4. Demand/Capacity Assessment and Facility Requirements

In this section, the demand forecast for FLL is compared with the existing capacity of each Airport component or system. Capacity gaps are identified and used to quantify future facility requirements for the Airport. The facility requirements reflect improvements necessary to meet growing demand and potentially changing demand characteristics, as well as necessary to improve operating efficiency and customer service, or to renew necessary infrastructure, systems, and facilities.

4.1 General Overview

The relationship between demand and capacity and how that relationship impacts the planning of future facilities is complex. Numerous issues affect how efficiently a certain level of activity (i.e., demand) can be accommodated within a specific system or facility (i.e., capacity). Acceptable levels of service or convenience vary by user, facility, and airport sponsor.

The purpose of the comparative analyses is to determine the relationship between demand and capacity in the context of various Airport components or systems, as well as to provide general assessments of the ability of existing facilities to accommodate current and future demand levels. The Master Plan Update (MPU)'s Aviation Activity Forecasts included two sets of demand forecasts: the Baseline Forecasts and the Accelerated Baseline Forecasts. The Baseline Forecasts reflect forecasts of future activity based upon historical trends at the Airport, aviation industry factors anticipated to have an effect on future activity at FLL, and socioeconomic regressions analysis correlating passenger activity at the Airport with socioeconomic factors, such as population, employment, and per capita personal income. The Accelerated Baseline Forecasts estimate the effect of faster passenger airline growth at the Airport. Assumptions on the magnitude and timing of the accelerated passenger airline growth in these forecasts were developed with the consideration of information gathered during individual discussions with several airline representatives regarding their respective growth plans at FLL. The information gathered included planned (future) daily activity levels, distribution of activity throughout the day, peaking profiles, regions and timing for growth, capacity increases, load factor assumptions, and potential aircraft use. An assessment of the origin/destination absorption and market potential for FLL and the South Florida region was conducted to assess the ability of the airlines to concurrently implement and sustain various levels of the future service identified during the individual airline discussions. The Accelerated Baseline Forecasts reflect a combination of the individual airline discussions and the market assessment, resulting in an alternate set of future Airport activity levels deemed achievable and sustainable.

Demand levels are presented for the 2020, 2025, and 2035 planning horizons. **Table 4.1-1** summarizes the FAA-approved forecast demand at each planning year for the Baseline and Accelerated Baseline Forecasts. The Baseline Forecasts comprise the FAA-preferred forecasts, and they are used to evaluate functional systems whose requirements are based on aircraft operations. The Accelerated Baseline Forecasts are the BCAD-preferred forecasts, and they are used to evaluate passenger terminal and landside facilities whose requirements are based on enplanement numbers.

Table 4.1-1: Forecast Demand

ESTIMATED TIMELINE (FISCAL YEAR)	ANNUAL ENPLANED PASSENGERS	ANNUAL TOTAL AIRCRAFT OPERATIONS
Current (2015 - Actual)	13,214,469	274,754
Baseline Forecast:		
2020	16,393,000	322,600
2025	18,327,000	347,400
2035	22,293,000	400,300
Accelerated Forecast:		
2020	18,372,000	346,600
2025	20,955,000	377,600
2035	26,198,000	432,600

SOURCE: Ricondo & Associates, Inc., *FLL Master Plan Forecast*, June 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

The analyses documented in this section are organized by functional system, with each system assessed separately. The facility requirements for each system will provide the foundation for the subsequent definition of alternative concepts to meet the forecast demand over the 20-year planning horizon. Eight functional systems were identified:

- **Airfield Facilities** include airfield elements that support the arrival, departure, ground circulation, overnight parking, and remote aircraft parking beyond the terminal apron area. The assessment of required facilities addresses the airfield configuration (runway location and runway lengths), the supporting taxiway system, and aircraft overnight parking and remote parking capabilities. The ability of the existing airfield to accommodate forecast operational demand (magnitude and characteristics), in terms of runway capacity and design standards, was evaluated.
- **Passenger Terminal Gates and Facilities** include the passenger processing, baggage screening and handling, airline, and security facilities from the terminal curbside to the aircraft gates. Enplaning, deplaning, and connecting passenger demands define the need for various facilities, such as passenger holdrooms, baggage claim facilities, international arrivals processing facilities, public circulation areas, airline leased space (ticket counters, operations area, baggage makeup area), security screening space, concessions, and other terminal space (e.g., administration). Terminal gates/aircraft parking requirements were established according to peak-hour demand for commercial passenger aircraft currently serving, and anticipated to serve, the Airport.

- **Airport Ground Access** includes on- and off-Airport vehicular roadway, access, and circulation systems. The demand associated with these systems is driven by passenger demand and the distribution of the various modes of transportation that serve the Airport and operate on the local roadways:
  - on-Airport terminal roadways
  - on-Airport nonterminal roadways
  - off-Airport roadways
- **Public and Employee Parking Facilities** include the on-Airport parking facilities, such as short-term, long-term, and employee, as well as off-Airport parking facilities on BCAD-controlled parcels and operated by Airport staff or Airport contractor. Parking requirements are based on forecast originating passengers. The ability of existing parking facilities to accommodate forecast demand for parking spaces was evaluated.
- **Rental Car Facilities** include the customer service area, ready/return and onsite vehicle storage areas, and the QTA facilities. Rental car facility requirements are based on forecast terminating passengers. The ability of existing rental car facilities to accommodate forecast demand was evaluated.
- **General Aviation Facilities** include:
  - FBO facilities
  - corporate-based operator facilities
  - general aviation aircraft manufacturing and service repair centers
- **Support Facilities** include:
  - airline support facilities (aircraft maintenance and aircraft ground support equipment)
  - airport support facilities (i.e., Airport maintenance, Airport administration, operations, Aircraft Rescue and Firefighting [ARFF] station, and fuel storage facility)
  - FAA facilities (i.e., ATCT)
  - U.S. CBP facilities
- **Air Cargo Facilities** include cargo apron space, processing facilities/building areas, other cargo terminal space (administration, utilities, etc.), aircraft parking positions, and vehicle parking/truck docks. Air Cargo requirements were established according to the type of cargo companies expected to operate at the Airport and the forecast annual air cargo operations and tonnage.
- **Regional Roadways** include off-Airport ground access. The demand associated with these facilities is driven by passenger demand, as well as by the distribution of the various modes of transportation that serve the Airport and local roadway system.

The methodologies used to determine facility capacity and requirements are in accordance with industry standards, FAA guidance, and planning factors adjusted, as appropriate, to reflect actual Airport-use characteristics. In calculating demand/capacity, the information presented in Sections 2 and 3 of this MPU was used, along with any additional information that more accurately reflects existing or future conditions. Planning experience at, and knowledge of, other airports was also used as appropriate in the evaluation of facility capacities. This approach ensures that capacity assessments are sensitive to the specific requirements at FLL but are also reflective of industry standards and practices.

4.2 Airfield Facilities

The planning and design of airport facilities are typically based on the role of the airport and the design aircraft expected to operate on the airfield. The FAA provides planning and design guidance through published ACs, Orders, and other guidelines that are intended to promote airport safety, efficiency, and security. FAA airfield planning and design standards governing the geometric layout of runways and taxiways are detailed in AC 150/5300-13A, *Airport Design*, Change 1.

In addition to providing the appropriate geometric parameters for the design aircraft expected to operate on the airfield, airfield facilities must also be designed to provide sufficient capacity to accommodate the activity forecast to occur over the 20-year planning period. An airfield demand/capacity analysis is typically conducted to assess the capability of airfield facilities to accommodate existing and forecast aircraft operations. In analyzing the ability of FLL facilities to accommodate operational demand, airfield demand and capacity and potential aircraft delay were calculated using the methodologies set forth in AC 150/5060-5, *Airport Capacity and Delay*, Change 2.

4.2.1 DESIGN AIRCRAFT

This section summarizes the design aircraft that currently operate at FLL or could be expected to operate at the Airport in the future, which is in accordance with the fleet mix projection from the ongoing FLL MPU and recent service announcements by select air carriers. The design aircraft is the most demanding aircraft with 500 or more annual operations at the Airport.

4.2.1.1 Airplane Design Group - Existing Fleet Mix

Based on the FLL ANOMS data from the period of January 1, 2015, through December 31, 2015, the B787-8 was the largest aircraft (in terms of wingspan, tail height, and weight) that conducted more than 500 operations. While the B777-200 is larger in terms of wingspan and tail height, it did not meet the 500 annual operations threshold in 2015. However, with Emirates now operating the B777-200 and British Airways scheduled to start daily service of the same aircraft type in July 2017, the B777-200 will replace the B787-8 as the design aircraft, in terms of wingspan and tail height.

