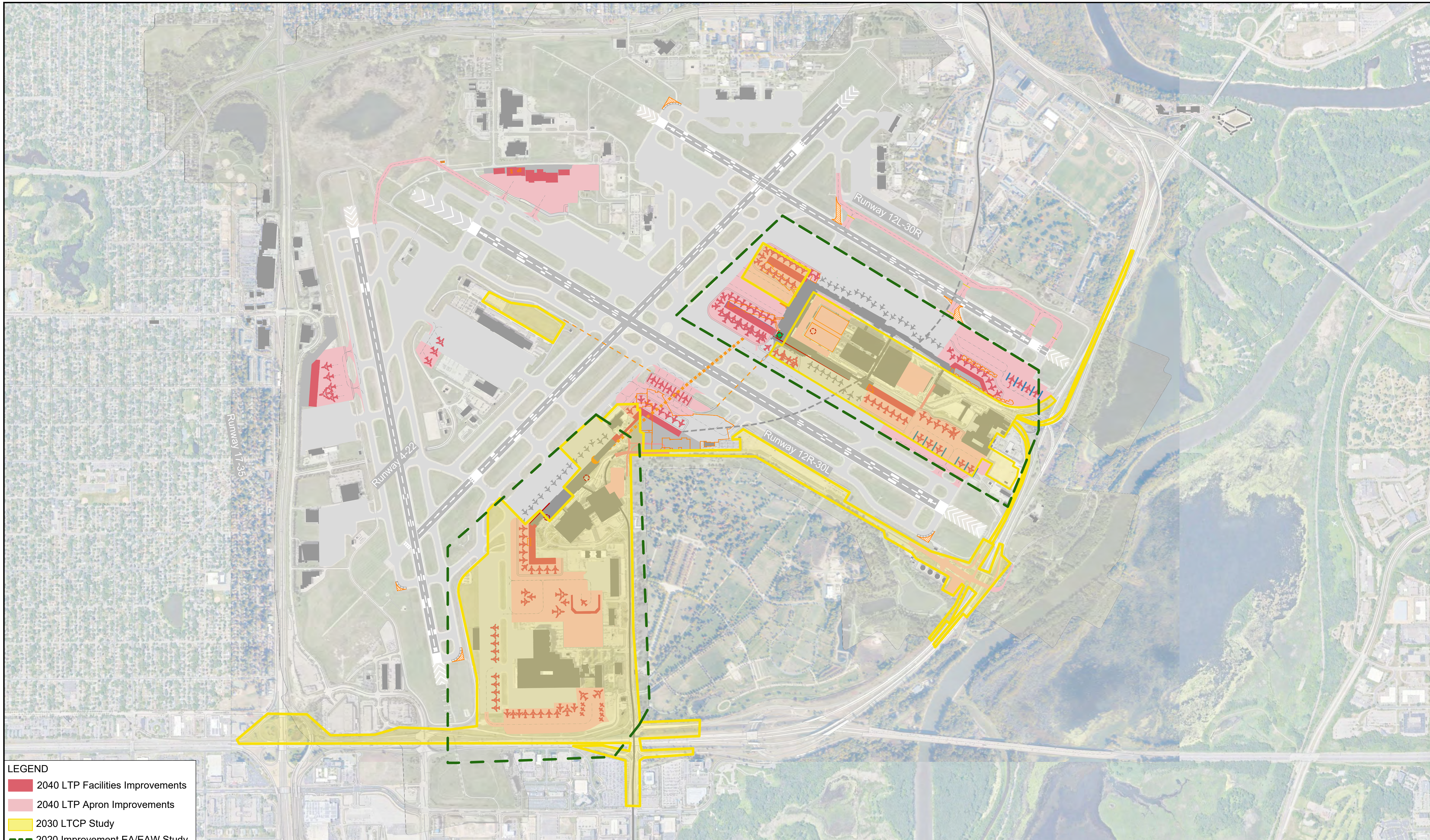
Development projects included in the 2030 LTCP which are also in the 2040 LTP include:

- North and south extensions of T2
- South extension of the G Concourse
- Improvements to the T1 and T2 Terminal for ticketing, baggage, security, and Federal Inspection Services (FIS)
- Redevelopment and expansion of arrivals curbs for both T1 and T2
- Redevelopment of the Green/Gold Ramps
- Redevelopment of the U.S. Postal Service area
- Additional multi-level parking garages at both T1 and T2
- Interchange improvements at I-494 and 34th Avenue South
- Interchange improvements at John A. Johnson Memorial Highway and Post Road
- Improvements at the intersection at 34th Avenue and 70th Street

Additional development projects beyond the 2030 LTCP that are were in the 2020 EA/EAW Preferred Development which are in the 2040 LTP include:

- Relocation of the 30L deicing pad
- Redevelopment of Concourse E
- Reconfiguration of the 34th Avenue. South/East 70 Street and Humphrey Drive/East 70th Street intersections
- Relocation of the Ground Runup Enclosure (GRE)/Construct Remain Overnight (RON) Aircraft Apron

Though these projects from the 2030 LTCP and the 2040 LTP do differ in some respects, the study area envelope for the projects in each study are consistent. The comparison between the 2030 LTCP study area and the 2040 LTP is depicted in **Exhibit 5-1**.



SOURCE: Metropolitan Airports Commission, 2022 (basemap); HNTB, 2022 (Aerial Imagery and Airfield Geometry), Kimley-Horn and Associates, Inc., 2022 (Landside Geometry); Ricondo & Associates, Inc., 2022

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EXHIBIT 5-1
2020 EA/EAW Comparison to 2040 LTP

5.2 AIRCRAFT NOISE

5.2.1 Quantifying Aircraft Noise

Sound is energy transferred through the air that our ears detect as small changes in air pressure. A sound source vibrates or otherwise disturbs the air immediately surrounding the source, causing variations in pressure above and below the static (at-rest) value of atmospheric pressure. These disturbances force air to compress and expand setting up a wavelike movement of air particles that move away from the source. Sound waves, or fluctuations in pressure, vibrate the eardrum creating audible sound.

Noise is sound that is unwanted. Noise has both a measurable, physical component as well as a subjective component that takes account of an individual's reaction to a sound. For example, the same sound can be pleasant for one person and annoying to another. Even sounds that are pleasant at one volume can become annoying as they get louder.

Sound levels are measured in decibels (dB), which is a logarithmic scale of energy referenced to human hearing. The dB scale accounts for the range of hearing with values from 0 dB to around 200 dB. Most human hearing of sound experience falls into the 30 dB to 120 dB range.

Decibels are logarithmic, and thus cannot be added directly. Two identical noise sources each producing 70 dB do not add to a total of 140 dB, but to 73 dB. Each time the number of sources is doubled, the sound pressure level increases 3 dB.

- 2 sources: 70 dB + 70 dB = 73 dB
- 4 sources: 70 dB + 70 dB + 70 dB + 70 dB = 76 dB
- 8 sources: 70 dB + 70 dB + 70 dB + 70 dB + 70 dB + 70 dB + 70 dB + 70 dB = 79 dB

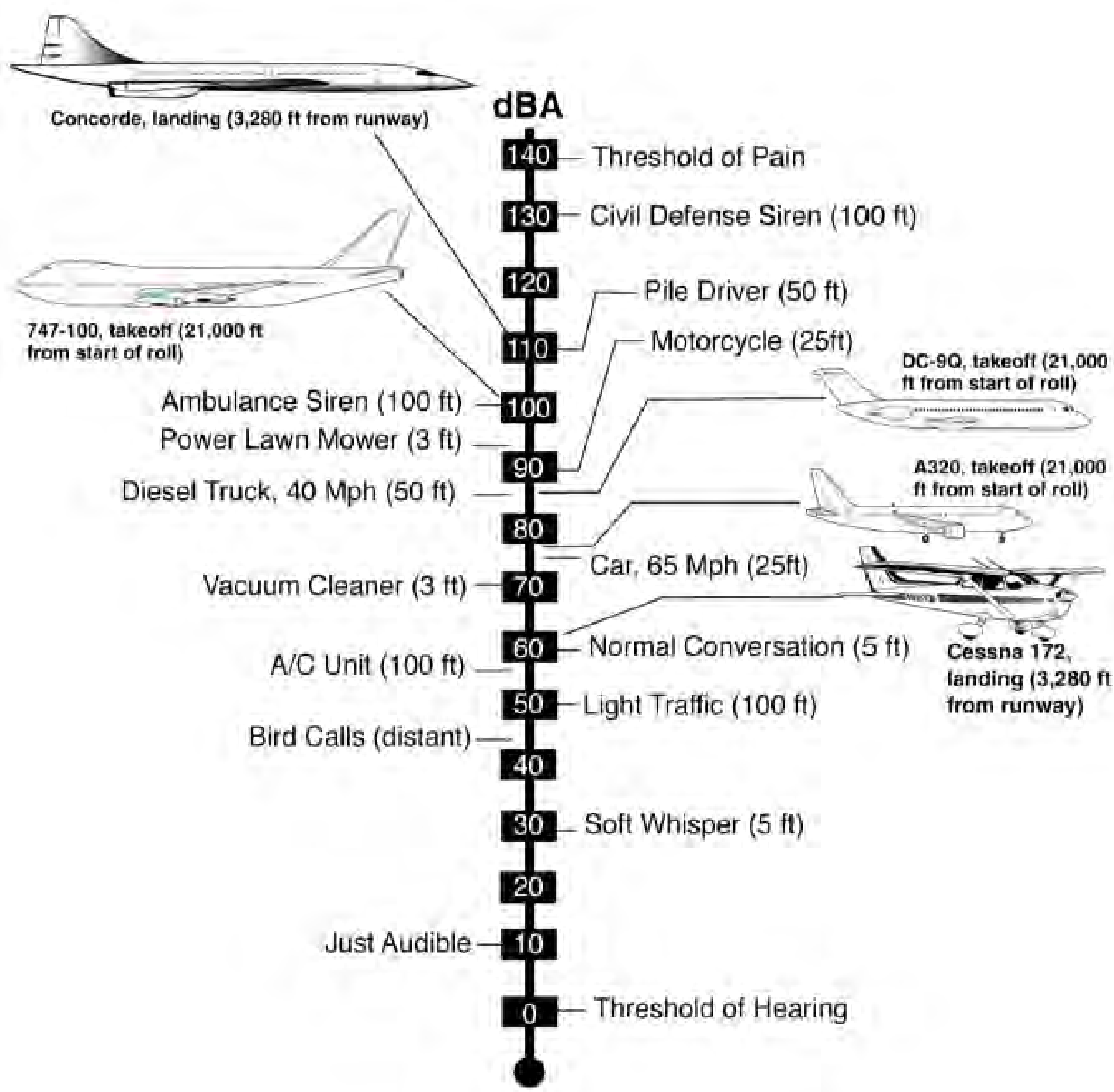
The just-noticeable change in loudness for normal hearing adults is about 3 dB. That is, changes in sound level of 3 dB or less are difficult to notice. A doubling of loudness for the average listener of A-weighted sound is about 10 dB[1]. Measured, A-weighted sound levels changing by 10 dBA result in a subjective perception of being "twice as loud."[2]

Exhibit 5-2 provides the noise levels for various common sources.

[1] A-weighted decibels represent noise levels that are adjusted relative to the frequencies that are most audible to the human ear.

[2] Peppin and Rodman, Community Noise, p. 47-48; additionally, Harris, Handbook, Beranek and Vér, Noise and Vibration Control Engineering, among others.

Exhibit 5-2: Sound Levels of Typical Noise Sources



SOURCE: Metropolitan Airports Commission, 2022

5.2.1 Day-Night Average Sound Level (DNL)

Through the Aviation Safety and Noise Abatement Act (ANSA) of 1979, Congress directed the Federal Aviation Administration (FAA) to establish a single metric for assessing land use compatibility with respect to noise from aircraft operations and to establish standards and methods for assessing the noise environment associated with ongoing aircraft operations near airports. In 1981, the FAA implemented the ANSA provisions. These are published at 14 Code of Federal Regulations (CFR), Part 150 (“Part 150”).

This regulation adopted the Day-Night Average Sound Level (DNL) metric. The DNL metric reflects a person's cumulative exposure to sound over a 24-hour period. The metric uses aircraft operations over the course of the year to calculate noise exposure for an average annual day. To account for a higher sensitivity to noise exposure at night (10:00 PM to 7:00 AM), DNL calculations add 10 times weighting for each nighttime flight. This equates to each nighttime flight being measured as if 10 daytime flights had occurred. Due to the logarithmic scale of decibels, this is equivalent to adding 10 decibels to nighttime flights.

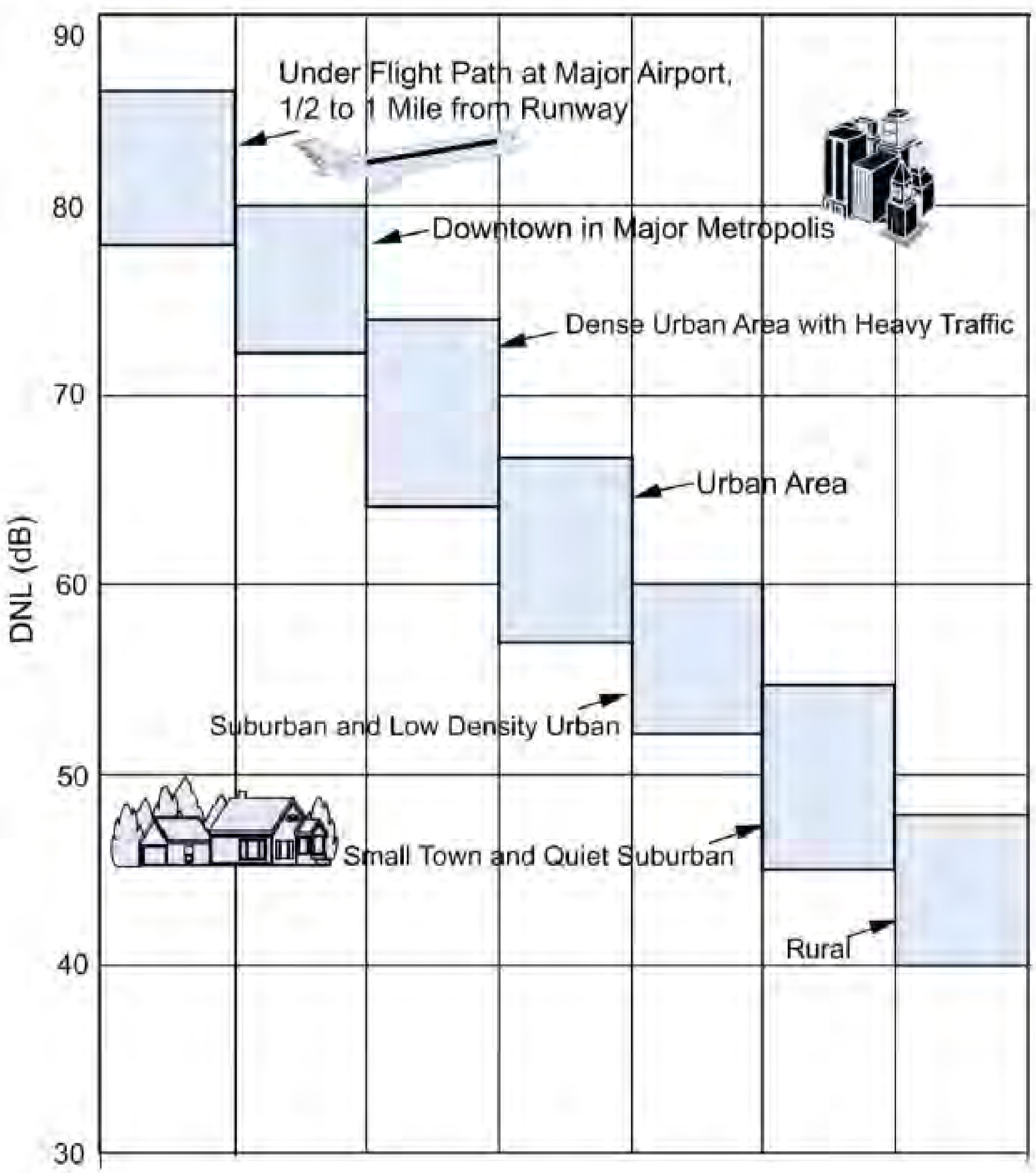
The FAA also established land use compatibility guidelines for aircraft noise, determining 65 A-weighted decibels (dB) DNL is the threshold of significant noise exposure, and thus would be incompatible with residential and other noise-sensitive land uses.

Exhibit 5-3 provides examples of typical DNL levels in various environments.

Currently, the FAA requires the DNL metric be used in a variety of policy objectives, including assessment, identification, and mitigation of incompatible land uses in the vicinity of civil airports, and evaluation of environmental consequences that would occur if changes to aircraft operations or airfield infrastructure near an airport were implemented. DNL has also been formally adopted by most federal agencies dealing with noise exposure, such as the U.S. Environmental Protection Agency (EPA), U.S. Department of Defense, U.S. Department of Housing and Urban Development, and Veterans Administration.

MSP is unique relative to noise mitigation provided to incompatible residential land uses around the airport. This is due to the conditions of a consent decree that settled noise mitigation litigation in 2007. Since this settlement, the MAC has provided noise relief to eligible homes within the 60 dB DNL contour (five dB beyond the federal requirement). The MSP Noise Mitigation Program has been amended three times and is currently in place until 2032.

Exhibit 5-3: Typical Outdoor Community Day-Night Average Sound Levels



SOURCE: U.S. Department of Defense. Departments of the Air Force, the Army, and the Navy, 1978. *Planning the Noise Environment*. AFM 19-10. TM 5-803-2, and NAVFAC P-970.

5.2.1 MSP Noise Reduction Efforts

The MAC has a long history of working with community stakeholders, airport users, the FAA, and other government entities to address aircraft noise issues. These efforts date back to before 1970 and include operational noise abatement and land use measures.

Noise abatement measures are those that affect the shape and size of the noise contours. A voluntary Noise Abatement Plan is in place to promote aircraft operating procedures that help reduce aircraft noise and overflights for residents living near MSP. There are a total of 12 voluntary noise abatement procedures in place at MSP. A description of these procedures is available at metroairports.org/msp-noise-abatement-efforts.

Beginning in 1992, the MAC's efforts included land use management measures, which are measures that address incompatible land use that remains after the implementation of noise abatement measures. The MAC's most notable land use measure is the delivery of noise reducing modifications to homes, apartment buildings and schools around MSP. The MAC's work in this area is the most expansive in the country and represents the most direct form of tangible relief to neighbors most affected by aircraft noise from MSP air traffic.

Between 1992 through January 2023, the MAC's noise mitigation program has provided noise relief to almost 20,000 single- and multi-family homes and 19 schools around MSP at a total cost of over $513 million.

In 2021, the MAC committed to continue providing noise relief to qualifying homes through 2032. For a home to qualify, it must be located, for a period of three consecutive years in the actual 60 DNL aircraft noise contour published in an annual noise contour report, and, be located within a higher noise impact area when compared to the home's status under a previous phase of the program.

The 2040 Forecast scenarios noise contours and analysis contained in this report do not qualify homes for the MAC's noise mitigation program. Eligibility for noise relief provided by the MAC is determined annually, based upon actual MSP noise contours developed for the preceding calendar year.

5.3 NOISE CONTOUR DEVELOPMENT

5.3.1 Aviation Environmental Design Tool

The noise contours presented in this document were developed using the FAA's AEDT.

The AEDT model produces DNL noise contours depicting an annualized average day of aircraft noise impacts. The model uses operational information such as runway use, flight track use, aircraft type, aircraft performance and thrust settings and operation time of day as inputs. The model also considers environmental variables, such as topography and atmospheric conditions. Quantifying aircraft-specific noise characteristics in AEDT is accomplished using a comprehensive noise database that has been developed under 14 CFR Part 36. As part of the airworthiness certification process, aircraft manufacturers are required to subject aircraft to a battery of noise tests. Using federally adopted and endorsed methodology, this aircraft-specific noise information is used in the generation of DNL contours. Justification for this approach is rooted in national standardization of noise quantification at airports.