4.2.1.2 Airplane Design Group - Potential Future Fleet Mix

Other potential aircraft that could be expected to operate at FLL in the 20-year planning horizon, and eventually exceed the 500 operational demand threshold, include the A330-800neo, B777-300/300ER, and B787-9. Since all of these aircraft fall into ADG V, the ARC and RDC would not change. Operations by ADG VI aircraft, such as the B747-8 or A380, are not anticipated to occur at FLL in the 20-year planning horizon.

4.2.1.3 Taxiway Design Group Considerations

In terms of Taxiway Design Group (TDG), the B787 and B777 are also the critical aircraft, resulting in a TDG 5. While the MD11, which is currently operated by FedEx at FLL, falls into TDG 6, it does not exceed the threshold of 500 annual operations (357 operations reported in 2015). However, if Emirates (or another carrier) decides to operate the B777-300 in the future, which is also TDG 6, it could exceed the 500 annual operations threshold. Therefore, it is prudent to apply the TDG 6 pavement geometry design standards into the taxiway design. **Table 4.2-1** summarizes the characteristics of potential design aircraft at FLL.

Table 4.2-1: Potential Design Aircraft

AIRCRAFT TYPE	WINGSPAN (FEET)	TAIL HEIGHT (FEET)	MTOW (POUNDS)	TAXIWAY DESIGN GROUP
Current Fleet:				
B787-8	197.0	56.0	502,500	5
B777-200	212.6	61.5	766,800	5
MD-11	170.5	58.8	630,500	6
Potential Future Fleet:				
A330-800neo	210.0	57.1	533,500	5
B777-300	199.8	61.5	660,000	6
B777-300 ER	212.6	61.8	775,000	6
B787-9	197.3	56.0	560,000	5

NOTE: Current design aircraft in purple box.

SOURCES: Broward County Aviation Department, Fort Lauderdale-Hollywood International Airport Noise and Operations Monitoring System, 2016 (January 1, 2015, through December 31, 2015); Ricondo & Associates, Inc., FLL Master Plan Update Activity Forecasts, January 2017; Federal Aviation Administration, Advisory Circular 150/5300-13, Airport Design, Change 1, February 2016.

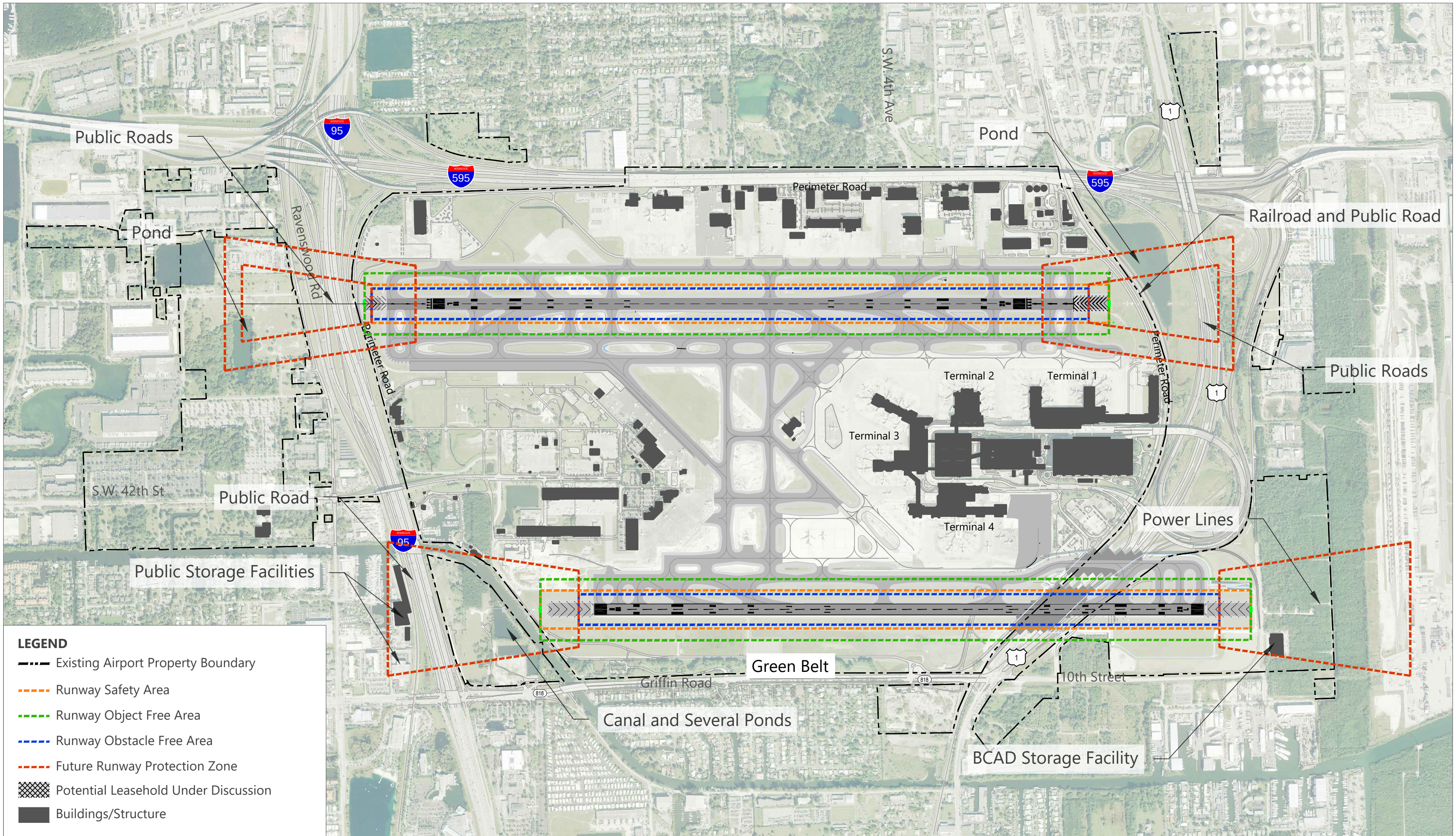
PREPARED BY: Ricondo & Associates, Inc., March 2017.

4.2.2 AIRFIELD SAFETY AND PROTECTION AREAS

Safe and efficient Airport operations require that certain areas on or near the Airport are clear of objects/obstructions or are restricted to those objects functionally necessary, such as lights and navigational aids. An evaluation of the runway safety areas, runway object free areas, runway object free zones, and runway protection zones (RPZ) revealed no encroachments or incompatible land uses on these surfaces. **Exhibit 4.2-1** depicts these surfaces and highlights land uses inside the RPZs that may need to be considered, should the RPZ locations and/or dimensions change as a result of the *Alternatives Definition and Evaluation* analysis in Chapter 5:

- public roads through RPZs
- building in Runway 28L RPZ (Lancaster Steel Building) used for BCAD storage
- buildings in Runway 10R RPZ (Dry Dock Boat Storage Facility and Private Storage Facility)
- High-voltage power lines in Runway 28L RPZ

THIS PAGE INTENTIONALLY LEFT BLANK



SOURCE: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport Layout Plan*, July 15, 2015.
PREPARED BY: Ricondo & Associates, Inc., May 2017.

EXHIBIT 4.2-1

NORTH 0 2,000 ft.

Runway Surfaces and Relevant Land Uses

Drawing: P:\Project-Miami\BCAD\2015 Master Plan Updates\01 - FLL Tasks\II-2 D-C & Facility Requirements\CAD\FLL - Surfaces Exhibit_20160921.dwgLayout: Runway Surfaces and Relevant Land Uses Plotted: Oct 28, 2020, 05:41PM

THIS PAGE INTENTIONALLY LEFT BLANK

4.2.3 AIRFIELD GEOMETRY

In addition to a significant evolution in aircraft characteristics at an airport, many airports were designed long before current geometry standards came into effect and, as a result, may not meet the latest standards set forth in AC 150/5300-13A, *Airport Design*, Change 1. Airfield geometry is typically tailored to the projected design aircraft. The existing design aircraft at FLL is the Boeing 787-8, an ADG V aircraft. The future design aircraft through the planning horizon is the Boeing 787-9, also an ADG V aircraft. The existing and baseline airfield geometry fully complies with ADG V and TDG 6 design standards and, therefore, requires no modifications.

4.2.4 AIRFIELD DEMAND/CAPACITY ANALYSIS

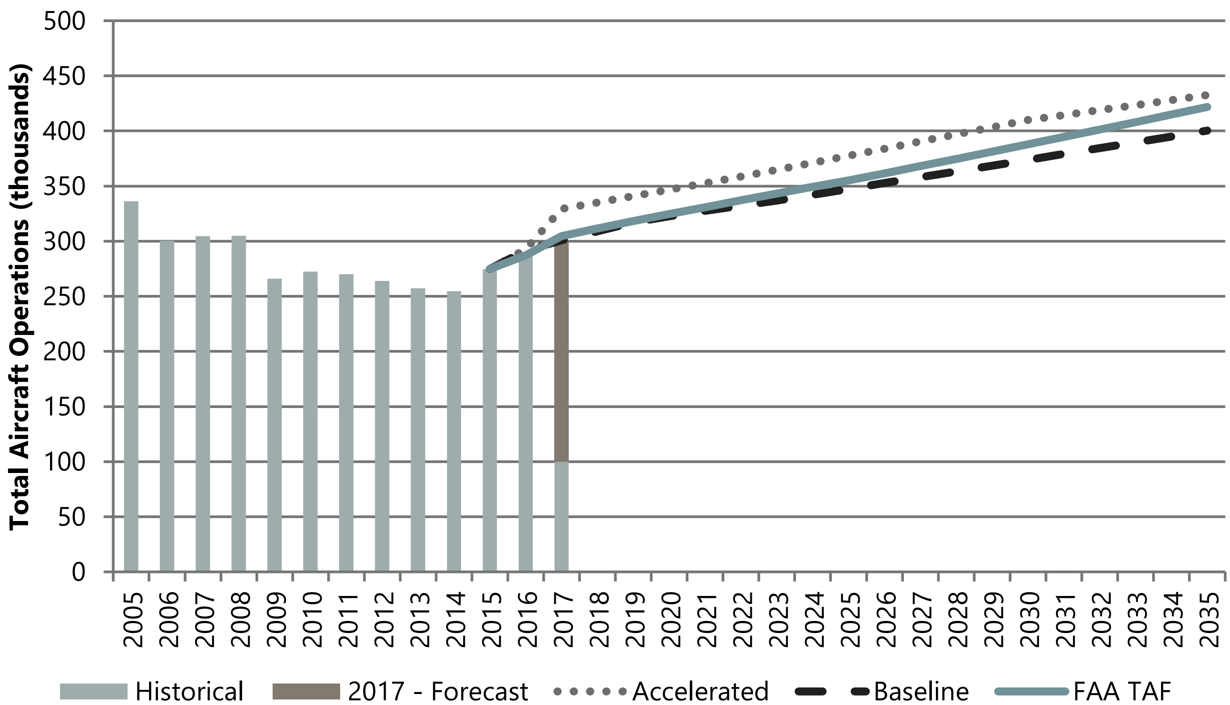
An airfield demand/capacity analysis was conducted to assess the capability of the airfield facilities at FLL to accommodate existing and forecast aircraft operations (baseline forecast) through the planning horizon (2035), as depicted on **Exhibit 4.2-2**. Hourly runway capacity estimates were identified and compared to the peak-hour design day flight schedule (DDFS) to determine if any airfield capacity enhancement measures may be required during the planning period (2015–2035). Details pertaining to the methodology and results of this analysis are documented in the following subsections.

Airfield capacity, also referred to as “throughput,” is defined as the maximum number of aircraft operations that can be accommodated on an airfield during a specific period of time without incurring an unacceptable level of delay. The threshold for acceptable level of delay varies among airports is dependent on tolerance of aircraft operators that utilize the facility. For a large hub airport, the level of acceptable delay typically range between 6 and 10 minutes. Airfield capacity varies according to weather conditions, types of aircraft operating on the airfield, airfield configuration, and ATC procedures. The number and location of runway exits, and the share of touch-and-go operations also influence airfield capacity. Aircraft delay increases exponentially as the number of aircraft operations (i.e., demand) nears or exceeds the airfield capacity under a specific operating condition.

The following terms, as defined by the FAA, are used in describing the analysis:

- **Annual Service Volume (ASV).** As defined in AC 150/5060-5, *Airport Capacity and Delay*, Change 2, ASV “is a reasonable estimate of an airport’s annual capacity.” In estimating ASV, the hourly, daily, and seasonal variations in aircraft demand associated with the airfield are considered, as well as the occurrence of low visibility and/or cloud ceiling heights in which ATC procedures are modified to maintain aircraft operational safety.
- **Average annual delay per operation.** This is an estimate of the average delay that each aircraft operation is expected to experience in a given year. Some aircraft operations, such as those occurring during peak operating hours, would likely experience higher delays, while other operations, such as nighttime operations, would likely experience little or no delay.

Exhibit 4.2-2: Operations Forecast Comparison—Baseline Forecast versus FAA Terminal Area Forecast



NOTE: The FAA Terminal Area Forecast is based on federal FY (October–September).

SOURCES: Broward County Aviation Department, March 2016 (Historical); Federal Aviation Administration, Terminal Area Forecast, January 2016; Ricondo & Associates, Inc., March 2016 (Forecast).

PREPARED BY: Ricondo & Associates, Inc., March 2017.

4.2.4.1 Factors Affecting Airfield Capacity

The capacity of an airfield, including the runways and associated exit taxiways, is not constant over time. A variety of factors can affect airfield capacity at an airport, including:

- airfield layout
- percentage of time the airport experiences poor weather conditions (i.e., low cloud ceilings and/or low visibility)
- aircraft fleet mix (types of aircraft operating at the airport)
- frequency of touch-and-go operations
- airfield operating configuration (runway use restrictions)
- existing airfield demand/capacity and delay relationships
- hourly airfield capacity

Airfield Layout

The number of runways, their orientation, the locations of runway intersections, and the lateral separation between parallel runways are primary factors affecting airfield capacity. The number of runway exits, their locations, and their type (high-speed, acute angle, 90-degree, etc.) also affect the capacity of the airfield.

When an airfield configuration includes parallel runways, such as FLL, the lateral spacing between the runways also affects airfield capacity. The separation between the centerlines of Runways 10L-28R and 10R-28L is 4,005 feet. Parallel runways with a lateral centerline-to-centerline separation of 2,500 feet or more can operate as independent runways during VMC. This separation allows aircraft to arrive on or depart from each runway simultaneously.

During IMC in a radar-controlled environment, the minimum lateral spacing between the centerlines of parallel runways is 2,500 feet for dependent arrivals. At this separation, simultaneous departures may occur independently. Dependent staggered approaches to the parallel runways are typically conducted with a minimum 1.5-mile separation diagonally between successive aircraft on adjacent runways. Increasing the lateral separation of the runways to 4,300 feet or more would allow for simultaneous independent arrivals and/or simultaneous departures on the parallel runways during IMC, provided that instrument approach procedures are in place for both runways. If an airport is equipped with a precision runway monitor (PRM), then simultaneous arrivals or simultaneous departures may occur during IMC with a centerline separation of 3,400 feet between parallel runways (FLL is not currently equipped with a PRM).

Another factor affecting airfield capacity is the amount of time an aircraft occupies a runway. Runway occupancy time (ROT) for arriving aircraft is a function of the number, type, and location of runway exits, as well as aircraft performance. Typically, lighter aircraft require shorter runway distances for landing and, therefore, occupy the runway for a shorter time. However, if a runway exit is not available once the aircraft has decelerated to a speed that allows for safe maneuvering off the runway, then airfield capacity is reduced.

Obliquely angled exit taxiways, when properly located along a runway, can more effectively reduce ROTs than 90-degree exit taxiways. Angled exit taxiways are aligned at an oblique angle relative to the runway centerline, typically between 30 and 45 degrees relative to the runway orientation. This angle allows arriving aircraft to exit more expeditiously than standard exit taxiways that are perpendicular to the runway, resulting in lower ROT and increased airfield capacity.

Weather Conditions

Airfield capacity can vary significantly based on the weather conditions at an airport. Prevailing winds (direction and speed) dictate which runways can be used for aircraft arrivals and departures. Aircraft typically land and take off into the wind, and they can accommodate a limited amount of crosswind and tailwind. If the maximum crosswind or tailwind is exceeded, then the aircraft may not operate safely on that particular runway. Therefore, wind conditions may prevent the use of a higher capacity runway operating configuration, thereby increasing aircraft delay.