The 2040 Forecast scenarios noise contours were developed using AEDT version 3e, which is the most current version released by the FAA. The noise contours developed for the 2018 Base Year, as developed in the MAC's 2018 Annual Noise Contour Report, were developed using AEDT version 2d, which was the most current version at the time of its development (January 2019).

Updates made to the aircraft fleet database are the primary change between these versions. AEDT 3e includes the following aircraft types, which were not available in AEDT 2d:

- Gulfstream 650ER
- Boeing 737 MAX 8
- Airbus A320-271N
- Airbus A320-272N
- Falcon 900EX
- ATR72-212A
- Boeing 767-300ER
- Boeing 747-400RN
- Boeing 787-900

The number of operations by new or updated noise aircraft types account for approximately 18.4% of the 2018 Base Year operations and 26.7% of the projected 2040 operations. Noise aircraft types are one of the most critical components in AEDT as they represent aircraft performance and associated noise levels. It is expected that the new and updated noise aircraft types would introduce the most significant change from AEDT 2d to AEDT 3e. However, their impacts are expected to be relatively minor as the noise aircraft types they replace have similar performance and noise characteristics.

Another change between the AEDT versions include weather inputs. Default weather parameters were applied in both the 2018 Base Year and 2040 Forecast scenarios noise analyses. The default weather parameters in AEDT 2d (used in the 2018 Base Year) represent 30-year average weather readings at the MSP weather station. The default weather parameters in AEDT 3e represent a 10-year average at the same weather station. The resultant weather inputs are similar and would have minimal impacts on the noise contour results.

5.3.2 Aircraft Activity Levels

The MAC owns and operates a Noise and Operations Monitoring System (MACOMS). In addition to monitoring noise levels at 39 remote sound monitoring stations located around MSP, the system collects flight track data to approximately 40 miles around the Airport up to 20,000 feet. MACNOMS flight track data in the vicinity of MSP was used in the AEDT modeling for both the 2018 Base Year and to aid in the development process of the AEDT input file for the 2040 Forecast scenarios noise contours.

Activity forecasts were developed to identify a potential range of demand scenarios for aviation services to the year 2040. Chapter 2 discusses the forecasts and the inherent uncertainty in predicting the level of air traffic demand for the next 20 years. Three scenarios were developed in the forecast, which consider this uncertainty and promote efficiency and flexibility.

The 2040 Revised Forecast is the expected outcome and is the forecast contour that is used in the noise impact analysis. A 2040 high scenario was developed, which reflects demand growth driven by the most optimistic socioeconomic drivers. Lastly, a 2040 low scenario was developed, which is informed by more conservative forecasts used for the financial planning process. This generally reflects lower demand, due to an assumption of reduced hub connectivity. The forecast operations range from 460,600 in the low scenario to 554,900 in the high scenario. All three forecast scenarios were used to develop DNL contours to display a range potential of noise impact levels 20 years into the future.

As summarized in **Table 2-11** in **Chapter 2**, the total number of MSP operations in the 2018 Base Year is 406,913 (1,115 average daily flights) and the 2040 Forecast scenarios total operations ranges from 460,600 (1,262 average daily flights) in the low scenario to 554,900 (1,520 average daily flights) in the high scenario. The baseline forecast number of total operations is 509,700 (1,396 average daily flights).

5.3.3 Fleet Mix

The 2018 Base Year fleet mix was based on 2018 annual MACNOMS data. MACNOMS annual operations were 0.4% lower than the operations number reported in the FAA's Operations Network (OPSNET). To rectify the numbers, MACNOMS data was adjusted upward to equal the OPSNET number.

The Baseline Forecast High scenario, and Low scenario operations were based on the 2040 Long-Term Plan activity forecast3 (2040 LTP Forecast). Details about the forecast are provided in Chapter 2 of this document.

A summary of the 2018 Base Year and 2040 Forecast scenario fleet mixes are provided in **Table 5-1**. A more detailed presentation of the 2018 Base Year aircraft fleet mix is provided in **Chapter 2**.

The use of newer and quieter aircraft is expected to increase over the 20-year forecast. In 2018, there were 283 operations in the Boeing 737 MAX 8. According to Boeing, the 737 MAX aircraft variants are 40% quieter than the B737-800 jets. The 2040 baseline forecast includes 10,950 operations in the B737 MAX family of aircraft.

Additionally, 1,400 Airbus A320neo ("new engine option") operations occurred in 2018. According to Airbus, the A320neo is 50% quieter than the current engine option. By 2040, MSP is anticipated to have approximately 95,600 operations in A319, A320 and A321 NEOs.

The AEDT model includes a group of representative aircraft and helicopter types with noise parameters. For this analysis, aircraft types were assigned to the AEDT model aircraft. The model also provides pre-approved aircraft substitutions for instances where an aircraft type does not have a direct match with the model aircraft types. AEDT version 3e, which was used to develop the 2040 Forecast scenarios, does not have a noise profile for the B737 MAX 10. A conservative approach was taken consistent with FAA guidance, to input the B737 MAX 8 noise parameters in place of the B737 MAX 10. All nonstandard aircraft substitutions in AEDT were approved by the FAA Office of Energy and Environment.

[3] Minneapolis-Saint Paul International Airport, 2040 Long-Term Plan: Activity Forecast Summary Technical Memorandum, Ricondo, November 2021.

5.3.4 Day/Night Split of Operations

The DNL metric adds a 10 decibel (dB) penalty to noise events occurring at night (between 10 p.m. and 7 a.m.). It is important to separate aircraft operations over the course of a year into daytime or nighttime operations, creating a day/night split.

The split of daytime and nighttime operations for the 2018 Base Year was determined from MACNOMS flight track data for MSP. A summary of the day/night splits for the 2018 Base Year Condition and the 2040 Forecast scenarios are provided in **Table 5-1**. A more detailed report of the 2018 Base Year and 2040 Forecast scenario day/night splits are provided in **Appendix D**.

The percentage of nighttime operations is expected to increase slightly from 11% in 2018 to approximately 12% in 2040 as a result of increased nighttime operations projected in the design day flight schedule.

Table 5-1: Summary of Average Daily Flight Operations

Average Daily Flight Operations	Day	Night	Total	% of Total Operations
2018 Base Year Condition				
Manufactured to be Stage 3+	953	117	1,071	96%
Hushkit Stage 3 Jets	0	1	1	0%
Microjet	1	0	1	0%
Propeller	38	2	40	4%
Helicopter	0	0	0	0%
Military	2	0	2	0%
Total	*995*	*120*	*1115*	*100%*
% of Total Operations	*89%*	*11%*	*100%*	
2040 Baseline Forecast Scenario				
Manufactured to be Stage 3+	1,194	157	1,351	97%
Hushkit Stage 3 Jets	0	0	0	0%
Microjet	1	0	1	0%
Propeller	34	3	37	3%
Helicopter	0	0	0	0%
Military	7	1	7	1%
Total	*1,236*	*161*	*1,396*	*100%*
% of Total Operations	*88%*	*12%*	*100%*	
2040 High Forecast Scenario				
Manufactured to be Stage 3+	1,301	171	1,472	97%
Hushkit Stage 3 Jets	0	0	0	0%
Microjet	1	0	1	0%
Propeller	36	43	39	3%
Helicopter	0	0	0	0%
Military	7	1	8	1%
Total	*1,345*	*175*	*1,520*	*100%*
% of Total Operations	*88%*	*12%*	*100%*	
2040 Low Forecast Scenario				
Manufactured to be Stage 3+	1,075	142	1,218	96%
Hushkit Stage 3 Jets	0	0	0	0%
Microjet	1	0	1	0%
Propeller	33	43	35	3%
Helicopter	0	0	0	0%
Military	7	1	8	1%
Total	*1,116*	*146*	*1,262*	*100%*
% of Total Operations	*88%*	*12%*	*100%*	

NOTES:
Number is shown as 0 when less than 0.5. Totals may differ due to rounding.
SOURCES: MACNOMS Flight Track Data (2018 Base Year); 2040 Long-Term Plan: Activity Forecast Summary Technical Memorandum, Ricondo, Nov. 2021 and HNTB analysis, 2022 (2040 Forecast scenarios).

5.3.5 Runway Use

Runway use represents how aircraft utilize the runway(s) and helipad(s) at an airport and is a primary factor determining noise exposure. FAA Air Traffic Control determines the runway use throughout the year for arrival and departure operations.

Prior to 2005 when Runway 17/35 opened, arrival and departure operations at MSP occurred on the parallel runways (12L/30R and 12R/30L) in a manner that resulted in approximately 50% of the arrival and departure operations occurring to the northwest over south Minneapolis and 50% to the southeast over Mendota Heights and Eagan. Because of the dense residential land uses to the northwest and the predominantly industrial/commercial land uses southeast of MSP, there was a concerted effort to focus departure operations over areas to the southeast as the preferred operational configuration. This tactic proved to affect fewer sensitive land uses and people from an aircraft noise perspective.

Runway 17/35 opened at MSP in October 2005 and provided FAA with new runway use options. The use of the runways has changed over time as a natural result of weather and operational variables.

One noise abatement procedure in place at MSP is the Runway Use System (RUS). The RUS prioritizes arrival and departure runways to promote flight activity over less-populated residential areas as much as possible.

The RUS was updated in 2005 to coincide with the opening of Runway 17/35. For departures, Runways 12L and 12R are the first priority (Priority 1) since aircraft are directed over non-residential (industrial use) areas to the southeast immediately after takeoff. Runway 17 is the second priority (Priority 2) departure runway and is used for departures to the south to augment the flow of air traffic using the parallel runways. The Minnesota River Valley and commercial land uses in Bloomington provide another opportunity to route aircraft over an unpopulated area. There are, however, residential areas to the south, impacted by Runway 17 departures turning eastbound after crossing the Minnesota River.

Runway uses in 2040 Forecast scenarios by airlines and aircraft were assumed to be consistent with the 2018 Base Year runway use. For aircraft not included in the 2018 Base Year fleet mix, it was assumed that their runway use would be the same as the aircraft they are expected to replace or similar aircraft types.

Table 5-2 compares the runway use in 2018 Base Year and 2040 Forecast scenarios. In general, the projected 2040 Forecast scenarios runway use is consistent with the 2018 Base Year runway use with minor variances. Compared with the 2018 Base Year runway use, the 2040 Forecast scenarios departures from Runway 12L decrease by approximately 1.7% and, from Runway 30L, increase by approximately 1.5%-1.6%. The 2040 Forecast arrivals to Runway 30L increase by approximately 1.4%-1.6%. Changes in other runways are less than 1%.

A more detailed presentation of the 2018 Base Year condition and 2040 Forecast scenarios runway use are provided in **Appendix D**.

Table 5-2: Summary of Average Annual Runway Use

Average Annual Runway Use %	Arrivals			Departures		
	Day	Night	Total	Day	Night	Total
2018 Base Year Condition						
Runway 4	0.1%	0.3%	0.1%	0.5%	1.0%	0.5%
Runway 12L	22.2%	14.2%	21.3%	14.2%	18.6%	14.7%
Runway 12R	25.6%	27.5%	25.8%	4.1%	24.9%	6.2%
Runway 17	0.0%	0.6%	0.1%	36.3%	11.7%	33.8%
Runway 22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Runway 30L	24.8%	34.7%	25.9%	23.2%	25.0%	23.4%
Runway 30R	21.9%	16.6%	21.3%	21.6%	18.5%	21.3%
Runway 35	5.4%	6.1%	5.5%	0.0%	0.2%	0.0%
2040 Baseline Forecast Scenario						
Runway 4	0.0%	0.2%	0.1%	0.5%	0.9%	0.5%
Runway 12L	21.2%	15.4%	20.5%	12.3%	18.3%	13.0%
Runway 12R	26.7%	25.2%	26.5%	4.8%	22.0%	6.7%
Runway 17	0.0%	0.5%	0.1%	37.3%	11.0%	34.4%
Runway 22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Runway 30L	26.6%	33.4%	27.4%	24.7%	27.7%	25.0%
Runway 30R	20.8%	17.2%	20.3%	20.4%	19.9%	20.4%
Runway 35	4.7%	8.2%	5.1%	0.0%	0.2%	0.0%
2040 High Forecast Scenario						
Runway 4	0.0%	0.2%	0.1%	0.5%	0.9%	0.5%
Runway 12L	21.2%	15.4%	20.5%	12.3%	18.4%	13.0%
Runway 12R	26.7%	25.2%	26.5%	4.8%	22.0%	6.7%
Runway 17	0.0%	0.5%	0.1%	37.3%	11.0%	34.4%
Runway 22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Runway 30L	26.5%	33.3%	27.3%	24.6%	27.7%	25.0%
Runway 30R	20.8%	17.2%	20.4%	20.4%	19.9%	20.4%
Runway 35	4.7%	8.2%	5.1%	0.0%	0.2%	0.0%
2040 Low Forecast Scenario						
Runway 4	0.0%	0.2%	0.1%	0.5%	0.9%	0.5%
Runway 12L	21.2%	15.2%	20.4%	12.3%	18.2%	12.9%
Runway 12R	26.7%	25.2%	26.5%	4.9%	21.9%	6.7%
Runway 17	0.0%	0.5%	0.1%	37.2%	11.1%	34.3%
Runway 22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Runway 30L	26.6%	33.7%	27.5%	24.7%	27.8%	25.1%
Runway 30R	20.7%	17.0%	20.3%	20.4%	19.9%	20.3%
Runway 35	4.7%	8.1%	5.1%	0.0%	0.2%	0.0%

NOTES: Total may not add up due to rounding. Helicopters are excluded.
SOURCES: MAC Data and HNTB Analysis, 2022.

5.3.6 Flight Tracks

To determine projected noise levels on the ground, it is necessary to determine not only the frequency of aircraft operations, but also their altitudes and locations. Flight tracks to and from an airport are generally a function of the geometry of the airport's runways and the surrounding airspace structure near the airfield.

Actual flight track data is used to develop AEDT model tracks. The 2018 Base Year actual flight tracks are assigned to the model tracks using a geospatial best-fit analysis of the actual flight track geometry based on linear trends. This method provides the ability to match each actual flight track directly to the appropriate model track. Arrival and departure sub-tracks are added to distribute operations among the backbone and sub-tracks using a standard "bell curve" distribution based on the number of sub-tracks developed.

Flight track layout and associated use for all three 2040 Forecast scenarios were derived from the 2018 Base Year noise contour analysis. The AEDT model flight tracks used for the 2040 Forecast scenarios are the same as those used for the 2018 Base Year noise contour. The 2040 Forecast scenarios operations were then assigned to the model flight tracks based on aircraft type and airline.

Figures depicting flight track locations and additional detail related to flight track use for the 2018 Base Year and 2040 Forecast scenarios are provided in **Appendix D.**

The flight tracks used for this noise analysis did not change based on Area Navigation (RNAV) departure procedures being developed as part of the FAA's Very-High Frequency Omnidirectional Radial (VOR) Minimum Operational Network program. In January 2023, the FAA, along with representatives from airlines, air traffic control, support contractors, and the MAC, began the process of developing new satellite-based departure procedures to replace the published procedures that use the MSP VOR. The goal is to develop procedures that replicate existing flight patterns to the extent possible; therefore, differences in flight tracks are expected to be negligible in the noise contour area. These procedures will be evaluated in a separate environmental review conducted by the FAA.

5.3.7 2018 Base Year Modeled Versus Measured DNL Levels

As part of the 2018 Base Year actual noise contour evaluation, a comparison was conducted on the actual 2018 Base Year measured aircraft noise levels at the MAC's 39 sound monitoring sites to the modeled DNL noise values from AEDT. The latitude and longitude coordinates for each sound monitoring site was used to calculate modeled DNL values in AEDT.

Table 5-3 provides a comparison of the AEDT modeled DNL noise values and the actual measured aircraft DNLs at those locations in 2018.

There is an inherent difference between modeled noise results and measured noise results. AEDT modeled data only reports on aircraft noise. It cannot replicate the various other sources of community noise that exist and contribute to ambient conditions. AEDT cannot replicate the exact operating characteristics of each aircraft that is input into the model. AEDT uses average weather conditions instead of actual weather conditions at the time of the flight. AEDT also uses conservative aircraft substitutions when new aircraft are not yet available in the model. Conversely, RMT measured data is highly impacted by community sound. The MACNOMS system must set thresholds for events to attempt to eliminate occurrences of community sound events being assigned to aircraft noise. While some of the data is evaluated by staff, most events are assumed to be aircraft if a flight track existed during the time of the event. The factors that may contribute to differences include site terrain, building reflection, foliage and ground cover, ambient noise level, and atmospheric conditions. There variables will impact the propagation of sound differently.

The use of absolute values provides a perspective of total difference between the modeled values and the measured DNL values provided by MACNOMS in 2018. The median is considered the most reliable indicator of correlation when considering the data variability across modeled and measured data.

Table 5-3: 2018 Measured vs. Modeled DNL Values

Sound Monitoring Site	2018 Measured DNL (a)	2018 Modeled DNL	Difference	Absolute Difference
1	55.9	57.6	1.7	1.7
2	58.1	58.2	0.1	0.1
3	62.6	63.6	1.0	1.0
4	59.2	59.7	0.5	0.5
5	67.5	68.2	0.7	0.7
6	67.1	66.0	-1.1	1.1
7	58.8	58.1	-0.7	0.7
8	55.3	55.6	0.3	0.3
9	36.9	43.5	6.6	6.6
10	44.1	50.2	6.1	6.1
11	38.3	45.1	6.8	6.8
12	39.2	47.7	8.5	8.5
13	53.9	55.3	1.4	1.4
14	59.8	61.2	1.4	1.4
15	55.7	55.9	0.2	0.2
16	64.0	63.6	-0.4	0.4
17	44.0	49.7	5.7	5.7
18	52.4	58.9	6.5	6.5
19	48.0	54.5	6.5	6.5
20	40.8	51.3	10.5	10.5
21	44.5	50.1	5.6	5.6
22	54.9	57.6	2.7	2.7
23	60.6	60.2	-0.4	0.4
24	58.1	59.9	1.8	1.8
25	50.0	52.8	2.8	2.8
26	51.0	54.8	3.8	3.8
27	52.1	55.3	3.2	3.2
28	54.9	61.1	6.2	6.2
29	51.5	53.1	1.6	1.6
30	60.6	60.6	0	0
31	46.1	50.9	4.8	4.8
32	40.4	48.2	7.8	7.8
33	46.0	50.6	4.6	4.6
34	42.8	48.5	5.7	5.7
35	50.8	53.2	2.4	2.4
36	50.8	51.4	0.6	0.6
37	46.0	48.8	2.8	2.8
38	49.1	50.9	1.8	1.8
39	49.9	51.6	1.7	1.7
			Average	3.3
			Median	2.4

NOTES: All units in dB DNL
(a) Computed from daily DNLs
SOURCE: MAC sound monitoring data and HNTB, 2019

More differences between measured and modeled data occur at sites that have less events overall. When more data is available, that variance begins to decrease. Overall, the small variation between actual measured aircraft noise levels and the AEDT modeled noise levels provides additional system verification that AEDT is providing an accurate assessment of the aircraft noise impacts around MSP.

5.3.8 2018 Base Year Condition Noise Impacts

In the 2018 Base Year noise contours there are 638 acres within the 75 DNL contour, which is entirely contained on airport property. The 70 DNL contour contains approximately 1,588 acres. The 65 DNL contour contains approximately 4,444 acres. The 60 DNL contour contains approximately 11,323 acres.