Other meteorological conditions affecting airfield capacity include cloud-ceiling height and visibility. Low cloud ceilings and poor visibility result in increased spacing between aircraft in the airspace surrounding the airport. These conditions may also restrict which runways can be used, as arrivals in these conditions require the use of instrument landing systems. Visual flight rules govern the procedures used to conduct aircraft operations in VMC. Similarly, instrument flight rules govern the procedures used to conduct aircraft operations in IMC. The criteria defining the two operating conditions are summarized in **Table 4.2-2**.

Table 4.2-2: Operating Conditions for Airfield Capacity and Aircraft Delay Analysis

	WEATHER CONDITIONS		
CLASSIFICATION	VISIBILITY		CLOUD CEILING
VMC	Greater than or equal to 3 statute miles	and	Greater than or equal to 1,000 feet above ground level
IMC	Less than 3 statute miles	and/or	Less than 1,000 feet above ground level

NOTES:

VMC = Visual Meteorological Conditions

IMC = Instrument Meteorological Conditions

SOURCE: Federal Aviation Administration, Advisory Circular 150/5060-5, *Airport Capacity and Delay*, Change 2, December 1, 1995.
PREPARED BY: Ricondo & Associates, Inc., October 2015.

During VMC, aircraft arrive on and depart from both parallel runways. During IMC, in-trail separations for arrivals and departures are increased, thus reducing the hourly capacity of the airfield.

Aircraft Fleet Mix

The aircraft fleet mix operating at an airport is an important factor in determining airfield capacity. As the diversity of approach speeds and aircraft weights increases, airfield capacity decreases because of the increased in-trail separation required to avoid wake vortices or wake turbulence. Turbulence is created behind an aircraft as a result of its movement through the air. Heavier aircraft produce more severe wake vortices than lighter aircraft. Although more prevalent during departures than arrivals, wake vortices are considered a significant safety hazard during any airborne operation.

To alleviate the hazards of wake vortices to the in-trail (following) aircraft, aircraft are spaced according to the differences in their airspeed and weight. Light aircraft are more likely to be impacted by wake vortices than heavy aircraft. Therefore, light aircraft are typically required to wait up to 2 minutes before operating on a runway after a heavy aircraft. This delay results in a reduction in airfield capacity. The greater the size and weight differential of the aircraft fleet using a specific runway, the greater the increased separation required between successive aircraft operations on that runway.

AC 150/5060-5, *Airport Capacity and Delay*, Change 2, uses a factor referred to as the “mix index” to account for aircraft fleet composition. The mix index is represented as a percentage to quantify the share of large aircraft in the fleet mix. To establish the mix index, aircraft are assigned to one of five categories based on the maximum certificated takeoff weight of the aircraft. Based on the number of operations in each classification, a percentage is established to quantify the share of total aircraft operations at an airport by aircraft type that result in wake turbulence hazards. **Table 4.2-3** summarizes the five aircraft classifications in accordance with the maximum certificated takeoff weight of the aircraft in the fleet mix.

Table 4.2-3: Aircraft Classifications for Establishing Aircraft Mix Index

AIRCRAFT CLASSIFICATION	MAXIMUM CERTIFICATED TAKEOFF WEIGHT (POUNDS)	REPRESENTATIVE AIRCRAFT
Small	12,500 or less	Piper P23, Cessna C-180, Cessna C-207, and King Air
Small +	12,501 to 41,000	Lear 25, Cessna Citation, and Grumman G-1
Large	41,001 to 225,000	Gulfstream IV, F-28, Dash 8, Boeing 737, and Boeing 727
B757	225,001 to 300,000	Boeing 757-200/300
Heavy	300,001 or more	Boeing 767, DC-10, A380, Boeing 747-8

NOTE:

The B757 is in a separate category to account for special wake turbulence separation criteria.

SOURCES: Federal Aviation Administration, Advisory Circular 150/5060-5, *Aircraft Capacity and Delay*, Change 2, December 1, 1995; Airport Cooperative Research Program (ACRP) Report 79, *Measuring Airfield Capacity and Delay*, 2012.

PREPARED BY: Ricondo & Associates, Inc., October 2012.

Airfield Operating Configuration

As previously discussed, the layout of the airfield can result in a variety of operating configurations. Weather is a primary factor in dictating which operating configuration is used. However, other factors may influence operating configuration, including available runway departure and arrival lengths and the proximity of obstructions (structures and terrain), the proximity of other airports, and airspace constraints and interactions.

Aircraft performance characteristics may restrict aircraft operations on a runway. For departures, the available runway length must equal or exceed the runway length requirements specified for the departing aircraft. These requirements include the runway length needed for the takeoff ground roll, the runway length needed to clear an obstruction of a specified height (typically 35 feet AGL), and the aircraft accelerate-stop distance. If the available runway length is not adequate to accommodate an aircraft, then that aircraft is required to depart from a runway that provides adequate departure length, or the aircraft payload must be reduced. Similarly, the landing distance available on the runway must exceed the landing distance requirements prescribed for the aircraft. Otherwise, the aircraft would be required to land on a longer runway.

Aircraft departures may also be restricted by the presence of obstacles. These restrictions are based on the climb performance of the aircraft and the location of the obstacles relative to the departure route of the aircraft. Potential obstructions to aircraft takeoff and initial departure climb are of particular importance. Aircraft operations conducted under 14 Code of Federal Regulations (CFR) Part 121, *Operating Requirements: Domestic, Flag, and Supplemental*

Operations, or 14 CFR Part 135, *Operating Requirements: Commuter and On-Demand Operations and Rules Governing Persons on Board Such Aircraft,* must adhere to an airport obstacle analysis prior to departure. If an obstacle that would not allow the departing aircraft to meet the minimum obstacle clearance requirements prescribed by the FAA is identified, then the departure would not be permitted. The presence of this obstacle would restrict the use of the runway, thus affecting the airfield's operating configurations.

Runway use may also be predicated on regional ATC procedures associated with nearby airports. The presence of neighboring airports often requires the shared use of navigational facilities or approach/departure fixes. In such cases, strict coordination between ATC facilities is required, and the capacity of the overall regional airspace system could be restricted. In some instances, specific operating configurations at one airport may take precedence over operations at another airport, which could restrict the use of certain operating configurations at the airport that has lower priority.

There are no obstacle constraints that influence airfield operating configurations at FLL. The proximity of the MIA Class B airspace prevents jet aircraft from flying downwind on the south side of the Airport. Heavier departing aircraft may be assigned to the longer Runway 10L-28R.

Existing Airfield Demand/Capacity and Delay Relationships

This section presents the estimated capacity of the existing airfield in terms of hourly capacity and ASV for each one of these planning horizons for the Baseline and Accelerated Baseline Forecasts: 2015, 2020, 2025, and 2035.

For each runway use configuration, hourly capacities were established for operations during VMC and IMC. Historical weather and runway use data obtained from the FAA were employed to determine how often each configuration is used. A weighted hourly capacity was then established based on the occurrence rate of each runway use configuration/weather condition and its respective hourly capacities. The weighted hourly capacity forms the basis for determining the airfield's ASV.

ASV represents the estimated annual number of aircraft operations an airport can efficiently accommodate, taking hourly, daily, and monthly operational patterns into consideration. The formula for calculating ASV consists of three variables: CW (weighted hourly capacity), D (the ratio of annual demand to average daily demand in the peak month), and H (the ratio of average daily demand to average peak-hour demand during the peak month). These variables are multiplied together (CW*D*H) to obtain the ASV for the Airport.

Hourly Airfield Capacity

When hourly demand begins to reach hourly capacity, aircraft delays grow at an increasing rate. These delays take the form of extended arrival traffic patterns and departure queue delays in VMC, or holding patterns and flow control delays in IMC. As aircraft delays are most prevalent during peak demand periods, the hourly throughput of the airfield is compared with peak-hour demand in the demand/capacity analysis. Peak-hour demand that meets or exceeds hourly capacity is likely to result in delays during the peak demand period. The rate at which an airfield can "recover" from peak period delays is dependent on the operational demand profile throughout the day.

4.2.4.2 Hourly Airfield Capacity Estimates

Hourly airfield capacity estimates were obtained from the 2008 FLL Environmental Impact Statement (EIS), **Appendix F**: Net Benefits Analysis.[1] Discussions with ATCT personnel, as well as the data published by the FAA for FLL[2], confirmed the EIS hourly capacity estimates. **Table 4.2-4** summarizes the hourly airfield capacity estimates for FLL.