While the FAA considers residential structures incompatible within the 65 DNL noise contour, the MAC's noise mitigation program at MSP Airport offers residential noise mitigation to the 60 DNL level.

A depiction of the 2018 Base Year noise contour is provided in **Exhibit 5-4.**

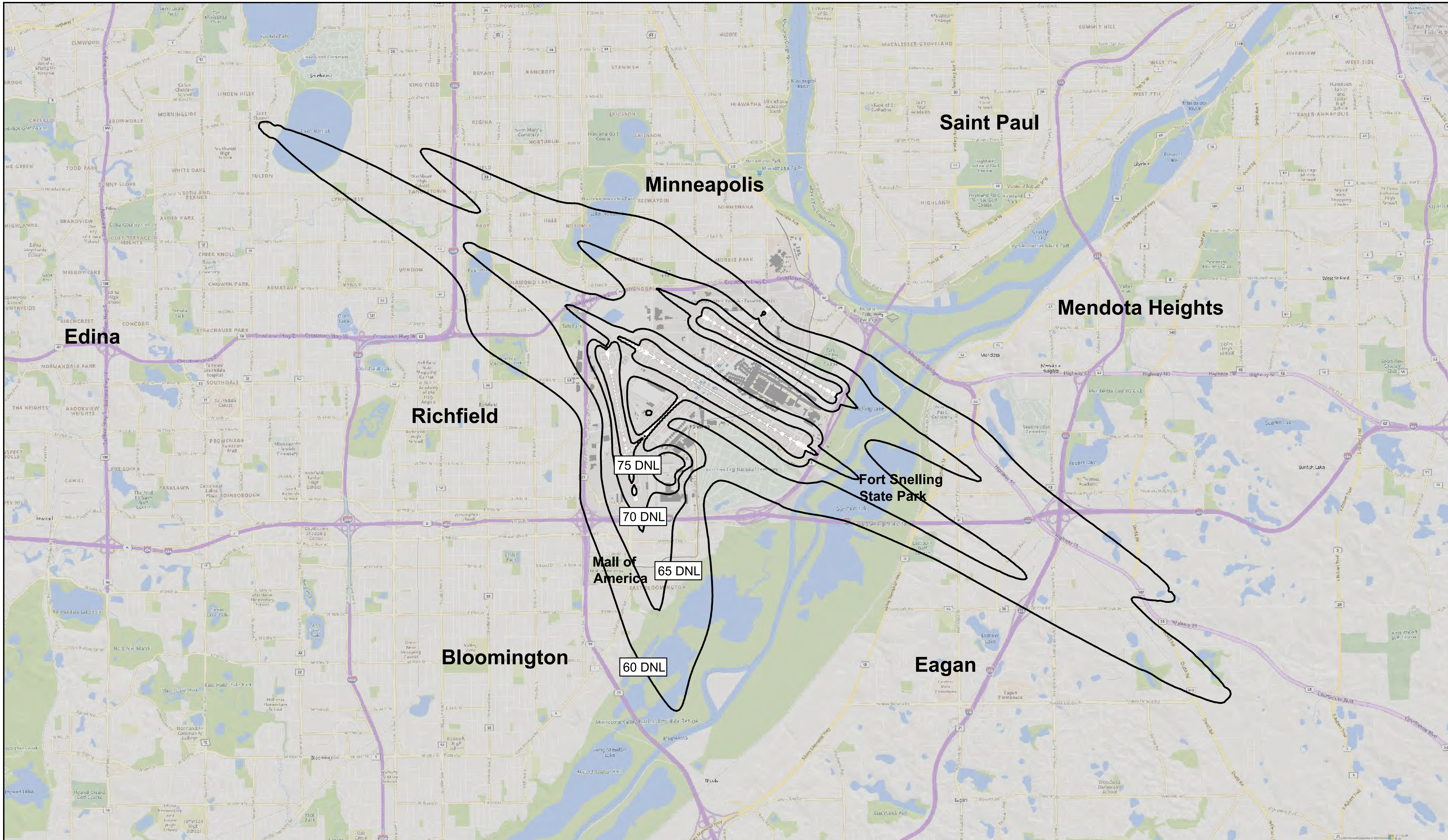
Table 5-4 contains the count of residential units in the 2018 Base Year noise contours. The analysis is based on parcels intersect methodology where all parcels that are within or touched by the noise contour are counted.

Table 5-4: 2018 Base Year Noise Impact Summary

	Single-Family					Multi-Family				
City	**60-64**	**65-69**	**70-74**	**75+**	**Total**	**60-64**	**65-69**	**70-74**	**75+**	**Total**
Bloomington	13	-	-	-	13	1,377	-	-	-	1,377
Eagan	258	1	-	-	259	-	-	-	-	-
Mendota Heights	46	1			47					-
Minneapolis	6,703	957	-	-	7,660	1,540	256	-	-	1,796
Richfield	582	4			586	184				184
Total	***7,602***	***963***	**-**	**-**	***8,565***	***3,101***	***256***	**-**	**-**	***3,357***

NOTES: Parcel intersect method. Single-family units defined as one unit per structure. Multi-family units defined as greater than one unit per structure. The spatial analysis was performed in Universal Transverse Mercator (UTM Zone 15).
SOURCE: HNTB provided AEDT contours; Metropolitan Council parcel data, Jan 2023; MAC analysis, 2023

The 2018 Base Year contour qualified 243 residences to become eligible for the MAC's noise mitigation program. Another 313 residences were within the 2018 Base Year 60 DNL contour and at a higher noise impact area for one year; however, these homes did not stay in higher noise impact areas in 2019 and were not eligible to receive noise relief from the MAC.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries); Ricondo & Associates, Inc., December 2022.

MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT

2040 LONG-TERM PLAN

N

0 5,000' 10,000'

MARCH 2023

EXHIBIT 5-4

2018 Base Year Noise Contours

5.3.9 2040 Forecast Scenarios Noise Impacts

All three forecast scenarios (2040 Baseline, High and Low) were used to develop DNL contours to display a range potential of noise impact levels 20 years into the future.

A depiction of the three 2040 forecast scenarios is provided in **Exhibit 5-5**.

In the 2040 Baseline Forecast noise contours there are 826 acres within the 75 DNL contour, which is entirely contained on airport property. The 70 DNL contour contains approximately 2,212 acres. The 65 DNL contour contains approximately 5,933 acres. The 60 DNL contour contains approximately 15,775 acres.

A depiction of the 2040 Baseline Forecast noise contour is provided in **Exhibit 5-6.**

Table 5-5 contains a summary of the 2040 Baseline Forecast noise impact. The analysis followed the same methodology and definitions as the 2018 Base Year analysis described above.

Table 5-5: 2040 Baseline Forecast Noise Impact Summary

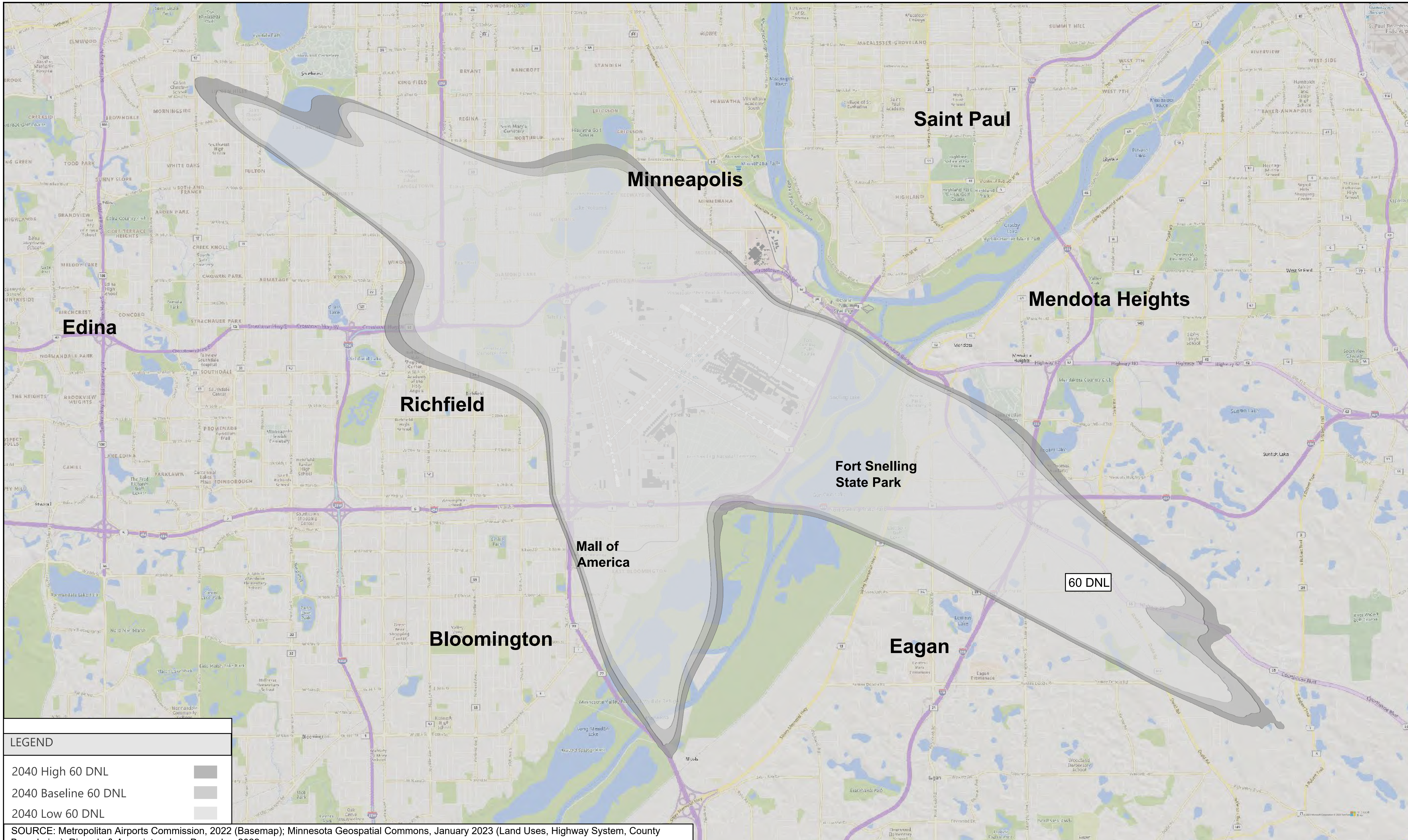
	Single-Family					Multi-Family				
City	60-64	65-69	70-74	75+	Total	60-64	65-69	70-74	75+	Total
Bloomington	94				94	1,895				1,895
Eagan	586	4			590					
Inver Grove Heights	63				63					
Mendota Heights	48	1			49					
Minneapolis	9,752	2,251	49		12,052	2,745	743	4		3,492
Richfield	1,506	116			1,622	585				585
Total	***12,049***	***2,372***	***49***	***-***	***14,470***	***5,225***	***743***	***4***	***-***	***5,972***

Notes: Parcel intersect method. Single-family units defined as one unit per structure. Multi-family units defined as greater than one unit per structure. The spatial analysis was performed in Universal Transverse Mercator (UTM Zone 15).

Source: HNTB provided AEDT contours; Metropolitan Council parcel data, Jan 2023; MAC analysis, 2023

Of the 14,470 single-family homes within the 2040 Baseline Forecast 60 DNL contour, there are 1,388 that are outside the area mitigated by the MAC's noise mitigation program. All single-family homes within the 2040 Baseline Forecast 65 DNL contour have been eligible for the MAC's 5 dB noise reduction package. Of the 5,972 multi-family units within the 2040 Baseline Forecast 60 DNL contour, there are 649 that are outside the area mitigated by the MAC's noise mitigation program.

A comparison of the 2018 Base Year and 2040 Baseline Forecast noise contours is shown in **Exhibit 5-7**.



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries); Ricondo & Associates, Inc., December 2022.

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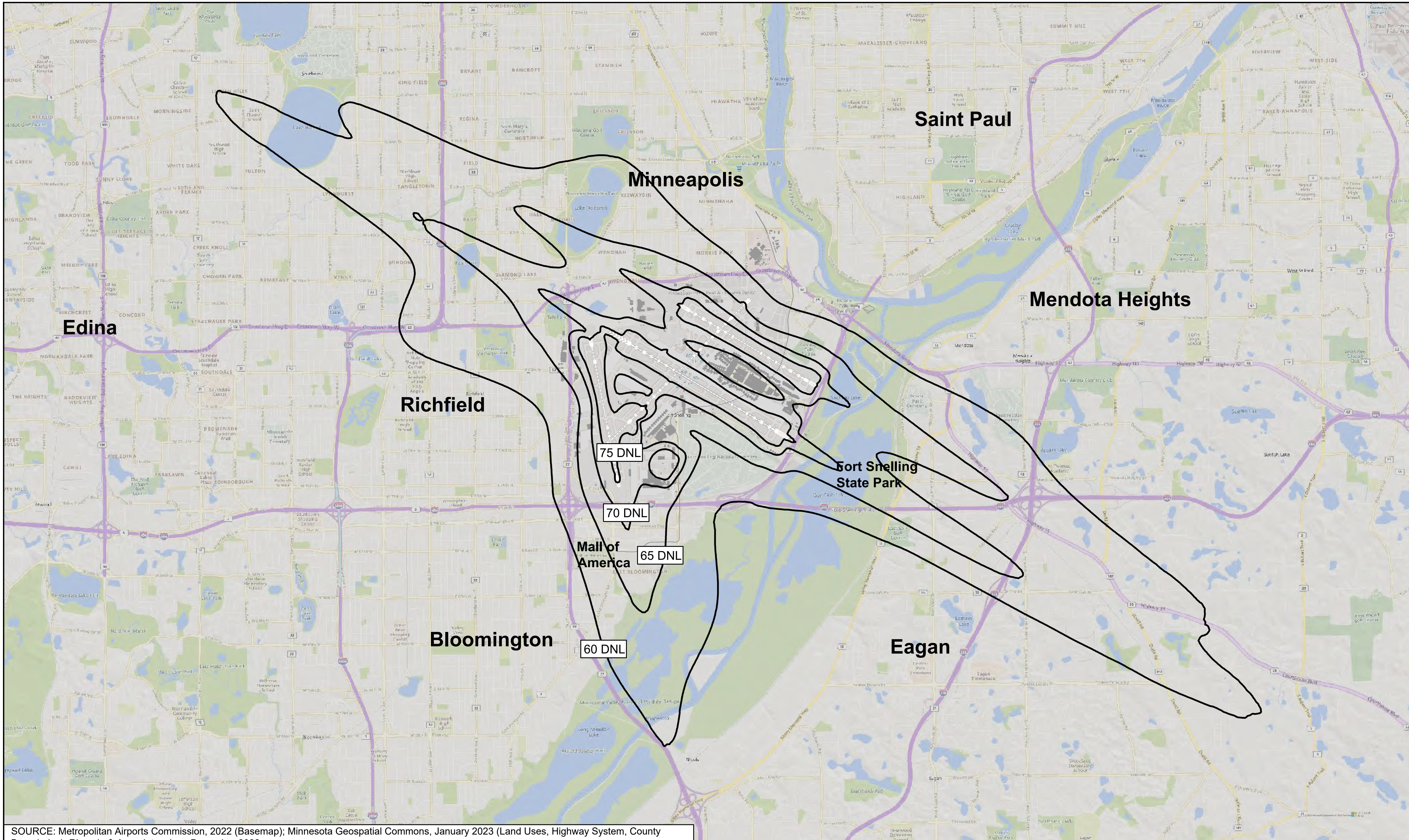
2040 LONG-TERM PLAN

MARCH 2023

EXHIBIT 5-5
2040 Forecast Scenarios Noise Contours



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries); Ricondo & Associates, Inc., December 2022.

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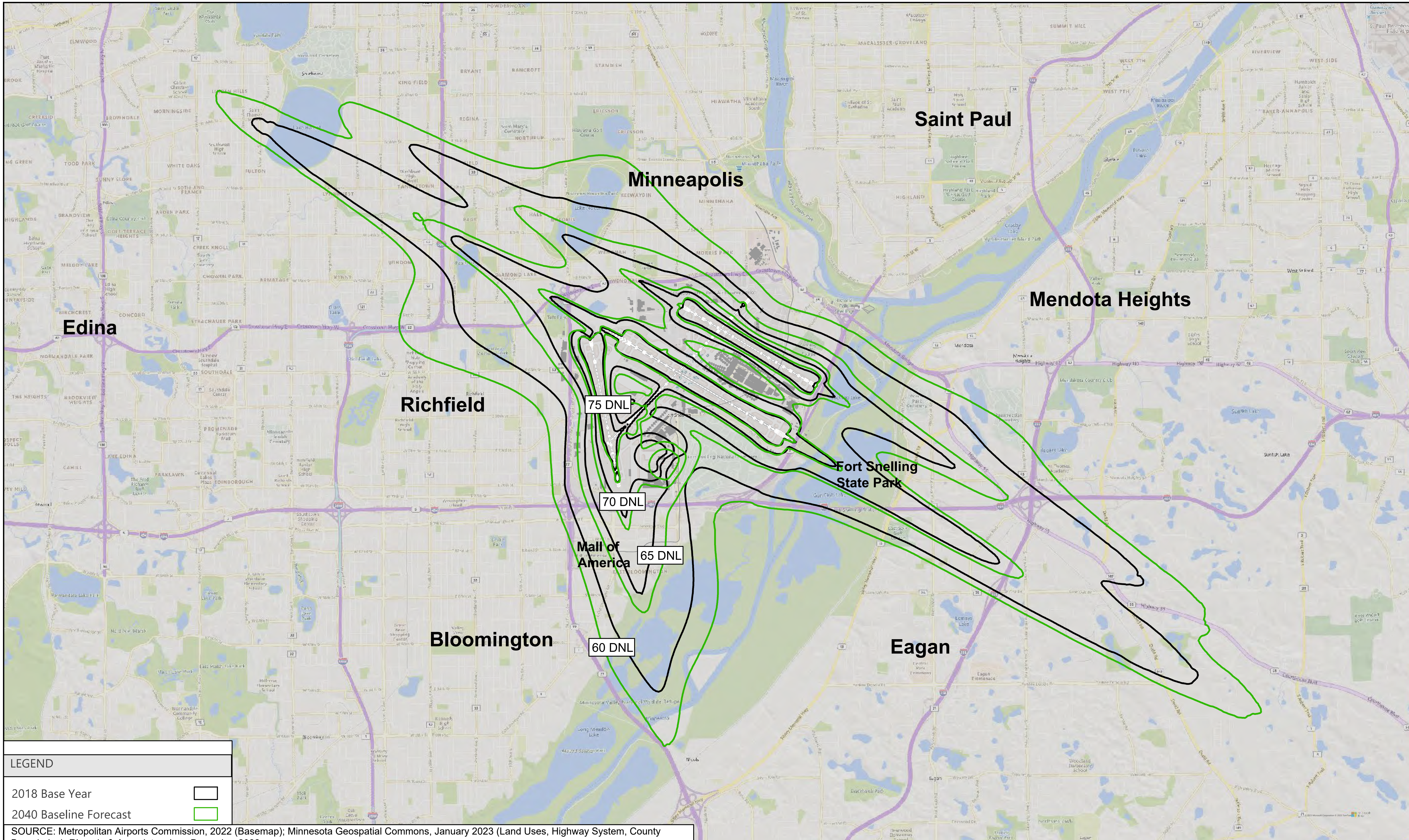
EXHIBIT 5-6
2040 Baseline Forecast Noise Contours



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries); Ricondo & Associates, Inc., December 2022.