Table 4.2-4: Hourly Airfield Capacity

EAST FLOW		WEST FLOW		
VMC	IMC	VMC	IMC	ALL WEATHER AVERAGE
108	104	102	98	107

NOTES:

VMC = Visual Meteorological Conditions

IMC = Instrument Meteorological Conditions

SOURCES: Landrum & Brown, *FLL Environmental Impact Statement*, June 2008; Ricondo & Associates, Inc., FLL Air Traffic Control Personnel Interviews, January 17, 2016.

PREPARED BY: Ricondo & Associates, Inc., September 2016.

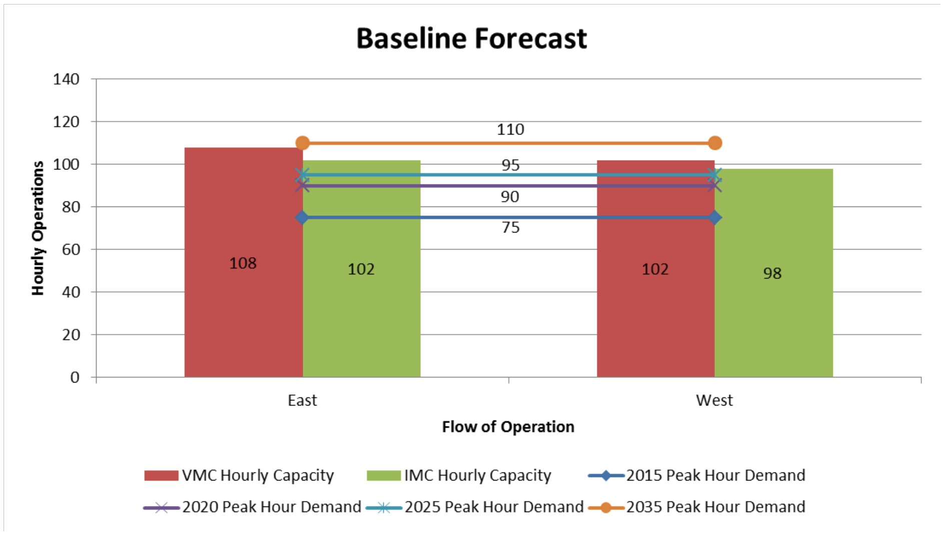
4.2.4.3 Hourly Demand/Capacity Comparisons

Exhibit 4.2-3 presents the hourly capacity estimates associated with each airfield operating configuration and peak-hour demand at the Airport in 2015 (existing), 2020, 2025, and 2035 for the Baseline Forecast scenario. These capacity estimates assume an arrivals mix of 50 percent. As shown, the VMC and IMC peak-hour aircraft operations are anticipated to exceed the hourly airfield capacity in 2035. During peak demand periods when demand exceeds capacity, aircraft operational delays would be incurred. However, the average annual delay metric of 6 to 10 minutes would not be exceeded in 2035.

1 Federal Aviation Administration, *Fort Lauderdale/Hollywood International Airport Environmental Impact Statement*, June 2008.

2 Federal Aviation Administration, Air Traffic Control System Command Center, OIS System, accessed June 2017, http://www.fly.faa.gov/ois/.

Exhibit 4.2-3: Hourly Airfield Demand/Capacity Comparison – Existing Airfield (Baseline Forecast)



NOTES:

VMC = Visual Meteorological Conditions

IMC = Instrument Meteorological Conditions

1/ Peak hour operations are a hybrid of the peak hour for commercial and general aviation operations and assume 50 percent arrivals.

SOURCES: Landrum & Brown, *FLL Environmental Impact Statement*, June 2008; Ricondo & Associates, Inc., *FLL Master Plan Design Day Flight Schedules*, August 2016; Federal Aviation Administration, Advisory Circular 150/5060-5, *Airport Capacity and Delay*, Change 2, December 1, 1995; Ricondo & Associates, Inc., November 2016.

PREPARED BY: Ricondo & Associates, Inc., November 2016.

Annual Service Volume

The peak-hour airfield capacity estimates for the Airport serve as the basis for establishing the ASV of the existing airfield. The ASVs are then compared with the annual aircraft operational demand forecast for 2020, 2025, and 2035. As annual demand exceeds the ASV of the airfield, aircraft delay increases exponentially. **Table 4.2-5** presents this comparison for the operational demand experienced during 2015 and that forecast for 2020, 2025, and 2035. The table also presents annual demand expressed as a percentage of the ASV, as well as the estimated peak-hour demand. The ASV for this analysis is based on an acceptable delay threshold of 6 minutes per aircraft operation.

Table 4.2-5: Comparison of Annual Demand and Annual Service Volume (Baseline Forecast)

CAPACITY/DEMAND METRIC	2015 (EXISTING)	2020	2025	2035
Estimated Peak-Hour Demand	75	90	95	110
Annual Service Volume 1/	425,000 – 475,000 Operations			
Annual Demand (Aircraft Operations)	274,754	323,000	347,000	400,000

NOTES:

Estimated annual service volume and aircraft operations rounded to nearest thousand.

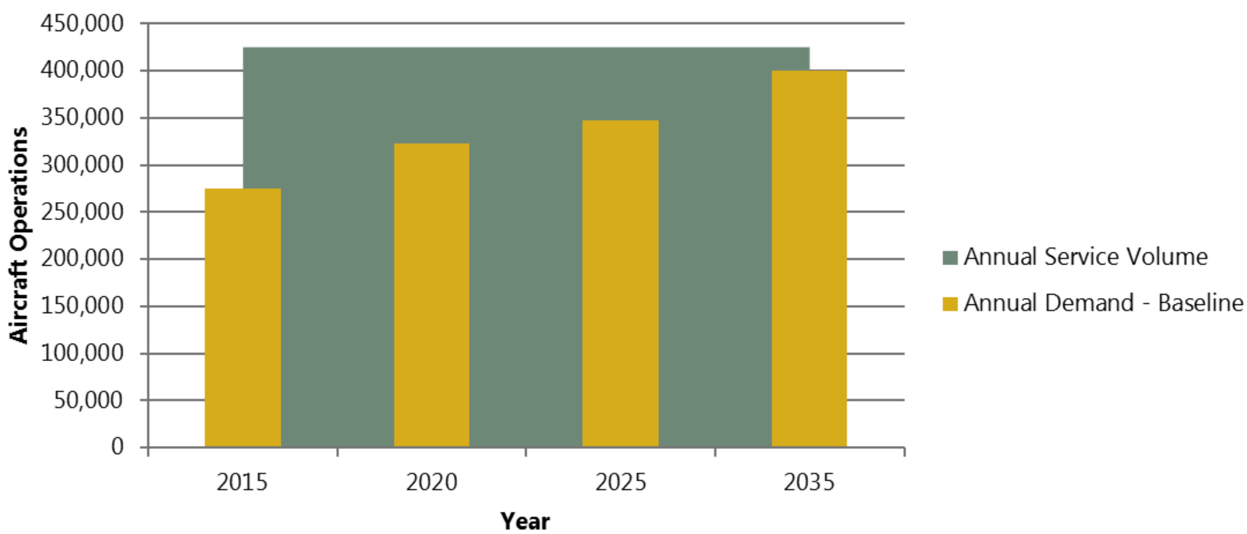
1/ Annual service volume based on an acceptable average annual delay threshold of 6 to 10 minutes per operation.

SOURCES: Federal Aviation Administration, Advisory Circular 150/5060-5, *Airport Capacity and Delay*, Change 2, December 1, 1995; Ricondo & Associates, Inc., August 2016.

PREPARED BY: Ricondo & Associates, Inc., August 2016.

As shown, the ASV at the Airport during 2015 (Baseline Forecast) was estimated at 425,000 operations (using 6 minutes as the acceptable delay threshold), while actual annual demand numbered 274,754 operations. The relationship between annual service volume and annual demand is graphically depicted on **Exhibit 4.2-4** for the Baseline Forecast scenario.

Exhibit 4.2-4: Annual Service Volume versus Annual Demand Relationship



NOTE:

ASV = Annual Service Volume

SOURCES: Federal Aviation Administration, Advisory Circular 150/5060-5, *Airport Capacity and Delay*, Change 2, December 1, 1995; Ricondo & Associates, Inc., November 2016.

PREPARED BY: Ricondo & Associates, Inc., November 2016.

As depicted on Exhibit 4.2-4, the annual demand does not exceed the ASV during the planning horizon.