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2040 LONG-TERM PLAN

N 0 5,000' 10,000'

MARCH 2023

EXHIBIT 5-7
2018 and 2040 Noise Contours Comparison

5.4 AIR QUALITY

This section reviews the methodologies and results of the air quality impact analyses that are presented in Section 5.1 of **Appendix B**, which was published in January 2013 (for additional details reference the appendix). Regarding the regulatory background, the main regulating rulings include NEPA and the Clean Air Act of 1970 (CAA). National Ambient Air Quality Standards (NAAQS) were used to establish criteria for pollutants. A criteria pollutant emissions inventory, including operational emissions and construction emissions, was used to evaluate the alternatives reviewed in this report (referred to as Action Alternatives).[4] Air quality thresholds of significance are based on the NAAQS / Minnesota Ambient Air Quality Standards (MAAQS) and the General Conformity Rule, as they relate to carbon monoxide (CO) and other pollutants. The Minnesota Pollution Control Agency (MPCA) operates ambient monitoring stations as part of the statewide air monitoring program.

At the time of the publication of **Appendix B**, the MAC functioned under an Option D Registration Permit, and based on forecast emissions, the MAC was not forecast to exceed permit thresholds. As explained earlier in this chapter, because 2040 operations were forecast as less than the operations forecasts used for **Appendix B**, the thresholds should not be exceeded (as long as the regulations used remain valid).

5.4.1 Aircraft, Ground Service Equipment, and On-Site Roadway Emissions

As part of its statewide air monitoring program, the MPCA runs ambient (outdoor) air quality monitoring stations. The closest monitoring stations to MSP are at the Hans Christian Andersen School and Ramsey Health Center. These stations document levels of U.S. Environmental Protection Agency (EPA) criteria air pollutants. All concentrations of pollutants are within the NAAQS. In May 2006, the MPCA published a study of ambient monitoring conditions near MSP. This study measured air toxins and criteria pollutants. The locations of the study included Wenonah School, Richfield Middle School, and two areas within the Airport property. The median and average concentrations of pollutants observed near MSP were comparable to other monitored locations in the Twin Cities metropolitan area.

The air quality study area differs by emission source (i.e., aircraft, ground service equipment [GSE], motor vehicles) and pollutant. Aircraft emissions during the modes of a landing/takeoff cycle reach the atmospheric mixing height of approximately 3,000 feet. This altitude stretches approximately 1.5 miles past the runway ends, depending on the aircraft type. GSE emissions are mainly restricted to the main terminal aprons and cargo facilities, whereas on-site motor vehicle emissions are mostly constricted to the on-site roadways, terminal curbsides, and parking facilities.

Because Airport-related motor traffic can potentially impact off-site intersections, the air quality study included several regional roadways near MSP: I-494, TH 77, TH 62, and TH 5. The following information summarizes the 2010 baseline conditions within the study area.

The total baseline (2010) emissions were measured as follows: 5,818 tons per year of CO; 407 tons per year of volatile organic compounds (VOCs); 2,027 tons per year of nitrogen oxide (NO_x);

[4] Action Alternative 1 represented a plan where airlines remained in their existing locations. Action Alternative 2 (the preferred alternative) represented a plan where the airlines relocated, as necessary. These action alternatives are similar to both the 2030 and 2040 preferred alternatives.

177 tons per year of sulfur dioxide (SO_2); 38.8 tons per year of particulate matter with a diameter of 10 microns or less (PM_{10}); 36.2 tons per year of particulate matter with a diameter of 2.5 microns or less ($PM_{2.5}$), and 0.04 tons per year of lead (Pb).

Table 5-6 summarizes the baseline condition for the macroscale dispersion analysis. The maximum concentration of 28.4 parts per million (ppm) of CO occurs southeast of T1. Here, GSE activity is the main contributor to CO concentration. The maximum-predicted concentration is less than the 1-hour CO standard of 30.0 ppm. The maximum 8-hour CO concentration of 8.0 ppm occurs in the same location because of the same activities. This concentration does not exceed the 8-hour CO standard of 9.0 ppm.

Table 5-7 summarizes the baseline condition for the roadway intersection analysis. The highest 1-hour CO concentration predicted at the Fort Snelling National Cemetery near the 34th Avenue South and I-494 interchange is estimated to be 6.2 ppm. The maximum 8-hour concentration of 4.4 ppm occurs at the same location. The 1-hour concentration at the Crowne Plaza Hotel at the 34th Avenue South and American Boulevard intersection is estimated to be 5.8 ppm, with an 8-hour concentration of 3.7 ppm. All the estimated maximum 1-hour and 8-hour CO concentrations are within the applicable standards of 35/30 and 9.0 ppm.

Table 5-6: Dispersion Modeling Results

2010 Baseline Condition – Carbon Monoxide Macroscale Dispersion Modeling Results (ppm)					
Averaging Time	**Maximum Modeled Concentration**	**Background Concentration**	**Total Predicted Concentration**	**NAAQS/ MAAQS**	**Exceeds NAAQS/MAAQS**
1-hour	24.0	4.4	28.4	35/30	No
8-hour	5.4	2.6	8.0	9/9	No

NOTES:
ppm – Parts per Million
NAAQS – National Ambient Air Quality Standards
MAAQS – Minnesota Ambient Air Quality Standards
SOURCE: Metropolitan Airports Commission, *Minneapolis–St. Paul International Airport 2020 Improvements Final Environmental Assessment Worksheet*, January 2013.

Table 5-7: Roadway Intersection Analysis Results

2010 Baseline Condition – Carbon Monoxide Roadway Intersection Analysis Results (ppm)						
Intersection	Averaging Time	Maximum Modeled Concentration	Background Concentration	Total Predicted Concentration	NAAQS/ MAAQS	Exceeds NAAQS/ MAAQS
34th Avenue South and I-494 Interchange	1-hour	1.8	4.4	6.2	35/30	No
	8-hour	1.8	2.6	4.4	9/9	No
34th Avenue South and American Boulevard	1-hour	1.4	4.4	5.8	35/30	No
	8-hour	1.1	2.6	3.7	9/9	No

NOTES:
ppm – Parts per Million
NAAQS – National Ambient Air Quality Standards
MAAQS – Minnesota Ambient Air Quality Standards
SOURCE: Metropolitan Airports Commission, *Minneapolis-St. Paul International Airport 2020 Improvements Final Environmental Assessment Worksheet*, January 2013.

5.4.2 Regional Roadway Emissions

The ozone levels within the Twin Cities metropolitan area currently meet both state and federal standards, and overall reductions in ozone levels were observed between 2007 and 2010. The EPA has classified the State of Minnesota as an "ozone attainment area," which implies Minnesota has been identified as a geographic area that meets the national health-based standards for ozone levels. Due to these factors, a quantitative ozone analysis was not conducted for this study.

Recently, the State of Minnesota was designated as an unclassifiable/attainment area for particulate matter (PM), meaning Minnesota has been established as a geographic area that meets the national health-based standards for PM levels; therefore, the state is exempt from qualitative hotspot analyses for PM.

Within the specified project area, the possibility of nitrogen dioxide (NO_2) standards being approached or exceeded is low based on the limited ambient concentrations of NO_2 in Minnesota and the long-term trend toward a reduction of NOx emissions. Due to these factors, a specific analysis of NO_2 was not conducted for this study.

Transportation sources produce emissions of SO_2, which are a small component of the overall production of emissions that continue to decline due to the desulphurization of fuels. The EPA has classified the State of Minnesota as a "SO_2 attainment area," which implies Minnesota has been identified as a geographic area that meets the national health-based standards for SO_2 levels. Due to these factors, a quantitative analysis for SO_2 was not conducted for this study.

Projects included in the Transportation Improvement Plan (TIP)[5] and evaluated for Transportation Conformity only include those that are funded and approved prior.

5.5 SANITARY SEWER AND WATER

Using information from **Appendices A** and **B**, which were published in 2008 and 2010, respectively, this section reviews the key information regarding sanitary sewer (also known as wastewater) and stormwater, water supply, solid waste, and wetlands.

During the development of the 2040 LTP, additional review and studies for sanitary sewer and water will be completed as necessary. These studies will be in collaboration with adjacent communities to ensure the most up-to-date information on capacity and other related factors are available prior to advancing project construction.

5.5.1 Sanitary Sewer

According to Section 5.18.4 in **Appendix B**, generated wastewater discharged from the MSP campus is conveyed and treated by the Metropolitan Council Environmental Services (MCES) at the Metro Wastewater Treatment Plant (Metro Plant). The Metro Plant has an operating and design capacity of 251 million gallons per day (MGD). Based on Chapter 5 of **Appendix B**, the proposed projects are expected to increase passenger loads by approximately 50% between 2008 and 2030, which will coincide with similar increases in wastewater discharge.

The wastewater is discharged to the Metro Plant per the MCES sewer interceptor system. MSP discharged wastewater is conveyed to the interceptor system through three different sewer systems. The majority of the discharged wastewater from the Airport is then transported to a tunnel near the Mississippi River and then discharged into the interceptor system. The City of Minneapolis sewer system discharges a small volume of wastewater prior to reaching the MCES interceptors. The southwest portion of the MSP campus wastewater is discharged to the City of Richfield sewer system before reaching the MCES inceptors.

Based on the passenger loads determined in **Appendix A** (completed in 2008), the estimated 50% increase in passenger loads would increase the daily discharge volume by approximately 0.35 MGD. The increase would be conveyed through the tunnel and Richfield systems. Assuming a 2.5 peak loading factor, this would amount to a peak addition of approximately 37,000 gallons per hour. The increase in loading would not be expected to be an issue with the Metro Plant's total capacity, because the increase would amount to less than 0.2% of the plant's daily treatment capacity. However, there could be issues with the wet-weather conveyance capacity of the interceptor system from other municipal sources. According to the MCES, there is sufficient dry-weather capacity in the MCES interceptor system to handle the proposed increase in flow. Additionally, the City of Bloomington has the option to divert its discharges through the Richfield oversized system to the Metro Plant if Bloomington's conveyance system to the Seneca Wastewater Treatment Plant is obstructed. However, this is unlikely as Bloomington's conveyance system was upgraded around 2008. Therefore, the Richfield system should have adequate capacity.

[5] Regionally significant projects are part of the 4-year TIP.

The MAC-owned sanitary sewer infrastructure, regardless of whether the proposed CIP projects for MSP are implemented, may require upgrades to convey both terminals' higher volumes of wastewater (upstream of the tunnel and Richfield systems). As development decisions are being made, the MAC will evaluate the existing capacity of the MAC-owned sanitary sewer system to identify when and where the limitations of wastewater capacity may be encountered.

The MAC has taken measures to reduce the municipality-supplied potable water through a reduction in water usage and wastewater volumes, such as through the use of high-efficiency fixtures/valves, like automatic sensors. The measures have resulted in the reduction of the sanitary sewer flow; therefore, capacity exists for the projects planned in the LTP.

5.5.2 Water Supply

As noted in **Appendix A**, the MSP campus uses an approximate 1 million gallons of potable water per day (as of 2008). The potable water is used for several Airport facilities and activities, such as concession facilities, restroom facilities, facility cleaning, tenant facilities, cargo facilities, irrigation, and rental car wash facilities. The proposed projects include expansions at both terminals' concourses. The expansions will include additions to both concession and restroom facilities, along with other water-using facilities. In addition, the plan also includes a hotel that would be another significant user of potable water.

The proposed projects would increase the water demand at the MSP campus. Both water and fire flow demand will be incorporated as projects are reviewed for preliminary engineering and design. However, the added water demand from the proposed projects is not expected to exceed the 1.5 MGD.

All the water used on the MSP campus is provided by the City of Minneapolis. At the time **Appendix A** was created, the city had a maximum capacity of 180 MGD, in which the city reached a maximum peak of approximately 145 MGD in 2007. Furthermore, capacity enhancements will not be required in Minneapolis for the increased water usage. An option to obtain additional water from the City of Richfield was studied. If this option is pursued, construction would occur at locations that are within a down gradient of public wells and outside the City of Richfield wellhead protection area limits.

Reducing the amount of water use on the campus is one of the key goals of the MAC's overall sustainability efforts. Upcoming projects to replace high-flow toilets and/or incorporate rainwater reuse for landscaping will help MAC attain its water reduction goal.

5.5.3 Water Resources

5.5.3.1 Surface Water

Based on Section 5.18 of **Appendix B**, the surface water study area includes the storm sewer collection, the MSP stormwater ponds, the Minnesota Department of Transportation (MnDOT) Almaz Pond, the I-494 bypass pond, and the Minnesota River. These ponds on the MSP site cover approximately 2,840 acres, where impervious surfaces cover 1,880 acres. The majority of stormwater drains to retention ponds to discharge to the Minnesota River via storm sewers from MSP. A smaller portion of the stormwater drains to Mother Lake from MSP.

Almost all Airport activity on the west side of MSP, including T2, the cargo facilities, and Runway 17-35, discharges stormwater to the MSP Pond 1 drainage area. The majority of Airport activity that includes most of T1 discharges stormwater to the MSP Pond 2 discharge area. MSP Ponds 1 and 2 were designed to determine total suspended solids to the Minnesota River by an approximate factor of 80%, and they can contain any fuel spills that may happen.

MSP Ponds 3 and 4 work together in which they receive stormwater discharge from portions of T1 that serve regional aircraft, parts of Runways 12L-30R and 4-22 and their associated taxiways, inbound and outbound roadways, the post office, Air Force Reserve, and the MNANG airside operations. The two ponds also diminish the total suspended solids (TSS) discharge to the Minnesota River by 80%, and they can contain fuel spills.

Additionally, portions of I-494, TH 77, and other related roadways discharge stormwater to the MnDOT Almaz Pond. The MnDOT Almaz Pond was also designed with the same standards as Ponds 1 and 2 to diminish the annual TSS discharge by approximately 80%.

5.5.3.2 Groundwater

The MSP groundwater flows toward the Minnesota River in an east/southeasterly direction, where all groundwater eventually flows into the Minnesota River basin. The MSP groundwater flows into the downstream receptors of the Minnesota River and Fort Snelling State Park.

The Twin Cities basin, where the MSP campus is located, is underlain by a complete section of Paleozoic bedrock, which is mantled with a variety of glacial sediments. The bedrock units (from youngest to oldest) include Decorah shale, Platteville limestone, Glenwood shale, St. Peter sandstone, Prairie du Chien formation, Jordan sandstone, and the St. Lawrence formation. Both the Glenwood shale and the St. Peters sandstone serve as confining layers to prevent the vertical migration of groundwater to the Prairie du Chien-Jordan aquifer system.

The MAC created a comprehensive well network at MSP and has been regularly sampling and reporting the groundwater since 2005. Petroleum-related impacts and residuals from the aircraft deicing fluid (ADF) are the primary contaminates in groundwater at MSP.

The groundwater monitoring data that have been collected have shown that free product or petroleum contamination does not exist at the MSP campus, outside the petroleum release sites that are historically known. Additionally, demand testing for propylene glycol and chemical oxygen has indicated Airport-wide subsurface glycol impacts are not present.

The site has two factors that make MSP a suitable hydrogeological setting for the natural protection of deeper aquifers. First, the confining layers of the St. Peter sandstone and Glenwood shale inhibit the downward flow of fuel or other contaminants obtained from the surface into the water sources below. Secondly, the regional groundwater discharge location is believed to be the Minnesota River system, and the zone between MSP and the river system is the area of potential impact.

The MAC and its tenants have established active programs to help protect against groundwater contamination at the MSP campus, in addition to the natural protection features. The programs include fueling system and tank tightness testing, tanks and fueling systems in compliance with current regulations for secondary containment, corrosion protection and spill/overfill protection, an integrated spill plan (ISP), glycol collection systems at locations where ADF is applied, and an extensive groundwater monitoring network.

Based on **Appendix B**, when groundwater impacts occur, mitigation should be in accordance with MPCA permits and regulations.

5.5.3.3 Drinking Water

There are no drinking water wells located on the MSP campus or on the down gradient that is between MSP and the Minnesota River location for the groundwater discharge. The Minnesota River is not a resource for drinking water.

5.5.4 Solid Waste

Based on **Appendix B**, all Action Alternatives would produce the same quantity of solid waste. The number of passengers is proportional to the amount of solid waste. With the same number of passengers in each alternative, the amount of solid waste would be consistent; therefore, the Action Alternatives would not impact post-construction solid waste.

Reducing the amount of solid waste sent to landfill is a key goal of the MAC's overall sustainability goals. MAC is already incorporating waste reduction strategies into concession programs, including paper towel compactors in restrooms, compactors in trash cans within terminal spaces, expanding organics and recycling opportunities, and implementing compostable-only employee events.

A project's contractor typically oversees waste materials produced from construction. The reuse and salvaging of building materials is exercised whenever possible. Maximizing the recovery of recyclable construction and demolition waste, like metal and concrete, is a standard practice. When appropriate, high volumes of concrete are crushed and reused on-site. Non-recyclable materials are transported to a landfill. Hazardous waste is managed and regulated at local disposal facilities in accordance with applicable procedures. Waste generated from the Action Alternatives can be accommodated by the processing facilities and disposal sites.

5.5.5 Wetlands

Wetland activity is addressed in Executive Order 11990, *Protection of Wetlands*, U.S. Department of Transportation Order 5660.1A, *Preservation of the Nation's Wetlands,* the Rivers and Harbors Act of 1899, and the Clean Water Act. Additionally, the Minnesota Wetland Conservation Act (WCA) serves as the regulation for wetlands.

According to **Appendix B**, a location between the north- and south-bound lanes of TH 5 is the only study area with wetland characteristics, and it is not shown on the National Wetland Inventory map. The Hennepin County Soil Survey identifies non-hydric soils at this location. Based on old aerial photos and highway construction drawings, this area was previously an upland with a gravel roadway and maple trees. Because this area's wetland characteristics are not natural, the area is exempt from the WCA. Therefore, the study area does not include jurisdictional wetlands protected by the Minnesota Department of Natural Resources or WCA. Based on the same criteria, the area does not qualify as a U.S. Army Corps of Engineers wetland.

Because the study area is free of wetlands, it would not be impacted by any of the alternatives.

Potential impacts were also measured outside the study area. It was concluded that none of the alternatives would substantially alter the drainage areas or runoff volumes. Minor changes in impervious surfaces occur in areas where stormwater runoff is collected by storm sewers. These storm sewers discharge into stormwater ponds for control before being released into the Minnesota River. Thus, none of the alternatives would impact wetlands outside the study area.

5.6 OTHER ENVIRONMENTAL CONSIDERATIONS

It is anticipated that most of the projects in the preferred development plan will require an environmental review process per federal NEPA and Minnesota Environmental Policy Act (MEPA) requirements to identify the environmental footprint of the improvements more specifically before construction can begin. During that process, alternatives must be reviewed and any potential impacts must be avoided if possible. If impacts cannot be avoided, they must be minimized to the extent possible and mitigated in full compliance with federal and state requirements.

Please note that a few projects that are currently or soon to be implemented were covered in the previous environmental review process and will continue their implementation schedule ahead of new projects proposed in this LTP.

The following impact categories will be assessed during the environmental review:

- Air quality
- Biological resources (including fish, wildlife, and plants)
- Climate
- Department of Transportation Section 4(f) properties (park and recreational lands, wildlife and waterfowl refuges, and historic sites)
- Farmlands
- Hazardous materials, solid waste, and pollution prevention
- Historical, architectural, archeological, and cultural resources
- Land use
- Natural resources and energy supply
- Noise and compatible land use
- Socioeconomics, environmental justice, and children’s environmental health and safety risks
- Visual effects (including light emissions)
- Water resources (including wetlands, floodplains, surface waters, groundwater, and wild and scenic rivers)
- Construction impacts
- Cumulative effects

The environmental review process cannot begin until a sufficiently detailed plan is available to evaluate. The MAC will initiate the environmental review for the preferred development plan following the review by Metropolitan Council and formal adoption by the MAC Board. A full study of these environmental impact items currently falls outside the scope of this document.

Chapter 6. Land Use Compatibility

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Chapter 6 Land Use Compatibility

6.1 INTRODUCTION

Land use compatibility for Airports and their surrounding environments is a significant component of the planning process. Successfully developing airports requires coordination among airport operators, state, city, and local governments to ensure any future development considers the needs of the surrounding populations.

Airport operators and municipalities are both responsible for the ongoing development of public assets that serve the greater public interest. City governments ensure the responsible development and enhancement of city infrastructure in the same way that airport operators oversee the development and enhancement of our nation's airport system. This coordination among airport operators and local governments is essential to ensure that any future project considers the land use consequences of decisions made regarding airport development.

This chapter evaluates the land use implications of the operation and development of the 2040 Long-Term Plan (LTP).

6.2 LAND USE COMPATIBILITY

In 14 C.F.R. Part 150, the Federal Aviation Administration (FAA) has outlined criteria for land use compatibility, determining permissible land uses around airports through the assessment of noise impacts, measured in terms of Day-Night Sound Level (DNL). For airports located in the Minneapolis-Saint Paul Metropolitan Area, additional criteria also must be evaluated in relation to noise exposure as established by the Metropolitan Council's Transportation Policy Plan (TPP).

6.2.1 FAA Land Use Compatibility Guidelines

Compatible land use under federal guidelines use aviation noise as a factor for allowable development near an airport. Independent efforts by the FAA, U.S. Department of Housing and Urban Development, U.S. Air Force, U.S. Navy, U.S. Environmental Protection Agency, and other Federal agencies to develop compatible land use criteria were melded into a single effort by the Federal Interagency Committee on Urban Noise (FICUN) in 1979. The combination of criteria were codified in the FICUN guidelines document in 1980. The guidelines document adopted DNL as its standard noise descriptor, and the Standard Land Use Coding Manual (SLUCM) as its standard descriptor for land uses. The noise-to-land use relationships were then expanded for the FAA's Advisory Circular Airport-Land Use Compatibility Planning. The current individual agency compatible land use criteria have been, for the most part, derived from those in the FICUN Guidelines. Airport environments pertain only to certain categories of these guidelines.[1]

In 1985 the FAA adopted 14 C.F.R. Part 150 outlining land use compatibility guidelines around airports. **Table 6-1** provides the land use compatibility guidelines as established by the FAA.

[1] Federal Interagency Committee On Noise (FICON), "Federal Agency Review of Selected Airport Noise Analysis Issues," (1992), pp. 2-6 to 2-7.

According to FAA standards, areas with noise levels less than 65 DNL are considered compatible with residential development.

6.2.2 Metropolitan Council Land Use Compatibility Guidelines

The Metropolitan Council has developed a set of land-use planning guidelines for responsible community development in the Minneapolis-Saint Paul Metropolitan Area. The intent is to provide city governments with a comprehensive resource for planning and community development in a manner that considers the adequacy, quality and environmental elements of planned land uses.

In 1976 the Minnesota Legislature enacted the Minnesota State Land Planning Act, the underlying law that requires local units of government to prepare a comprehensive plan and submit it for Metropolitan Council review. Under the 1976 legislation, communities designated land uses and defined the zoning applicable to the land use parcel. Zoning was the statute's priority. The land use measure was a request that local jurisdictions review existing zoning in Airport Noise Zones to determine consistency with the regional compatibility guidelines and rezone property for compatible development if consistent with other development factors. In 1977, the Metropolitan Council also updated the 1973 Aviation Chapter of the Metropolitan Development Guide. In 1983, the Metropolitan Council amended its Aviation Policy Plan to include "Land Use Compatibility Guidelines for Aircraft Noise."

In 1994 the Minnesota Legislature amended the Land Planning Act to require that communities update their comprehensive plans at least every 10 years. As a result, all Metropolitan Development Guide chapters were updated by December 1996. Under the amended Land Planning Act, communities determine the land use designation; zoning must be consistent with that designation. Thus, the communities had to re-evaluate designated use, permitted uses within the designation, zoning classifications, and adequacy.

Table 6-1: FAA Aircraft Noise and Land Use Compatibility Guidelines

Land Use	DNL Contour Interval (dB)					
	Less than 65	65 69	70 74	75 79	80 84	Greater than 85
Residential						
Residential, other than mobile homes and transient lodgings	Y	N (1)	N (1)	N	N	N
Mobile home park	Y	N	N	N	N	N
Transient lodgings	Y	N (1)	N (1)	N (1)	N	N
Public use						
Schools	Y	N (1)	N (1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y (2)	Y (3)	Y (4)	Y (4)
Parking	Y	Y	Y (2)	Y (3)	Y (4)	Y
Commercial use						
Offices, business, and professional	Y	Y	25	30	N	N
Wholesale and retail-building materials, hardware, and farm equipment	Y	Y	Y (2)	Y (3)	Y (4)	N
Retail trade-general	Y	Y	25	30	N	N
Utilities	Y	Y	Y (2)	Y (3)	Y (4)	N
Communication	Y	Y	25	30	N	N
Manufacturing and production						
Manufacturing (general)	Y	Y	Y (2)	Y (3)	Y (4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y (6)	Y (7)	Y (8)	Y (8)	Y (8)
Livestock farming and breeding	Y	Y (6)	Y (7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y (5)	Y (5)	N	N	N
Outdoor music shells and amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts, and camps	Y	Y	Y	Y	N	N
Golf courses, riding stables, and water recreation	Y	Y	25	30	N	N

KEY:
SLUCM – Standard Land Use Coding Manual
Y (Yes) – Land use and related structures compatible without restrictions
N (No) – Land use and related structures are not compatible and should be prohibited.
NLR – Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25,30, or 35 – Land use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

NOTES:
See following page for Notes.

NOTES: The designations contained in this table do not constitute a federal determination that any use of land covered by the program is acceptable or unacceptable under federal, state, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute locally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB; thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year-round. However, the use of NLR criteria will not eliminate outdoor noise problems.
(2) Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.
(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.
(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.
(5) Land use compatible provided special sound reinforcement systems are installed.
(6) Residential buildings require an NLR of 25.
(7) Residential buildings require an NLR of 30.
(8) Residential buildings not permitted.

In 2004 the Metropolitan Council incorporated its Aviation Policy Plan into the Transportation Policy Plan (TPP) of the Metropolitan Development Guide. It was updated in January 2009. Land use compatibility guidelines for all metropolitan system airports are included in the TPP. The 2040 TPP was adopted in 2015 and amended in 2020. The TPP considered noise exposure associated with airports located in the Minneapolis-St. Paul Metropolitan Area and provided land use guidelines based on four noise zones around an airport. The following is the Metropolitan Council's description of each noise zone:

- **Zone 1** – Occurs on and immediately adjacent to the airport property. Existing and projected noise intensity in the zone is severe and permanent. It is an area affected by frequent landings and takeoffs and subjected to aircraft noise greater than 75 DNL. Proximity of the airfield operating area, particularly runway thresholds, reduces the probability of relief resulting from changes in the operating characteristics of either the aircraft or the airport. Only new, non-sensitive, land uses should be considered. In addition to preventing future noise problems, the severely noise impacted areas should be fully evaluated to determine alternative land use strategies, including eventual changes in existing land uses.[2]
- **Zone 2** – Noise impacts are generally sustained, especially close to the ends of runways. Noise levels are in the 70 to 74 DNL range. Based upon proximity to the airfield, the seriousness of the noise exposure routinely interferes with sleep and speech activity. The noise intensity in this area is generally serious and continuing. New development should be limited to uses that have been constructed to achieve certain exterior-to-interior noise attenuation and that discourage certain outdoor uses.[3]
- **Zone 3** – Noise impacts can be categorized as sustaining. Noise levels are in the 65 to 69 DNL range. In addition to the intensity of the noise, location of buildings receiving the noise must also be fully considered. Aircraft and runway use operational changes can provide some relief for certain uses in this area. Residential development may be acceptable if it is located outside areas exposed to frequent landings and takeoffs, is constructed to achieve certain

[2] Metropolitan Council 2040 Transportation Policy Plan – 2020 Update, Appendix L, 2020.

[3] Ibid.

exterior-to-interior noise attenuation and is restrictive as to outdoor use. Certain medical and educational facilities that involve permanent lodging and outdoor use should be discouraged.[4]

- **Zone 4** – Defined as a transitional area where noise exposure might be considered moderate. Noise levels are in the 60 to 64 DNL range. The area is considered transitional since potential changes in airport and aircraft operating procedures could lower or raise noise levels. Development in this area can benefit from insulation levels above typical new construction standards in Minnesota, but insulation cannot eliminate outdoor noise problems.[5]
- **Noise Buffer Zones** – Additional area that can be protected at the option of the affected community; generally, the buffer zone becomes an extension of Noise Zone 4. At MSP, a one-mile buffer zone beyond the DNL 60 has been established to address the range of variability in noise impact, by allowing implementation of additional local noise mitigation efforts. A buffer zone, out to DNL 55 is optional at those reliever airports with noise policy areas outside the Metropolitan Urban Service Area (MUSA).[6]

The listed Metropolitan Council noise zones also use the DNL noise exposure metric. The Metropolitan Council Land Use Compatibility Guidelines for Aircraft Noise are provided in **Table 6-2.**

As outlined above, the Metropolitan Council developed the Aviation Chapter of the Metropolitan Development Guide, including the Builder's Guide and Model Ordinance for Aircraft Noise Attenuation, to provide a program framework for community adoption, pursuant to MSP Part 150 preventive land use measures.

The Model Ordinance and Builder's Guide are intended to ensure consistency with local land use planning practices in areas of infill development (e.g., building a home on a vacant lot on a residential block – including reconstruction and/or additions to existing structures) in known airport noise impact areas (2007 – 60+ DNL noise contours) around MSP. Specifically, the documents provide a mechanism for cities around MSP to adopt building material and construction standards to ensure that developments in the airport impact areas are constructed consistent with MSP Part 150 program goals.

In establishing noise reduction level requirements, the March 2006 Metropolitan Council Builder's Guide states on page 20:

> "The overall noise reduction level (NRL) required within a given noise zone can be determined by subtracting the desired level (45 dBA) from the highest noise level within that contour. For example, in Noise Zone 4 (60 to 64 dBA), the required reduction is calculated as 64 – 45 = 19 dBA.[7]

[4] Metropolitan Council 2040 Transportation Policy Plan – 2020 Update, Appendix L, 2020.

[5] Ibid

[6] Ibid

[7] The Metropolitan Council's NRL calculation approach is consistent with the FAA's calculations in 14 C.F.R. Part 150.

Table 6-2: Metropolitan Council Land Use Compatibility Guidelines for Aircraft Noise

	Noise Exposure Zones									
Type of Development	New Development or Major Redevelopment					Infill Reconstruction or Additions to Existing Structures				
Land Use Category	1 DNL 75+	2 DNL 74 70	3 DNL 69 65	4 DNL 64 60	BZ	1 DNL 75+	2 DNL 74 70	3 DNL 69 65	4 DNL 64 60	BZ
Residential										
Single/multiplex, with individual entrance	INCO	INCO	INCO	INCO		COND	COND	COND	COND	
Multiples/apartment with shared entrance	INCO	INCO	COND	PROV		COND	COND	PROV	PROV	
Mobile home	INCO	INCO	INCO	COND		COND	COND	COND	COND	
Educational, medical, school, churches, hospitals, and nursing homes	INCO	INCO	INCO	COND		COND	COND	COND	PROV	
Cultural, entertainment, and recreation										
Indoor	COND	COND	COND	PROV		COND	COND	COND	PROV	
Outdoor	COND	COND	COND	COND		COND	COND	COND	COMP	
Office, commercial, retail, and services	COND	PROV	PROV	COMP		COND	PROV	PROV	COMP	
Services										
Transportation – passenger facilities	COND	PROV	PROV	COMP		COND	PROV	PROV	COMP	
Transient lodging	INCO	COND	PROV	PROV		COND	COND	PROV	PROV	
Other medical, health, and education	COND	PROV	PROV	COMP		COND	PROV	PROV	COMP	
Other services	COND	PROV	PROV	COMP		COND	PROV	PROV	COMP	
Industrial, communication, and utilities	PROV	COMP	COMP	COMP		PROV	COMP	COMP	COMP	
Agriculture, land/water area, and resource extraction	COMP	COMP	COMP	COMP		COMP	COMP	COMP	COMP	

KEY:
COMP/Compatible – uses that are acoustically acceptable for both indoors and outdoors.
PROV/Provisional – uses that should be discouraged if at all feasible; if allowed, uses must meet certain structural performance standards to be acceptable according to MS 473.192 (Metropolitan Area Noise Attenuation Act). Structures built after December 1983 shall be acoustically constructed so as to achieve the interior sound levels described in Metropolitan Council's 2040 Transportation Policy Plan, Appendix L, Table L-4. Each local governmental unit having land within the airport noise zones is responsible for implementing and enforcing the structure performance standards in its jurisdiction.
COND/Conditional – uses that should be strongly discouraged; if allowed, must meet the structural performance standards, and requires a comprehensive plan amendment for review of the project under the factors described in Metropolitan Council's 2040 Transportation Policy Plan, Appendix L, Table L-3.
INCO/Incompatible – uses that are not acceptable even if acoustical treatment were incorporated into the structure and outside uses restricted.

6.3 RUNWAY SAFETY ZONING CONSIDERATIONS

At the Federal level, the FAA is the agency primarily responsible for land use compatibility around airports. Although the FAA does not play a direct role in the zoning and land use planning practices around United States airports, it provides critical land use planning guidance, technical assistance, and funding to airports. In this capacity, the FAA issues a variety of regulations and guidance documents under federal law that affect land use planning around airports.

FAA land use guidance focuses on two areas: (1) runway protection zones; and (2) airspace protection.

6.3.1 Federal Runway Protection Zones

Runway Protection Zones (RPZs) are defined in FAA Advisory Circular 150/5300-13, *Airport Design*. RPZs are trapezoid shapes centered on the approximate extended runway centerline radiating from the end of a runway. The dimensions of an RPZ are a function of the type of aircraft using the runway and approach visibility minimums associated with the runway end. The intent of RPZs is to provide safety for people and property on the ground in the vicinity of runway ends at airports. The FAA accomplishes this goal through land use controls in RPZs designed to maintain areas near the ends of airport runways that are free of incompatible objects and activities.

6.3.2 Federal Airspace Protection

Federal Aviation Regulation Part 77, *Objects Affecting Navigable Airspace*, establishes standards for determining obstructions to navigable airspace and the effects of such obstructions on the safe and efficient use of that airspace.

The height limitations associated with Part 77 are defined in terms of imaginary surfaces in the airspace surrounding an airport. These surfaces extend from about two to three miles from the airport, except for runways with precision instrument approaches, in which case the surfaces extend approximately 9.5 miles from the runway end. The various imaginary surfaces include the primary surface, transitional surface, horizontal surface, conical surface, and the approach surface.

Under Part 77, the FAA has established a process for reviewing and evaluating proposed structures in the vicinity of airports. FAA Advisory Circular 7460 establishes an airspace review process and provides information to individuals wishing to erect or alter structures that may affect navigable airspace around an airport. In administering 14 CFR Part 77, the FAA's main objective is to ensure the safe and efficient use of navigable airspace around airports.

The FAA has established five different thresholds for evaluating whether a structure may affect navigable airspace around an airport. If any one of these thresholds is reached, the FAA requests that an individual wishing to erect or alter a structure seek its approval before commencing construction. One of the FAA thresholds applies if a structure is within "20,000 feet of an airport or seaplane base with at least one runway more than 3,200 feet in length and the object would exceed a slope of 100:1 horizontally (100 feet horizontally for each 1 foot vertically) from the nearest point of the nearest runway."

After receiving a request for approval, the FAA will typically issue one of the following three determinations:

- **Determination of No Hazard to Air Navigation** – "The subject construction does not exceed obstruction standards and marking/lighting is not required."
- **Conditional Determination** – "The proposed construction/alteration would be acceptable contingent upon implementing mitigating measures (marking and lighting etc.)."
- **Objectionable** – "The proposed construction/alteration is determined to be a hazard and is thus objectionable. The reasons for this determination are outlines to the proponent."

By establishing threshold criteria and then requiring a detailed airspace hazard analysis, the FAA process provides a safety buffer. In certain circumstances, the FAA's detailed airspace hazard analysis results in FAA approval for developments near airports that may be in excess of the general height limitations set forth in 14 CFR Part 77.

6.3.3 State Model Zoning Ordinance

On January 1, 1946, the State of Minnesota enacted its first model airport zoning ordinance. By 1958 the State designated Safety Zones A, B and C as part of the model airport zoning standard. In 1973, local protective airport zoning was made a condition for receiving federal and state funds. Minnesota is one of the few states that has land use safety controls for airports that go beyond the requirements of FAA regulations.

6.3.3.1 State Runway Safety Zones

The State Safety Zone A is a trapezoidal shape at the end of a runway, beginning at the edge of the primary surface and flaring outward to approximately 2/3 of the runway length. State Safety Zone B is a trapezoidal shape, with the same flare as Zone A, extending outward from the end of Zone A to approximately 1/3 of the runway length. The extent of State Safety Zone C is coincidental with the extent of the horizontal airspace surface.

Under Minnesota law, Zone A must not contain buildings, temporary structures, exposed transmission lines, or other similar above-ground land use structural hazards. Land uses in Zone A are restricted to those uses that will not create, attract, or bring together an assembly of persons. Permitted uses in Zone A include, but are not limited to, agriculture (seasonal crops), horticulture, animal husbandry, raising of livestock, wildlife habitat, light outdoor recreation (non-spectator), cemeteries, and automobile parking.

Zone B uses are restricted as follows:

- Each use must be on a site whose area is not less than 3 acres.
- Each use must not create, attract, or bring together a site population that would exceed 15 times that of the site acreage.
- Each site must have no more than one building plot upon which any number of structures may be erected.
- A building plot must be a single, uniform, and non-contrived area, whose shape is uncomplicated and whose area must not exceed minimum ratios with respect to the total site area.

The following uses are specifically prohibited in Zone B:

- Churches, hospitals, schools, theaters, stadiums, hotels, motels, trailer courts, campgrounds, and other places of frequent public or semi-public assembly.

In Zone C, no use may be made of any land that creates or causes interference with the operations of radio or electronic facilities on the airport or with radio or electronic communications between the airport and aircraft. In addition, Zone C prohibits land uses that make it difficult for pilots to distinguish between airport lights and other lights, result in glare in the eyes of pilots using the airport, impair visibility in the vicinity of the airport, or otherwise endanger the landing, taking off, or maneuvering of aircraft. All structure heights in Zone C are limited to 150 feet above the primary surface at the airport.

6.3.3.2 State Model Zoning Ordinance Airspace Protection

The State Model Zoning Ordinance height restrictions are predicated directly on the FAA's Part 77 imaginary airspace surfaces.

6.4 MSP ZONING ORDINANCE

Minnesota law establishes that airports in the state must adopt airport zoning ordinances. To do this, the statutes spell out the formation of a Joint Airport Board comprised of two members from each jurisdiction with land use control in the areas affected by airport zoning, as well as the airport proprietor.

In 2003, the MSP Joint Airport Zoning Board recommended a revised MSP zoning ordinance in light of the construction of Runway 17-35. An important part of this process was balancing the land use controls needed to provide safety while at the same time considering the social and economic impacts related to prospective land use controls. Minn. Stat. §360.066, subd. 1 is particularly instructive when addressing the question of zoning around complex urbanized airports such as MSP. The statute also addresses the concept of "reasonableness" when balancing the variables to be considered in the zoning process. Specifically, Minn. Stat. §360.066, subd. 1 states:

> "Reasonableness Standards of the commissioner defining airport hazard areas and the categories of uses permitted and airport zoning regulations adopted under sections 360.011 to 360.076, shall be reasonable, and none shall impose a requirement or restriction which is not reasonably necessary to effectuate the purposes of sections 360.011 to 360.076. In determining what minimum airport zoning regulations may be adopted, the commissioner and a local airport zoning authority shall consider, among other things, the character of the flying operations expected to be conducted at the airport, the location of the airport, the nature of the terrain within the airport hazard area, the existing land uses and character of the neighborhood around the airport, the uses to which the property to be zoned are planned and adaptable, and the social and economic costs of restricting land uses versus the benefits derived from a strict application of the standards of the commissioner."