Airfield Delay

For long-term planning, AC 150/5060-5, *Airport Capacity and Delay*, Change 2, recommends using a general demand versus a capacity comparison to estimate the average delay associated with the airfield. For purposes of this analysis, the ratio of annual demand to the airfield ASV serves as the basis for developing delay estimates. The aircraft delay estimates provide the basis for justifying capacity improvements, as they demonstrate the true operational consequences associated with exceeding the airfield's capacity throughput, or ASV.

It should be noted that the delay estimates contained in AC 150/5060-5 reflect delays associated with runways only. Additional delays associated with local airspace constraints, aircraft taxiing operations, and gate occupancies are not included. These other components of delay cannot be reasonably quantified without the use of advanced airfield and airspace simulation tools. As the delay estimates presented herein reflect delay associated exclusively with the runway components, the maximum allowable delay per operation is between 6.0 and 10.0 minutes for a large-hub airport, such as FLL.

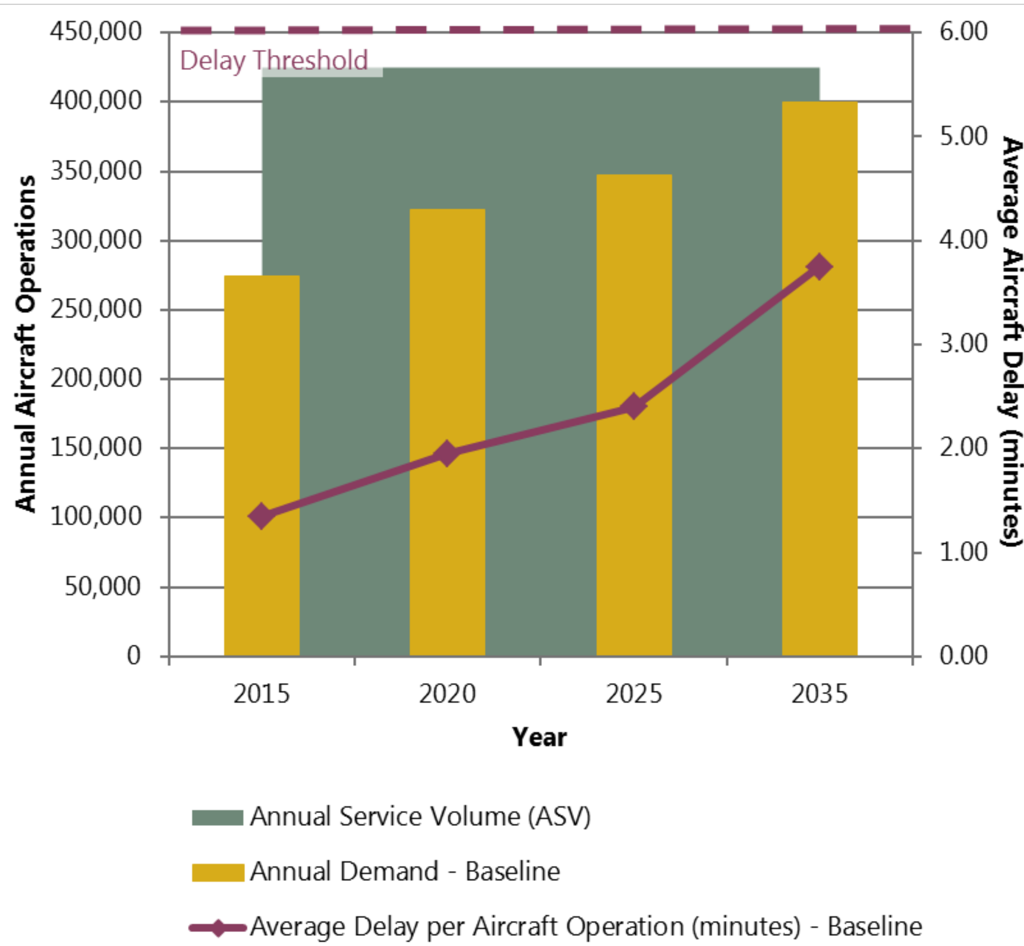
Exhibit 4.2-5 graphically presents the relationship among demand, capacity, and delay through 2035 under the Baseline Forecast. The exhibit presents a comparison of the forecast increase in annual demand with the ASV of the existing airfield through 2035, superimposed on the resulting average delay per aircraft operation. As shown, the average aircraft delay (runway component only) experienced at FLL in 2015 is approximately 1.4 minutes. In 2035, the average aircraft delay is anticipated to be 3.8 minutes under the Baseline Forecast scenario. The typical threshold of acceptable delay in the airline industry is between 6 to 10 minutes per operation at large-hub airports.

Existing Airfield Demand/Capacity Conclusions

The airfield demand/capacity analysis determined that the existing runway layout is adequate to accommodate existing (2015) and future (through 2035) operational demand at the Airport under the Baseline Forecast scenario. This analysis is based on the assumption that 6 minutes of delay is the acceptable delay threshold; this results in an ASV of 425,000 at FLL. Accordingly, the 2035 Accelerated Baseline aircraft operations demand (433,000) would marginally exceed the ASV. As a result, operational delay under the Accelerated Baseline Forecast would exceed 6 minutes, but would still not be close to 10 minutes.

For a large-hub airport such as FLL, the threshold of acceptable delay in the airline industry is between 6 to 10 minutes per operation. We anticipate airfield capacity will not be significantly increased at FLL, as building another runway is impractical due to space constraints; as such, using the upper range of 10 minutes of delay is more realistic when considering the Accelerated Baseline Forecast. With a 10-minute delay assumption, the ASV increases to 470,000, well above the 2035 Accelerated Baseline aircraft operations demand (433,000).

Exhibit 4.2-5: Relationship of Demand, Capacity, and Delay



NOTE: Minutes of delay is for runway component only.

SOURCES: Federal Aviation Administration, Advisory Circular 150/5060-5, *Airport Capacity and Delay*, Change 2, December 1, 1995; Ricondo & Associates, Inc., November 2016.

PREPARED BY: Ricondo & Associates, Inc., November 2016.

4.2.5 AIRSPACE SURFACES

As part of the South Runway Program, BCAD completed a comprehensive obstruction mitigation program for Runway 10R-28L. An obstruction mitigation program for Runway 10L-28R is currently underway. Upon completion of the latter obstruction mitigation program, both vegetative and manmade obstacles will have been mitigated to the extent that is practical. Therefore, no additional mitigation of obstructions is anticipated.

4.2.6 AIRPORT OPERATING AREA VEHICLE ACCESS

Permanent vehicle access to the Airport Operating Area (AOA) is provided at Gate 100, located in the northeast quadrant of the Airport. Currently, this is the only permanent gate that provides access for maintenance vehicles, concession vehicles, construction vehicles, and other airside vehicles. Vehicular congestion frequently occurs at

Gate 100 during peak periods. Vehicles with badged personnel and vehicles requiring escorts use Gate 100 and are screened by the security personnel at Gate 100. A separate study, Northeast Quadrant Facilities and Access Planning Study, was completed by Kimley-Horn and Associates, Inc. in March 2016. This study evaluated the vehicle demands, and it identified long-term options for Gate 100.

In addition to Gate 100, Gate 504 provides temporary construction access to the AOA and serves as an alternate to Gate 100. Gate 504 was opened for the construction activities associated with the South Runway Program, including the reconfiguration of Terminal 4, and it currently serves only construction vehicles. For vehicles entering Gate 100 and traveling to the south side of the AOA (e.g., Terminal 4), vehicles must travel through the AOA, thereby increasing congestion within the terminal ramp area. As such, BCAD Security identified the need for a permanent second gate on the south side of the Airport.

4.3 Aircraft Gates and Passenger Terminals

Passenger terminal facility requirements were developed to determine the scope and timing of facilities needed to serve activity while also maintaining the Airport's desired LOS through the MPU planning horizon. The deficiencies and/or surpluses identified by the demand/capacity analysis should guide the development of alternative concepts. Terminal space requirements set forth in this section do not in themselves constitute a facility program, since they do not comprehensively address considerations such as potential constraints imposed by the site, existing facilities, and implementation strategies. Rather, a preferred development concept will define a roadmap for future terminal development.

4.3.1 AIRCRAFT GATES AND HARDSTANDS

The gating analysis determined the number of gates and hardstands required to accommodate the existing (2015) and future (2020, 2025, and 2035) DDFSs prepared using the Accelerated Baseline Forecasts. The number of gates required to meet demand is a primary driver for the terminal requirements in the secure airside portions of the facility.