Consistent with the guidance provided in Minn. Stat. §360.066, subd. 1, the MSP Joint Airport Zoning Board focused its discussion on the land use controls that were necessary to ensure a reasonable degree of safety around MSP. Based on the substantial property development and/or structural modification restrictions that would be placed on the largely urbanized and developed areas around the airport, the MSP Joint Airport Zoning Board turned its focus to safety. The MSP Joint Airport Zoning Board directed staff to conduct a risk analysis to provide the Board with further clarification on the question of zoning requirements necessary to ensure a “reasonable standard of safety.”

In short, the analysis found that within State Safety Zones A and B, but outside the federal RPZ, the accident probability at MSP was less than the FAA standard of one accident in 10 million operations. Additionally, based on the accident rate calculations, the MSP Joint Airport Zoning Board determined that the likelihood of a fatality from an accident in State Safety Zones A and B outside the RPZ is extremely remote or extremely improbable, based on FAA criteria.

In addition to the risk analysis, the MSP Joint Airport Zoning Board focused on addressing the economic considerations as the statute requires. The Board relied on the analyses and information that were provided by the respective cities with jurisdiction over the land uses and concluded that there were significant financial costs associated with implementation of the State Model Zoning Ordinance.

In summary, based on the findings of the Safety Study and the Economic Analysis, the Board adopted the following changes to the State Model Zoning Ordinance:

- **Safety Zone A** – is co-terminus with the Federal Runway Protection Zone (RPZ).
- **Safety Zone B** – use restrictions do not include site acre/structure limitations and site-area-to-building-plot-area ratios and population criteria.
- **Exemption for Established Residential Neighborhoods** – allows for the improvement, expansion, and development of new residential uses in and adjacent to Established Residential Neighborhoods in Safety Zone B.

In 2004 the Commissioner of Transportation for the State of Minnesota approved the MSP Joint Airport Zoning Board’s recommended ordinance.

6.5 LAND USE COMPATIBILITY ANALYSIS

MSP is in Hennepin County. The airport is bordered to the northwest by the City of Minneapolis, to the west by the City of Richfield, to the south by the City of Bloomington, to the southeast by the cities of Eagan and Mendota Heights, and to the north by the City of St. Paul. The airport is bordered by residential land uses to the north, northwest, and west. A combination of mixed-use industrial, commercial, and single-family residential exists to the south and southeast of the airport.

The following sections detail land use considerations in the context of existing and planned land uses around MSP focusing on airport noise and runway safety zones.

6.5.1 Existing Condition Land Use Compatibility

In general, the area around the airport is primarily residential to the north, northwest, and east and to the south and southeast a combination of commercial/industrial and park/open space land uses. The Runway Protection Zones (RPZ) and State Safety Zones for MSP are shown on **Exhibit 6-1.**

6.5.1.1 Land Use Compatibility and Airport Noise Considerations

As detailed in Chapter 5, Section 5.3.8, the 2018 Base Year noise contours contain 638 acres within the 75 DNL contour, which is entirely contained on airport property. The 70 DNL contour contains approximately 1,588 acres. The 65 DNL contour contains approximately 4,444 acres. The 60 DNL contour contains approximately 11,323 acres.

Exhibit 6-2 provides the 2018 Base Year 60 DNL and greater noise contours around MSP with existing land use data provided by the Metropolitan Council.

6.5.1.2 Land Use Compatibility and Existing Runway Protection/Safety Zones

The existing RPZs and State Safety Zones A and B at MSP are depicted in **Exhibit 6-3** with the existing land uses around the airport.

Each RPZ/State Safety Zone A at MSP Contains 78.9 acres. **Table 6-3** provides existing land use acreage. The airport RPZ/State Safety Zone A areas do not contain any residential structures.

Table 6-3: RPZ/State Zone A Land Use Acreages

Land Use Acreage	RWY 4	RWY 17	RWY 22	RWY 35	RWY 12L	RWY 12R	RWY 30L	RWY 30R
Runway Protection Zone / State Zone A (Acres)	**78.9**	**78.9**	**78.9**	**78.9**	**78.9**	**78.9**	**78.9**	**78.9**
Airport	76.5	66.5	0.9	58.2	70.5	74.4	19.8	6.9
Agricultural								
Industrial and utility			27.4					
Institutional								
Major highway	2.1	3.5	41.2	16.7	6.9		10.7	8.9
Multi-family residential					0.1			
Open water		9.0				4.5	8.2	45.9
Park, recreational, or preserve			3.7		1.4		40.1	17.2
Railway			5.6					
Retail and other commercial	0.2			2.4				
Single family attached								
Undeveloped				1.5				

Notes: Totals may not add due to rounding.
Source: Minnesota Geospatial Commons, January 2023 (Land Uses and Parcels); Metropolitan Airports Commission, April 2023 (State Safety Zones and Analysis)

Each State Safety Zone B at MSP contains 250.3 acres. **Table 6-4** provides existing land use acreages and a count of residential structures encompassed by each State Safety Zone B.

Table 6-4: State Zone B Land Use Acreages

Land Use Acreage	RWY 4	RWY 17	RWY 22	RWY 35	RWY 12L	RWY 12R	RWY 30L	RWY 30R
State Safety Zone B (Acres)	**250.3**	**250.3**	**250.3**	**250.3**	**250.3**	**250.3**	**250.3**	**250.3**
Airport	8.3	16.3		2.6	19.0	77.0		
Agricultural				55.8				
Farmstead				3.2				
Industrial and utility	9.0			30.3		0.1		30.8
Institutional	2.2	1.4	2.2		5.0			3.3
Major highway	52.6	27.8	5.9		21.6	49.2	4.6	0.3
Mixed-use industrial	17.7							
Mixed-use residential			0.5					
Multi-family	17.5		2.8					
Office	14.8			11.9				14.6
Open water		75.0	16.2	4.2	20.2	18.0	137.6	92.4
Park, recreational, or preserve	10.4	60.3	127.9	34.9	44.5	26.5	108.1	108.9
Railway			6.4	12.4				
Retail and other commercial	54.4	1.6		51.7	0.1	0.1		
Single family attached	28.3	3.5	2.5		1.9	3.9		
Single family detached	30.9	63.9	80.4		137.9	75.3		
Undeveloped	4.1	0.6	5.4	43.3	0.2	0.2		
Count of single-family structures	*116*	*316*	*324*	*1*	*751*	*365*		
Count of multi-family structures	*46*		*11*					

Notes: Totals may not add due to rounding.
Source: Minnesota Geospatial Commons, January 2023 (Land Uses and Parcels); Metropolitan Airports Commission, April 2023 (State Safety Zones and Analysis)

6.5.2 2040 Preferred Alternative Land Use Compatibility

The preferred development alternative at MSP maintains the existing runway infrastructure. The anticipated increase in overall operations and nighttime flights results in larger noise contours around MSP.

6.5.2.1 2040 Baseline Forecast Land Use Compatibility and Airport Noise Considerations

As detailed in Chapter 5, Section 5.3.9, the 2040 Baseline Forecast noise contours contain 826 acres within the 75 DNL contour, which is entirely contained on airport property. The 70 DNL contour contains approximately 2,212 acres. The 65 DNL contour contains approximately 5,933 acres. The 60 DNL contour contains approximately 15,775 acres.

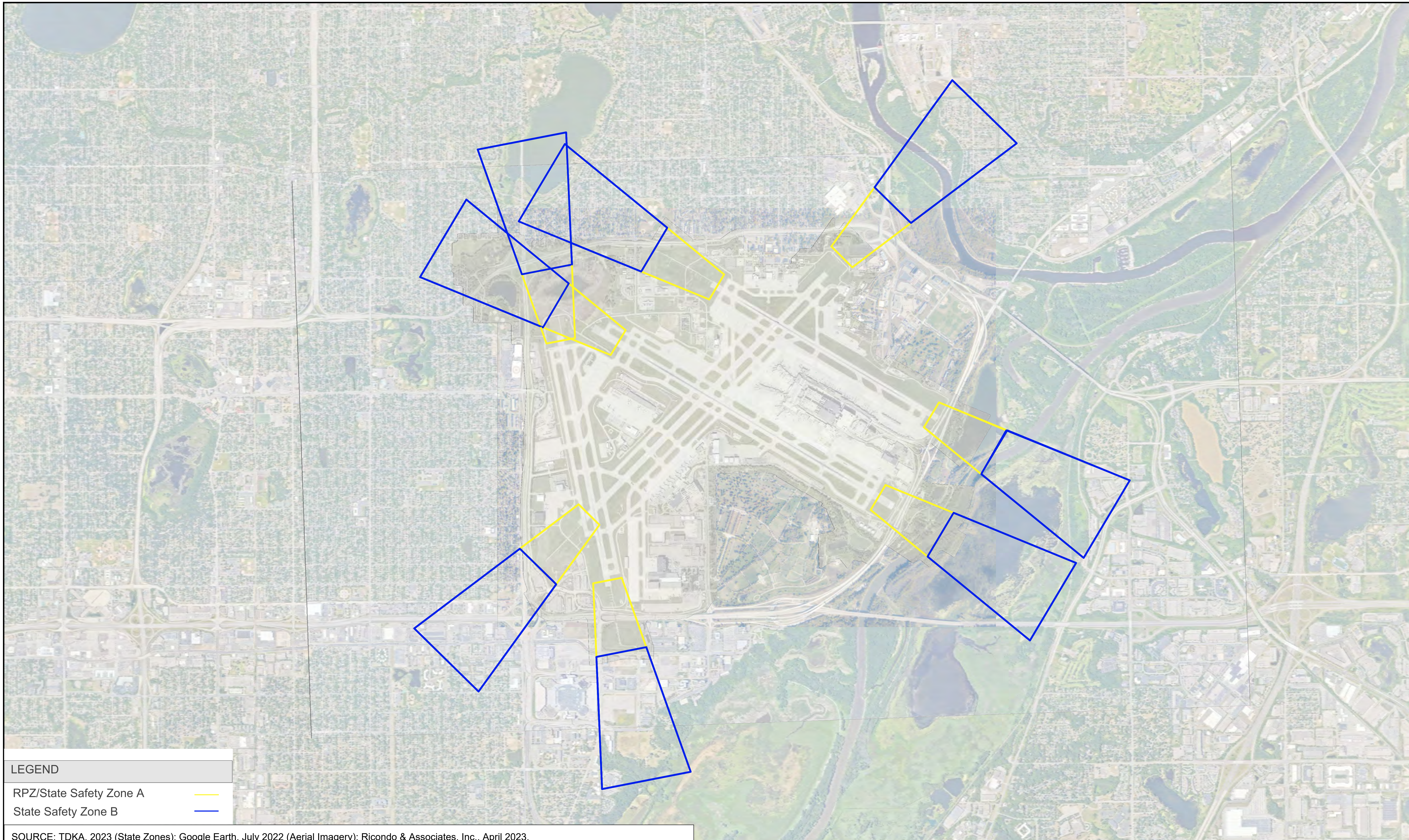
Exhibit 6-4 provides the 2040 Baseline Forecast noise contours around MSP with existing land use data provided by the Metropolitan Council.

6.5.2.2 2040 Baseline Forecast Land Use Compatibility and Runway Protection/Safety Zones

The 2040 Baseline Forecast RPZs and State Safety Zones A and B are the same as the 2018 Base Year RPZs and State Safety Zones, as depicted in **Exhibit 6-3**.

Additional analysis was conducted relative to the planned land uses around MSP as provided by the Metropolitan Council. **Exhibit 6-5** provides the RPZ and State Safety Zones A and B with planned land uses.

Proposed changes occur in State Safety Zone B off Runways 4, 12L, 12R and 17 where single-family detached homes become multi-optional development. Additionally, undeveloped land in Runway 35 State Safety Zone B becomes commercial and multi-optional development and undeveloped land in Runway 30R State Safety Zone B changes to industrial land use.



SOURCE: TDKA, 2023 (State Zones); Google Earth, July 2022 (Aerial Imagery); Ricondo & Associates, Inc., April 2023.

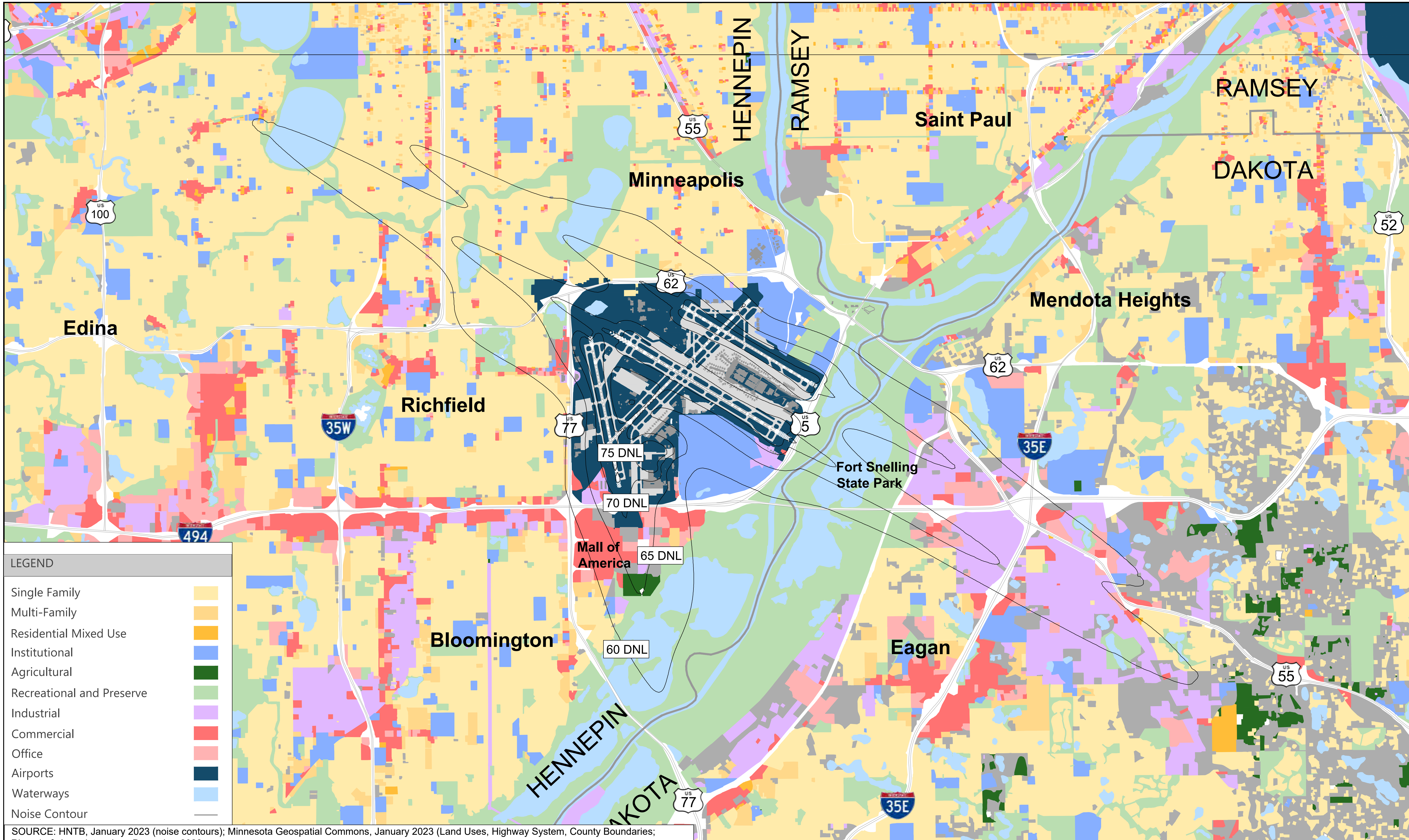
MSP

MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

DRAFT WORKING DOCUMENT | NOT FOR DISSEMINATION

MARCH 2023

EXHIBIT 6-1
RPZs and State Safety Zones



SOURCE: HNTB, January 2023 (noise contours); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries; Ricondo & Associates, Inc., December 2022.

MSP MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

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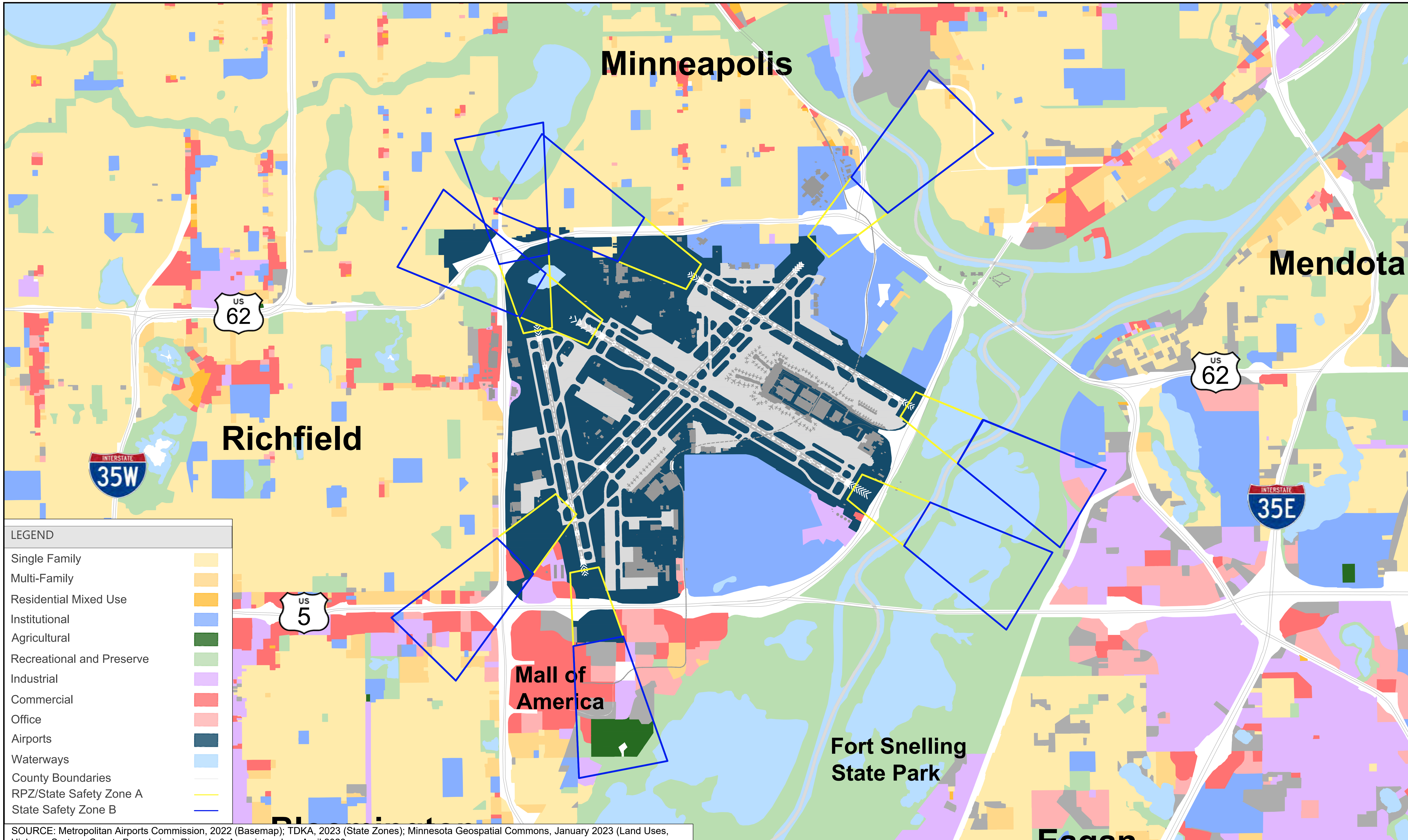
MARCH 2023

EXHIBIT 6-2
2018 Base Year Noise Contours with Existing Land Use



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); TDKA, 2023 (State Zones); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries); Ricondo & Associates, Inc., April 2023.

MSP MINNEAPOLIS-SAINT PAUL INTERNATIONAL AIRPORT
2040 LONG-TERM PLAN

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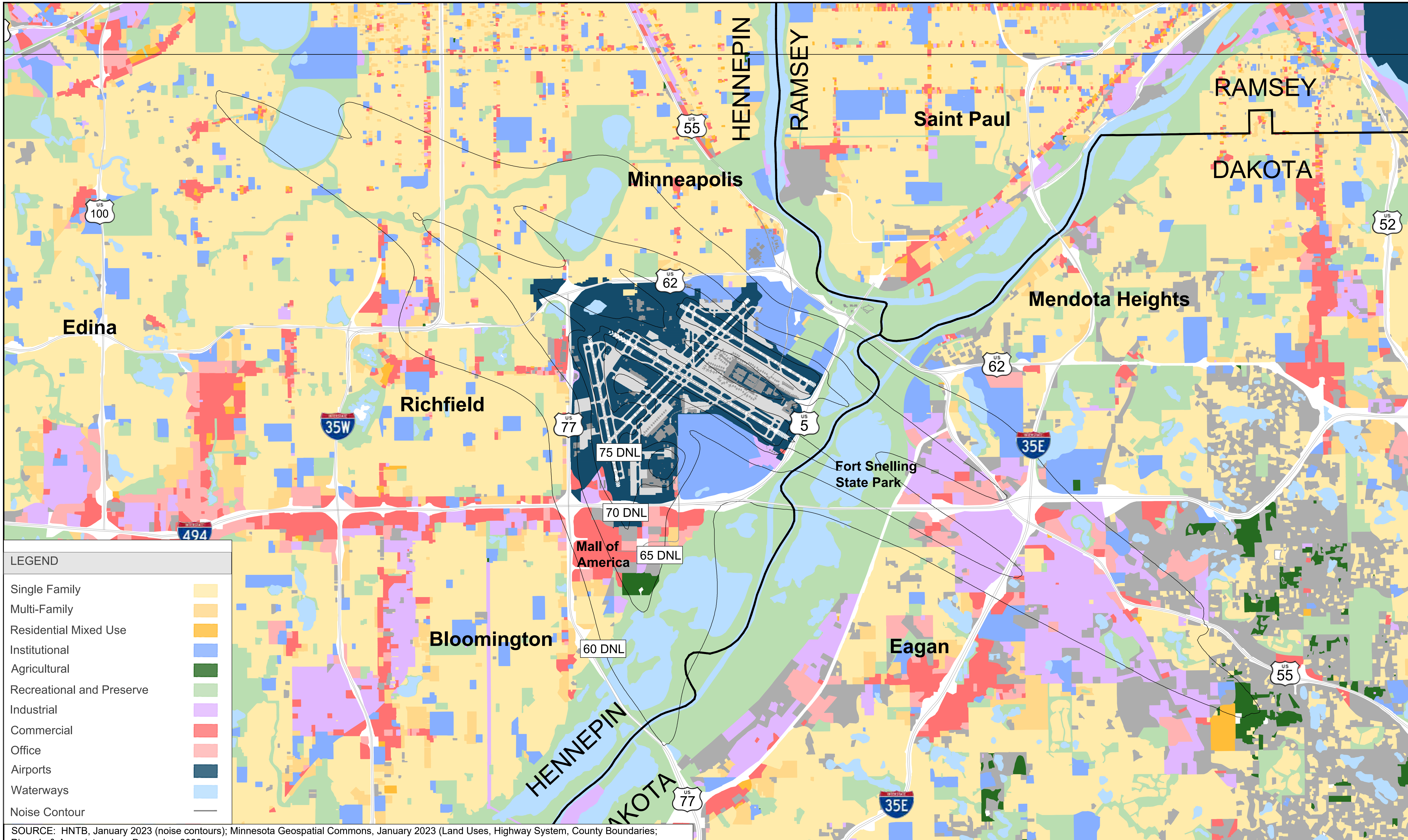
MARCH 2023

EXHIBIT 6-3
RPZs and State Safety Zones with Existing Land Use



SOURCE: HNTB, January 2023 (noise contours); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries; Ricondo & Associates, Inc., December 2022

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2040 LONG-TERM PLAN

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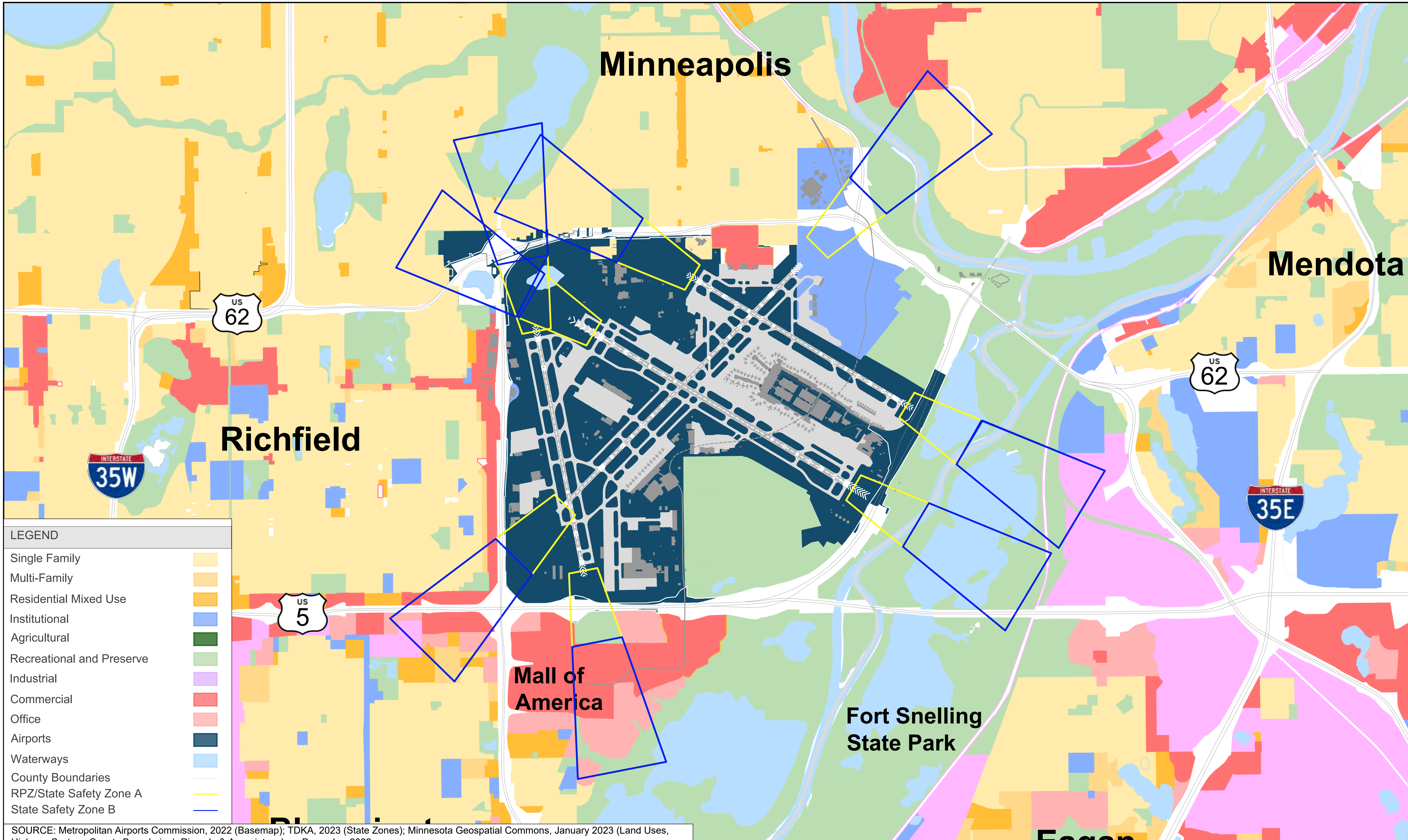
MARCH 2023

EXHIBIT 6-4

2040 Baseline Forecast Noise Contours with Existing Land Use



SOURCE: Metropolitan Airports Commission, 2022 (Basemap); TDKA, 2023 (State Zones); Minnesota Geospatial Commons, January 2023 (Land Uses, Highway System, County Boundaries); Ricondo & Associates, Inc., December 2022.

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2040 LONG-TERM PLAN

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MARCH 2023

EXHIBIT 6-5

RPZs and State Safety Zones with Planned Land Use

Chapter 7. Facility Implementation and Cost

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Chapter 7 Facility Implementation and Cost

The timing of facility construction greatly depends on decisions by the Metropolitan Airports Commission (MAC). Other factors, such as airline decisions, technology changes, evolving regulatory requirements, and aviation demand magnitude and characteristics may also influence these decisions. Most specific improvements outlined in the 2040 Long-Term Plan (LTP) would be triggered by activity (demand-driven) levels, policy decisions, regulatory changes, or discretionary development decisions. MAC has a process for identifying future projects as candidates for the capital improvement plan (CIP). This includes monitoring the need for a particular project to an eventual evaluation of the project (including design, scope, cost, etc.), coordinating with appropriate stakeholders (planning, engineering, and finance teams) and eventually integrating the project into the final CIP.

This process emphasizes the development of cost-benefit analyses and the definition of business cases for each project proposed for inclusion in the CIP. By using this process, the MAC management can make well-informed decisions regarding the CIP, which is one of the key drivers of the MAC's strategic business plan.

7.1 FACILITY IMPLEMENTATION

This section describes the recommended development plan for the 2040 LTP. The development plan includes the expansion of landside, terminal, and cargo facilities with efficiency improvements to the airfield and aprons. The strategy of the 2040 LTP is to identify projects that would provide the necessary capacity to meet projected vehicle, passenger, and aircraft demand while maintaining an optimal Level of Service (LOS) throughout the development.

The timing of implementation is based on the characteristics and magnitude of actual and forecasted demand. As actual demand may vary from what is forecasted, the phased development schedule includes specific triggers to reflect the point at which specific improvements are required to be operational to meet demand. This approach provides the MAC the flexibility needed to respond effectively to actual demand as it materializes, rather than making development decisions on a calendar-based schedule. Through regular monitoring, data analysis, and understanding the impacts of various airline and industry trends, the MAC can respond strategically to meet tenant and passenger needs by the timely development of demand-driven facilities.

Maximizing responsiveness to future changes and growth in demand requires the deferral of facility development decisions or actions for as long as reasonably feasible without compromising operational safety or efficiency. However, to meet the demands of growth and other requirements, it will be essential to make decisions that allow adequate time for comprehensive planning, environmental processing, design, and construction of necessary facilities.

During these crucial stages, the MAC must have a clearly defined development plan that takes into account the conditions and characteristics at the demand triggers, including provisions for enabling work and construction. Maintaining operational landside, terminal, and airside efficiency is a primary goal for the Airport. Project implementation must minimize impact to existing operations within the airport during development. The sequencing of phases has been considered regarding the impact on the operational efficiencies of the Airport while meeting the demand triggers of each phase of development.

The 2040 LTP is envisioned to involve three phases based on demand triggers; however, the phasing and timing of projects may change as conditions at the airport develop and will ultimately be determined by the MAC and its stakeholders. The 2040 LTP implementation strategy can summarily be described by three demand-based phases: Near-Term, Mid-Term, and Long-Term:

- **Near-Term:** Near-Term development projects are focused on expanding the current facilities' capacities while staging for further projects in the later terms. Projects in the Near-Term focus on relieving east airfield congestion and adding new gate capacity.
- **Mid-Term:** Mid-Term projects center on replacing end-of-life facilities with more integrated passenger-forward facilities. The projects concentrate on improving landside capacity, updating the concourses and apron to meet future aircraft needs, and maximizing Terminal 1 (T1)'s connectivity between Domestic and International flights.
- **Long-Term:** Long-Term projects help unify the T1 and Terminal 2 (T2) complexes with increased passenger and aircraft capacity. Projects include the expansion of gate capabilities on both terminals and the relocation of facilities not directly involved with commercial passenger service.

Each phase of development includes improvements to the landside, terminal, and airside to maintain balance of operations and growth within the Airport. Each project within the phase may have enabling projects that are identified, due to their impact on development. Though there is no direct development timeline indicated for each project, the enabling projects will need to be addressed prior to or during the project development process.

7.1.1 Near-Term Projects

Projects within the Near-Term are the basis for staging improvements within the Mid- and Long-Term while maintaining airfield capacity and a high passenger LOS.

Landside improvements at T1 and T2 both increase parking capacity and create staging space for the redevelopment of the terminals' landsides. Additional curb improvements at T2 will help with increasing demand for vehicles at the curbfront. Due to impacts to existing landside facilities and light rail transit, close coordination with Metro Transit will be necessary.

Additional gates on T2 will allow for maintaining gate requirement growth, with the flexibility of absorbing gate demand from concourses that will be impacted during development. To develop the south T2 gate expansion, the southern airfield apron areas will need to be reconfigured, including the Ground Runup Enclosure (GRE), support facilities, and Remain Overnight (RON) apron.

Taxiway improvement projects include reconfiguring taxiway edge pavement at 90-degree corners for improved pilot visibility, and an additional Runway 12L-30R partial parallel taxiway for improved 30R departures queuing.

Table 7-1: Near-Term Projects

Project Number	Project Name	Enabling Projects
1-1	Existing T1 FIS Facility Enhancements	N/A
1-2	T2 FIS South Terminal Expansion	Relocate flight kitchen, GRE, QTA; Realign TW S2, add baggage makeup
1-3	Taxiway Edge Geometry	N/A
1-4	Runway 12L-30R Partial Parallel Taxiway and Taxiway P3 Reconfiguration	N/A
1-5	GRE Relocation and RON Apron Construction	Relocate/demolish flight kitchen
1-6	USPS Site Redevelopment	Terminate USPS lease and demolish existing facilities
1-7	Orange Ramp North Expansion and Outrigger Expansions	Coordination with Metro Transit
1-8	Orange and Purple Ramps Vertical Expansion	Relocation of the ASR
1-9	T2 Curb Frontage Improvements	Relocation of the Rental Car CSB

NOTE: Timing for projects will depend on further staging, development, and design of the proposed facilities.
GRE - Ground Runup Enclosure; QTA - Quick Turnaround Area; TW - Taxiway; FIS - Federal Inspection Station; CSB – Customer; Service Building; USPS - United States Postal Service; Airport Surveillance Radar (ASR)
SOURCES: HNTB Corporation, 2023; Ricondo & Associates, Inc., 2023, Kimley-Horn and Associates, Inc., 2023.

7.1.2 Mid-Term Projects

Projects within the Mid-Term begin to replace facilities that are nearing the end of service and improve capacity for landside, terminal, cargo, and airfield.

The landside adjacent to T1 will be reconfigured in conjunction with the Green/Gold ramp redevelopment to allow for better curbside/terminal integration and additional parking. Parking along 34th Ave. will be built to support the facilities at and adjacent to Building C.

Concourses A and B will be reconstructed to accommodate larger aircraft as smaller commercial aircraft are not part of the future fleet mix at the Airport. The 60-year-old Concourse F will be reconstructed to accommodate the expanded international demand with improved LOS. The T1 Federal Inspection Service (FIS) facility will be relocated to the redeveloped Green/Gold ramps for more centralized Terminal access.

The Fixed Base Operator (FBO) will be relocated to the north side of the airfield to allow for further expansion of the T2 facility. Additional cargo projects in the western airfield are included to meet Mid- and Long-Term cargo demand.

Taxiway improvement projects include realigning Taxiway B and Q for better apron and gate access. Taxiway improvements will help minimize taxiway clearance issues in that area. Both RON/deicing locations by Runway End 30L and 30R will be reconfigured for better deicing throughput, including an increase in RON positions. These two projects also open more space for the development of concourse and gates along the eastern side of T1.

Table 7-2: Mid-Term Projects

Project Number	Project Name	Enabling Projects
2-1	Reconstruct Concourse A; Demolish Concourse B	Demolish Concourse B; (2-8) Reconfigure 30R Deice pad
2-2	Reconstruct Concourse F	Demolish Concourse F
2-3	Central Cargo Apron Expansion	N/A
2-4	Runway 30L RON Apron and Deice Pad Reconfiguration	N/A
2-5	West Cargo Apron and Facility	N/A
2-6	FBO Relocation	Relocate RTR/RCAG and fire training facilities
2-7	Runway 12R-30L Tunnel Reconstruction and Taxiway B Realignment	Reconfiguration of the Concourse G gating and VSR
2-8	Runway 30R Deice Pad Reconfiguration	(2-1) Demolish Concourse B
2-9	T1 Two-Level Roadway Reconstruction	(2-10) Green/Gold Ramps redevelopment
2-10	Green/Gold Ramp Redevelopment with New FIS Facility	Landside APM modifications; (1-6) USPS parking redevelopment; (1-7) Orange Ramp North Expansion
2-11	34th Avenue Parking Development	N/A
2-12	TH 5 Interchange Reconstruction	N/A

NOTE: Timing for projects will depend on further staging, development, and design of the proposed facilities.
RON - Remain Overnight; FBO - Fixed Base Operator; FIS - Federal Inspection Station; USPS - United States Postal Service; Vehicle Service Road (VSR); Remote Transmitter Receiver (RTR); Remote Communications Air/Ground (RCAG)
SOURCES: HNTB Corporation, 2023; Ricondo & Associates, Inc., 2023, Kimley-Horn and Associates, Inc., 2023.

7.1.2 Long-Term Projects

Projects within the Long-Term begin to integrate the two terminal complexes with additional increases in gate capabilities at both T1 and T2.

The entry and exit ways adjacent to the T2 landside will be redeveloped for better access and efficiency on the expanded T2 terminal complex.

Concourse E will be reconstructed to better align with the Concourse C flight line and reduce aircraft congestion between Concourses E and F. Concourse G will be expanded for additional gate capacity on the southern side on T1. With the relocation of the FBO, the site will include an expansion of gate and RON positions along the north end of T2. A new underground airside T1-T2 passenger connection will also be developed. The secure-side passenger tunnel will create the possibility for more unified terminal operations between T1 and T2.

A new RON apron will be developed on the southern airfield to add additional overnight aircraft capabilities adjacent to the Humphrey remote Apron.

Table 7-3: Long-Term Projects

Project Number	Project Name	Enabling Projects
3-1	New T2 North Expansion	(2-6) FBO Relocation; Demolish FBO Campus; realign ARFF entry road and 70th St.
3-2	Concourse G South Expansion	Demolish end of Concourse G
3-3	Reconstruct Concourse E	Demolish Concourse E and D
3-4	T1–T2 APM Tunnel Construction	Coincides with scheduled apron and Runway 12R- 30L rehabilitation
3-5	Runway 4-22 Tunnel Reconfiguration and Deice Pad Construction	(2-6) Relocation of the FBO
3-6	South RON Apron Construction	Relocation of the Building 3 employee surface lot
3-7	Runway 12R End-Around Taxiway Construction	Reconfiguration of Runway 12R ALSF-2
3-8	34th Ave. and East 70th St. Reconstruction	(1-9) T2 curb frontage improvements; (2-12) TH-5 Interchange Reconstruction

NOTE: Timing for projects will depend on further staging, development, and design of the proposed facilities.
RON - Remain Overnight; FBO - Fixed Base Operator; FIS - Federal Inspection Station; CSB - Customer Service Building
SOURCES: HNTB Corporation, 2023; Ricondo & Associates, Inc., 2023, Kimley-Horn and Associates, Inc., 2023.