4.3.1.1 Methodology and Assumptions

Gate requirements were generated based on the forecasts of future aviation activity and DDFSs developed to represent the operational profile of that activity on an AWDPM. The analysis of gate requirements utilized modeling software, *vGates*, which is designed to define requirements based on appropriate gating configurations and operational characteristics. *vGates* utilizes a hierarchical decision tree methodology to assign gates iteratively by (1) gate availability based on defined operational buffer times between flight departures and flight arrivals; (2) airline preferred gate assignments; (3) aircraft size (apron capacity); and (4) flight origin (typically domestic or international). The model analyzes each DDFS and assigns specific flights to specific gates, ensuring that the candidate flights/aircraft can be accommodated on the assigned gates. Any flights that cannot be accommodated are identified as unassigned/ungated, reflecting a requirement for additional gate(s) or gate operational changes to allow the accommodation of the flight(s). Manual iterations and specific assumptions are applied to reassign flights, as necessary, to increase or decrease gate utilization and to reflect the unique physical and operational environment at the Airport.

The amount of time a gate is unoccupied between operations (gate rest or buffer time) reflects airline practices/operations and/or aircraft types. Since airlines use different scheduling parameters and strategies, there can be variations in buffer times among airlines. For this gating analysis, the following minimum buffer times were assumed:

- 20 minutes – same airlines operating both flights (domestic or international)
- 30 minutes – different airlines operating both flights (domestic or international)

In specific cases, and to reflect actual operating conditions at the Airport, buffer times were reduced to 15 minutes.

Based on utilization and operational requirements specific to the Airport, aircraft parked on a gate for an extended period of time can be towed off the gate to a remote parking position to allow other operations to utilize the gate. In these instances, the aircraft would subsequently be towed from the remote parking position to a vacant gate (typically operated by the same airline) for boarding prior to its subsequent departure.

Due to the connectivity nature of some of the operations at FLL, some aircraft arriving from an international origin require an international-capable gate. However, departing flights can operate out of domestic and international-capable gates regardless of their destination. This operational practice can help maximize the use of international-capable gates for inbound flights. The standard tow times were set at 60 minutes. In specific cases, and to reflect actual operating conditions during peak times, tow-on/tow-off times for narrowbody aircraft were reduced to 30 minutes.

The average daily aircraft turns per gate was calculated to check the reasonableness of gate utilization at each demand level. A “turn” is a metric that defines the number of times that an aircraft arrives and subsequently departs, or is towed to or from a gate. As airline schedules grow, future flights can be added during existing gate utilization peaks or within the operational gaps (unoccupied periods) on existing gates. The calculated average turns per gate helps assess the validity of the gating strategy to prevent over- or underestimating of the gate requirements.

Manual iterations limit the average turns per gate for each airline on a concourse to 9 turns per domestic gate and 7 turns per international-capable gate. During the gating analysis, if the average turns per gate on a concourse or by airline on a concourse exceeded the maximum turns per gate, then aircraft were removed from gates and assigned to a different concourse, or they were assigned to a new or a “virtual” gate if no existing gates were available. These utilization thresholds are typical of an airport operating in the United States. Exceeding these levels of gate utilization may introduce operational challenges, such as the inability to effectively provide transfer times to connecting passengers, accommodate delays, or manage irregular operations.

Airline concourse assignments used as a baseline for the analysis were based on actual assignments as of May 2017. These airline assignments are presented in **Table 4.3-1.**

Table 4.3-1: Airline Concourse Assignments

	TERMINAL 1 (T1)			TERMINAL 2 (T2)	TERMINAL 3 (T3)		TERMINAL 4 (T4)	
	A	B	C	D	E	F	G	H
Multiple Concourse Locations					Air Transat			Air Transat
					American			American
					Azul			Azul
					JetBlue	JetBlue		JetBlue
					Norwegian Air Shuttle			Norwegian Air Shuttle
	Silver Airways		Silver Airways					Silver Airways
	Southwest	Southwest						
						Spirit	Southwest	Southwest
					Sunwing			Sunwing
			WestJet					WestJet
Single Concourse Location			Alaska	Air Canada	Bahamasair			Avianca
			Allegiant	Delta				British Airways
			Frontier					Cape Air
			United					Caribbean Airlines
			Virgin America					Copa Airlines
								Emirates
			Frontier					IBC Airways
								SkyBahamas
								TAME
								Volaris

NOTE:

1/ Gate assignments by concourse can vary.

SOURCE: Broward County Aviation Department, 2016 (Actual assignments for May 2017).
PREPARED BY: Ricondo & Associates, Inc., May 2017.

4.3.1.2 Gating Analysis and Results

This section presents the gating analysis for the Accelerated Baseline forecasts at each of the forecast years: 2015, 2020, 2025, and 2035. The 2015 schedule was gated to reflect existing gate allocations and assignments based on the FLL historical gated activity. This determined the existing gate utilization and was used as a foundation for future gating assumptions. **Table 4.3-2** summarizes the minimum gate and hardstand requirements.

Table 4.3-2: Minimum Gate and Hardstand Requirements

		ACCELERATED BASELINE FORECAST		
	EXISTING (2015)	2020	2025	2035
Annual Enplanements	13.2 million	18.4 million	21.0 million	26.2 million
Annual Aircraft Operations (Airline)	215,192	287,400	318,100	369,500
Design Day Aircraft Operations (Airline)	708	928	1,022	1,182
Gate and Hardstand Requirements 1/				
Gate Requirements	58	66	71	83
Hardstand Requirements	18	18	20	19
Gate Utilization (Average Turns/Gate)	6.1	7.0	7.2	7.2

NOTE:

1/ Demand driven, excluding spare gates, BCAD controlled gates or new entrant gates.

SOURCES: Broward County Aviation Department, 2016 (Actuals for FY 2015); Ricondo & Associates, Inc., 2016.
PREPARED BY: Ricondo & Associates, Inc., February 2017.

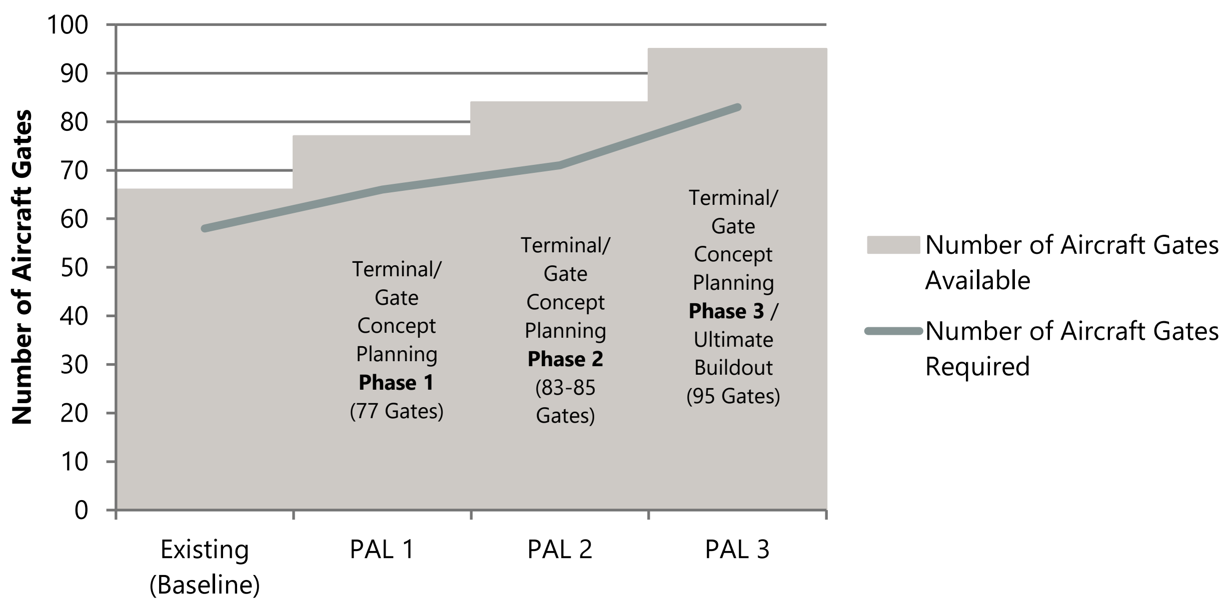
Projected gate requirements were used to define future incremental gate expansion thresholds. The thresholds represent planning activity levels that are associated with terminal expansion phases. The planning activity levels and their associated terminal/gate concepts planning phases are summarized in **Table 4.3-3** and depicted on **Exhibit 4.3-1**.