7.2 COST ESTIMATES

Rough order of magnitude (ROM) project cost estimates for the 2040 LTP are summarized in **Table 7-7**. In total, the projects in the 2040 LTP are estimated to cost approximately $6,195,871,000 over the approximately 20-year planning period. Cost estimates were developed by Connico, Inc. and Kimley Horn and Associates, Inc. and are included in **Appendix E**.

The projects' direct costs were based on a traditional design, bid, and build development model. The general contractor's overhead and profit, insurance, and payment and performance bonds were included in the unit costs. Additional cost contingencies, or markups, were added to the direct costs in the ROM estimation. As outlined in the appendix, the estimates were developed including the following markups:

- Estimating Design Evolution: 25.0%
- General Contractor Markups
  - Project Logistics / Phasing & Labor Factor: 5.0%
  - General Requirements and Temporary Construction: 5.0%
  - General Conditions: 8.0%
  - General Contractor Overhead and Profit: 5.0%
  - Insurance: 2.0%
  - Payment and Performance Bonds: 1.0%
- Owner's Soft Costs: 21.3%
  - Construction Manager / Program Management: 0.0%
  - Planning and Preconstruction: 0.2%
  - Architectural / Engineering Design: 10.0%
  - Architectural / Engineering Construction Admin: 2.0%
  - Airport Staff: 4.0%
  - Materials Testing / Inspection / Commissioning: 2.5%
  - Plan Check Services: 0.1%

- o Cost Estimating and Scheduling: 0.5%
- o Miscellaneous Owner Costs (i.e., Legal): 1.0%
- o Artwork: 1.0%

Specific timing of the projects has not been determined and can fluctuate due to changing conditions at the airport and changes in demand and regulatory requirements. Therefore, no escalation was included in the estimation. Additional contingency allowances may be necessary upon further development of each project and/or changes in implementation and scope.

The implementation of the 2040 LTP projects will require further development of design and costs during more in-depth architectural and engineering analyses. Due to these projects being developed at a high level, these costs should be considered “best estimates” that are sufficient for the development of the CIP.

Table 7-4 includes the ROM costs for each project with subtotals for the Near-, Mid-, and Long-Term.

Table 7-4: Rough Order of Magnitude Cost Estimates

Project Number	Project Name	Cost
1-1	Existing T1 FIS Facility Enhancements	$4,918,000
1-2	New T2 FIS South Terminal Expansion	$270,322,000
1-3	Taxiway Edge Geometry	$1,220,000
1-4	Runway 12L-30R Outboard Taxiway and Taxiway P3 Reconfiguration	$65,665,000
1-5	GRE Relocation and RON Apron Construction	$76,512,000
1-6	USPS Site Redevelopment	$620,666,000
1-7	Orange Ramp North Expansion and Outrigger Expansions	$375,353,000
1-8	Orange and Purple Ramps Vertical Expansion	$438,050,000
1-9	T2 Curb Frontage Improvements	$134,026,000
	Near-Term Total	**$1,986,732,000**
2-1	Reconstruct Concourse A, Demolish Concourse B	$161,779,000
2-2	Reconstruct Concourse F	$297,621,000
2-3	Central Cargo Apron Expansion	$29,469,000
2-4	Runway 30L RON Apron and Deice Pad Reconfiguration	$4,457,000
2-5	West Cargo Apron and Facility	$107,524,000
2-6	FBO Relocation	$177,000,000
2-7	Runway 12R-30L Tunnel Reconstruction and Taxiway B Realignment	$14,150,000
2-8	Runway 30R Deice Pad Reconfiguration	$1,689,000
2-9	T1 Two-Level Roadway Reconstruction	$265,978,000
2-10	Green/Gold Ramp Redevelopment with New FIS Facility	$1,288,511,000
2-11	34th Ave. Parking Development	$396,054,000
2-12	TH 5 Interchange Reconstruction	$76,742,000
	Mid-Term Total	**$2,820,974,000**
3-1	New T2 North Expansion	$331,536,000
3-2	Concourse G South Expansion	$256,894,000
3-3	Reconstruct Concourse E	$232,323,000
3-4	T1–T2 APM Tunnel Construction	$317,715,000
3-5	Runway 4-22 Tunnel Reconfiguration and Deice Pad Construction	$65,607,000
3-6	South RON Apron Construction	$86,331,000
3-7	Runway 12R End-Around Taxiway Construction	$68,664,000
3-8	34th Ave. and East 70th St. Reconstruction	$29,095,000
	Long-Term Total	**$1,388,165,000**
	2040 LTP Total	**$6,195,871,000**

NOTES: Dollar amounts are rounded to the nearest $1,000. Project costs are for planning purposes only.
RON - Remain Overnight; FBO - Fixed Base Operator; FIS - Federal Inspection Station; USPS - United State Postal Service

Chapter 8. Stakeholder and Public Engagement Process

Chapter 8 Stakeholder and Public Engagement Process

One of the goals established at the onset of the Minneapolis-Saint. Paul International Airport (MSP) 2040 Long-Term Plan (LTP) was to include meaningful stakeholder engagement throughout the planning process. To fulfill this goal, a series of meetings, events and outreach activities have been conducted throughout the LTP development.

Prior to initiating the LTP, the MAC created a standalone website for sharing information related to the project with the public. This website provides information regarding stakeholder outreach activities, project documentation, relevant internet links, and answers to frequently asked questions. When the draft LTP was out for public comment, it was posted on this website with an explanation about how the public is able to access and submit comments.

The MAC also developed a formal Stakeholder Engagement Plan in 2019. The plan included coordinated efforts to inform, educate, and engage the public and airport users as part of the LTP process. The plan also explained the MAC's approach for documenting the outreach process. MAC published the plan on the project website and used it as a dynamic guide for administering a thorough and effective public involvement program. The stakeholder engagement plan is included in **Appendix F.**

A Stakeholder Advisory Panel (SAP) was formed for the planning process, which met periodically throughout the development of the Draft LTP. The SAP consisted of a broad range of stakeholder groups that are more closely involved in the MSP Airport and long-term planning than the public at large. Stakeholder groups represented on the SAP included:

- Local community leaders and city planners (7)
- Government/Agency partners (6)
- MSP airport traveler groups (3)
- Airlines and other airport users (5)
- Regional business partners (5)
- Tourism associations (4)

The SAP served several important functions including: 1) hear and learn about the planning process; 2) share planning information with constituencies; 3) ensure that those tasked with making planning decisions hear and consider concerns and aspirations related to the development of the LTP. The SAP offers opinions, advice and guidance, but the MAC has sole discretion to act on these recommendations. Six SAP meetings were held during key milestones prior to release of the Draft LTP. A summary report of the SAP meetings, along with agendas, presentation materials, handouts, and minutes are included in **Appendix F**.

The MAC's Stakeholder Engagement Plan also included the use of online polling software to reach an audience wider than typical public meeting audiences. Responses allowed for purposeful information, offering greater value for what the planning team should consider as it began the planning process. Two surveys were conducted and generated a total of 725 responses which helped gather information about passenger travel habits, generate positive attributes of the airport, find improvement ideas and discover innovative opportunities. Summary reports of the surveys are included in **Appendix F**.

The MAC also held four public events at key milestones during the planning process. These public events, coined "Experience MSP", presented the same information provided at SAP meetings. Fliers, publication affidavits, presentation materials and handouts from these events are included in **Appendix F**.

The meetings and events held during the development of the draft LTP are listed in **Table 8-1**.

Table 8-1 (1 of 2): Meetings and Events Held During Draft LTP Development

Audience	Materials Covered	Date	Location
MSP Noise Oversight Committee (NOC)	LTP Introduction, Goals, Process, Engagement Program and Schedule	3/20/2019	MAC
MSP NOC	LTP Engagement and Schedule	5/15/2019	MAC
MAC Planning, Development and Environment (PD&E) Committee	LTP Introduction, Goals, Process, Engagement Program and Schedule	6/3/2019	MSP
MSP Long-Term Plan Stakeholder Advisory Panel	LTP Introduction, Goals, Process, Engagement Program and Schedule	6/10/2019	Crowne Plaza, Bloomington
MSP NOC	LTP Engagement and Schedule	7/17/2019	MAC
MSP Long-Term Plan Stakeholder Advisory Panel	Aviation Activity Forecast Overview, Capacity Study, Review Stakeholder and Public Input	8/27/2019	InterContinental MSP Airport
MAC PD&E Committee	Aviation Activity Forecasts	9/3/2019	MSP
Minneapolis Intergovernmental Relations Committee	LTP Introduction, Goals, Process, Engagement Program, Existing Conditions, Aviation Activity Forecasts and Capacity Study	9/25/2019	Minneapolis City Hall
Public Experience MSP Event #1	LTP Introduction, Goals, Process, Engagement Program, Existing Conditions and Aviation Activity Forecasts	10/2/2019	Mall of America Executive Center
Minneapolis City Council and Staff Meeting	Aviation Activity Forecasts and Capacity Study	10/18/2019	Minneapolis City Hall
MSP Long-Term Plan Stakeholder Advisory Panel	Aviation Activity Forecasts, Capacity Study, Review Stakeholder and Public Input	1/30/2020	Crowne Plaza, Bloomington
Pause in the LTP process due to the COVID-19 pandemic			

Source: Metropolitan Airports Commission (MAC)

Table 8-1 (2 of 2): Meetings and Events Held During Draft LTP Development

Audience	Materials Covered	Date	Location
Pause in the LTP process due to the COVID-19 pandemic			
MSP NOC	Aviation Activity Forecast Update and LTP Schedule	11/10/2021	Virtual
MAC PD&E Committee	Aviation Activity Forecast Update and LTP Schedule	12/6/2021	MSP
MSP Long-Term Plan Stakeholder Advisory Panel	COVID-19 Airport Impacts, Aviation Activity Forecast Update and LTP Schedule	12/10/2021	Virtual
MSP NOC	LTP Process, Engagement Program and Schedule	3/16/2022	Virtual
Public Experience MSP Event #2	LTP Goals, Process, Existing Conditions, Aviation Activity Forecast Update and Capacity Study	4/12/2022	Virtual
MSP Long-Term Plan Stakeholder Advisory Panel	LTP Process, Engagement Program, Facility Requirements Overview and Preliminary Alternatives Review	8/4/2022	Bloomington CVB and Virtual
Public Experience MSP Event #3	Facility Requirements and Alternatives Review	8/23/2022	MAC
MAC PD&E Committee	LTP Process, Engagement Program, Facility Requirements, Alternatives Review and Preferred Alternative	2/6/2023	MSP
MSP NOC	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Aircraft Noise Analysis	3/15/2023	MAC
City of Minneapolis Airport Working Group	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Aircraft Noise Analysis	4/12/2023	Virtual
MSP Long-Term Plan Stakeholder Advisory Panel	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Aircraft Noise Analysis	4/13/2023	Crowne Plaza, Bloomington and Virtual
Metropolitan Council Technical Advisory Committee	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	5/3/2023	Metropolitan Council
Metropolitan Council TAC Planning Sub-Committee	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	5/11/2023	Virtual
Metropolitan Council Transportation Advisory Board	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	5/17/2023	Metropolitan Council
MAC PD&E Committee	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	6/6/2023	MSP
Public Experience MSP Event #4	LTP Process, Engagement Program, Facility Requirements, Preferred Alternative and Preliminary Findings	7/11/23	Sabathani Community Center

Source: Metropolitan Airports Commission (MAC)

A 60-day public comment period began on June 21, 2023 and ended on August 21, 2023. Three weeks into the comment period, the fourth and final public Experience MSP event was held to present the draft LTP findings and preferred development alternative to the public. Approximately 60 members of the public attended the event.

The following communication tactics were used to advertise the public event and solicit comments on the draft 2040 LTP:

- Electronic newsletters
- Mailing 39,610 postcards to residents surrounding the airport
- Using paid advertising, focusing on people living within 10 of MSP Airport
- Publishing four Public Notices in area newspapers
- Issuing a Press Release
- Social Media Posts
- Updating the 2040 LTP website and advertising the event on metroairports.com
- Distributing four hard copies of the draft 2040 LTP document in the community
- Presenting updates at public meetings and airport employee/stakeholder meetings

A total of 139 public comments were received during the public comment period and ranged in a variety of topics, of which the pronounced areas of public comments included noise, terminal, landside, and MAC communications. In addition to members of the public, comment letters were submitted by the City of Minneapolis and Metropolitan Council.

The noise comments were largely comprised of complaints regarding existing aircraft noise, as well as the concern about aircraft noise for future aircraft operations. As the primary focus of the MSP 2040 LTP remains with terminal function and footprint, the MAC will continue its long history of collaborating with stakeholders, including neighboring communities, to reduce noise. There are existing noise abatement procedures air traffic control will continue to utilize in reducing noise over residential areas when feasible, as well as continue to implement eligible homes with sound insulation mitigation. To-date, the sound insulation program has invested over $500 million in communities that surround the airport.

The terminal comments focused on passenger connectivity and the promotion of connecting passengers between T1 and T2 from the secure-side of the airport. Other topics included the notion of an undersized Federal Inspection Service (FIS) facility in T1, passenger connection times for connecting passengers in T1, and the request to add moving walkways in the terminals where they do not exist today.

Landside public comments focused on the need for curbfront improvements required in front of both T1 and T2 and acknowledged the need to reduce vehicle congestion. There were a couple of comments regarding the existing Metro Transit Light Rail (LRT) connection between both terminals and the need for increased safety, however the MAC has been partnering with LRT police and the City of Bloomington police department in an effort to improve LRT safety concerns. Electrical vehicles (Evs) were commented on, though the LTP acknowledges the emerging nature of this topic and MAC's desire to continue evolving landside services available. **Table 8-2** summarizes the number of comments by each category.

Table 8-2: Public Comments: Summary of Topics

Comment Category	Number of Comments	Percent of Total
Airline Relations	2	1%
Airside	6	4%
Environmental	9	6%
Indiscernible	6	4%
Landside	15	11%
MAC Communications	11	8%
Noise	69	50%
Terminal	21	15%
TOTAL	139	100%

Source: Metropolitan Airports Commission (MAC)

Appendix G includes general responses developed to address questions and comments that were consistent among the public comments received. Specific responses to comments received from municipalities and agencies are also provided.

After reviewing the body of public comments, MAC staff has affirmed its position that the preferred alternative represents a reasonable, practical, and cost-effective way to address the stated planning goals.

The Final Draft 2040 MSP LTP narrative report was submitted to the Metropolitan Council for review in January 2024. Under MS 473.165 and MS 473.611, the Metropolitan Council reviews long term comprehensive plans for each airport owned and operated by the MAC. The Council reviews and comments on all plans for consistency with the metropolitan development guide including Thrive MSP 2040 and the Transportation Policy Plan.

Obtaining the full Council's determination of consistency involved presentations to four standing committees as well as the Full Council, as outlined in **Table 8-3**. The Full Metropolitan Council provided its determination of consistency on March 27, 2024.

Table 8-3: Metropolitan Council Consistency Determination Meetings

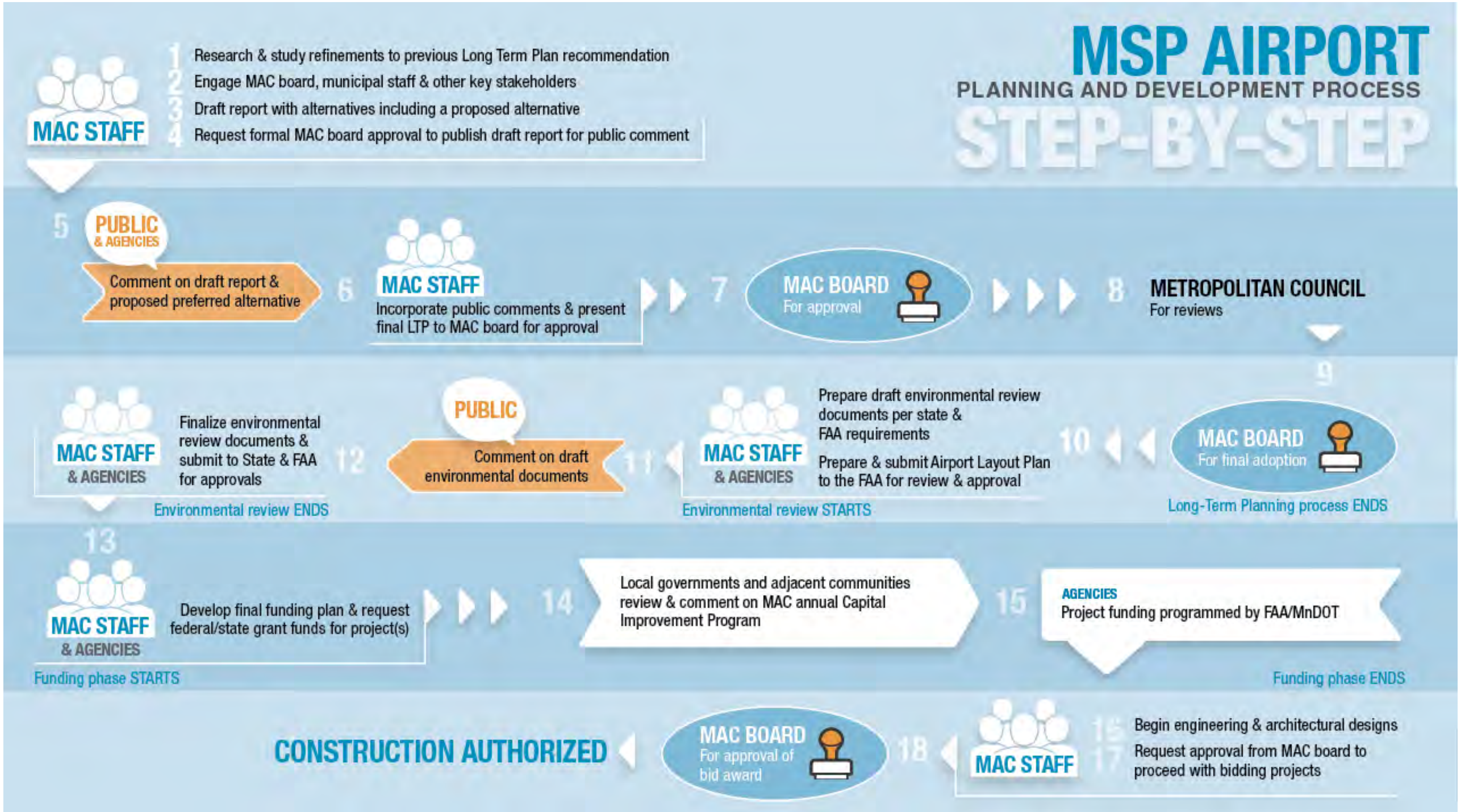
Council Body	Date	Action Requested	Result
TAC Planning	January 11, 2024	Review & Recommend	Passed unanimously
Technical Advisory Committee	February 7, 2024	Review & Recommend	Passed unanimously
Transportation Advisory Board	February 21, 2024	Review & Recommend	Passed unanimously
Transportation Committee	March 11, 2024	Review & Recommend	Passed unanimously
Full Council	March 27, 2024	Review & Determine	Passed unanimously

Note: Meeting materials are available at www.metrocouncil.org.

The MAC Board voted to formally adopt the MSP 2040 LTP on May 20, 2024.

Exhibit 8-1 illustrates the next steps for the planning and project implementation process, including what points additional approvals are needed and what points public feedback will be solicited.

Exhibit 8-1: Planning and Project Implementation Process



Source: Metropolitan Airports Commission (MAC)

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