Table 4.3-3: Planning Activity Levels and Terminal/Gate Concept Planning Phases

PLANNED ACTIVITY LEVEL (PAL)	PEAK MONTH/AVERAGE DAY OPERATIONS	ANNUAL ENPLANEMENTS	ANNUAL AIRCRAFT OPERATIONS (AIRLINE)	GATE REQUIREMENTS
Existing (2015)	708	13.2 million	215,192	58
66 gates will be available upon completion of the current capital improvement program with the gate expansions on T1 and T4, sufficient to serve the PAL 1 demand.				
PAL 1	928	18.4 million	287,400	66
Terminal/Gate Concept Planning Phase 1 (77 Gates) The current EIS Record of Decision approved gate development for up to 77 gates, sufficient to serve the PAL 2 demand.				
PAL 2	1,022	21.0 million	318,100	71
Terminal/Gate Concept Planning Phase 2 (83-85 Gates) Phase 2 will increase the gate capacity to meet the PAL 3 demand.				
PAL 3	1,182	26.2 million	369,500	83
Terminal/Gate Concept Planning Phase 3/Ultimate Buildout (95 Gates)				

SOURCES: Broward County Aviation Department, 2016 (Actuals for FY 2015); Ricondo & Associates, Inc., 2016.
PREPARED BY: Ricondo & Associates, Inc., May 2017.

Exhibit 4.3-1: Aircraft Gate Availability vs. Requirements



SOURCES: Broward County Aviation Department, 2016 (Actuals for FY 2015); Ricondo & Associates, Inc., 2016.
PREPARED BY: Ricondo & Associates, Inc., May 2017.

4.3.2 PASSENGER TERMINALS

The passenger terminals analysis determined functional space requirements to accommodate the existing (2015) and future (2020, 2025, and 2035) DDFSs, for each terminal at FLL.

4.3.2.1 Methodology

Table 4.3-4 summarizes the passenger activity forecast data for the 10-year and 20-year horizons utilized in this analysis of passenger terminal requirements. The Accelerated Baseline Forecast was used to develop these requirements.

Table 4.3-4: Passenger Activity (Accelerated Baseline Forecast)

	EXISTING 2015	2025	2035
Enplaned Passengers	13,214,469	20,955,000	26,198,000
Million Annual Passengers (MAP)	26.4	41.9	52.4

SOURCE: Ricondo & Associates, Inc., *FLL Master Plan Forecast*, June 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

Planning activity levels (PALs) are reflected in annual passenger forecasts, expressed in million annual passengers (MAP), as they both refer to the level of Airport activity used to determine the terminal facilities needed to maintain the desired levels of service. 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. Facility requirements derived from dynamic terminal simulation models created for FLL as part of this MPU were developed for the projected activity associated with FY 2025 and FY 2035, for 41.9 MAP and 52.4 MAP, respectively.

Terminal facility needs are principally 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 a terminal processes for the year). The unique nature of different terminals—their different processing capabilities—and their missions require separate evaluations of the peak-hour demand. The peak-hour demands are generated by three types of passengers: departing, arriving-domestic, and arriving-international passengers.

Peak-hour demand levels are derived using DDFS that correlate to each PAL. A DDFS is a forecast of the commercial airline flight schedule representative of the average weekday in the peak month (AWDPM) associated with a specific PAL. The DDFS provides information on a flight-by-flight basis for time of aircraft arrival or departure, operating airline, aircraft type, domestic/international designation, points of origin and destination (airport codes), seat capacity, load factor, and originating/terminating passenger percentages. **Table 4.3-5** and **Table 4.3-6** summarize daily and peak-hour DDFS activity.

THIS PAGE INTENTIONALLY LEFT BLANK

Table 4.3-5: Daily Design Day Flight Schedule – Activity Summary

	TERMINAL 1			TERMINAL 2			TERMINAL 3			TERMINAL 4		
AIRPORT MAP LEVEL	26.4 MAP	41.9 MAP	52.4 MAP	26.4 MAP	41.9 MAP	52.4 MAP	26.4 MAP	41.9 MAP	52.4 MAP	26.4 MAP	41.9 MAP	52.4 MAP
TERMINAL MAP LEVEL	8.3 MAP	14.1 MAP	17.6 MAP	4.5 MAP	5.8 MAP	6.4 MAP	8.2 MAP	13.3 MAP	17.5 MAP	5.4 MAP	8.8 MAP	10.9 MAP
PROJECTED FISCAL YEAR	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
Departures												
Aircraft Operations	129	205	227	50	50	53	116	164	187	59	92	124
Seats	16,058	27,899	32,927	8,396	8,843	9,505	16,758	24,681	29,832	9,657	16,383	22,724
Enplaned Passengers	13,458	24,277	29,129	7,277	7,906	8,771	14,177	20,782	25,585	8,015	13,632	19,240
Originating Passengers	12,624	18,198	21,432	6,693	7,227	8,018	12,467	17,653	21,320	5,855	10,142	14,068
Arrivals												
Aircraft Operations	122	204	227	50	50	53	97	128	146	78	121	162
Seats	15,763	27,703	32,927	8,396	8,843	9,505	13,584	18,932	22,736	12,831	20,935	28,944
Deplaned Passengers	13,410	24,832	29,095	6,967	7,550	8,372	11,441	16,180	19,766	11,237	17,940	25,473
Terminating Passengers	12,698	18,038	21,308	6,438	6,915	7,666	10,145	13,825	16,612	8,648	13,574	18,956

NOTES:

MAP = Million Annual Passengers

Totals may not add due to rounding.

Table shows total daily values for each terminal.

Table based on the Accelerated Baseline Forecast schedule.

SOURCE: Ricondo & Associates, Inc., January 2017.
PREPARED BY: Ricondo & Associates, Inc., January 2017.

THIS PAGE INTENTIONALLY LEFT BLANK

Table 4.3-6: Peak Hour Design Day Flight Schedule – Activity Summary

AIRPORT MAP LEVEL	TERMINAL 1			TERMINAL 2			TERMINAL 3			TERMINAL 4		
TERMINAL MAP LEVEL	26.4 MAP	41.9 MAP	52.4 MAP	26.4 MAP	41.9 MAP	52.4 MAP	26.4 MAP	41.9 MAP	52.4 MAP	26.4 MAP	41.9 MAP	52.4 MAP
PROJECTED FISCAL YEAR	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
Departures												
Aircraft Operations	15	22	22	7	7	7	11	15	17	9	15	19
Seats	1,771	2,899	3,147	1,208	1,228	1,240	1,619	2,279	2,652	1,649	2,486	3,206
Enplaned Passengers	1,513	2,513	2,803	1,038	1,104	1,128	1,374	1,904	2,218	1,411	2,147	2,659
Originating Passengers	1,413	2,242	2,667	954	1,008	1,031	1,221	1,614	1,838	1,000	1,568	1,931
Arrivals												
Domestic/Preclearance												
Aircraft Operations	14	19	19	7	7	7	10	12	13	9	13	15
Seats	1,730	2,496	2,712	1,186	1,226	1,237	1,345	1,707	2,069	1,616	2,348	2,737
Deplaned Passengers	1,482	2,116	2,334	1,020	1,083	1,156	1,128	1,454	1,757	1,405	2,121	2,521
Terminating Passengers	1,387	1,546	1,720	938	996	1,065	1,005	1,216	1,461	999	1,548	1,802
International												
Aircraft Operations	N/A	7	7	N/A	N/A	N/A	N/A	N/A	N/A	7	10	13
Seats	N/A	715	843	N/A	N/A	N/A	N/A	N/A	N/A	1,096	1,852	2,370
Deplaned Passengers	N/A	635	746	N/A	N/A	N/A	N/A	N/A	N/A	1,005	1,481	1,978
Terminating Passengers	N/A	413	472	N/A	N/A	N/A	N/A	N/A	N/A	770	1,172	1,476

NOTES:

MAP = Million Annual Passengers

N/A = Not Applicable

Represents peak period for each terminal as a unit. Not representative of Airport-wide peak.

Totals may not add due to rounding.

SOURCE: Ricondo & Associates, Inc., January 2017.
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Facility requirements were determined using different methodologies that reflect the unique mission of each terminal function. As appropriate, dynamic computer modeling and/or static modeling were used to determine requirements for discrete processors, such as the following: airline check-in; security checkpoints; baggage handling and screening; baggage claim; and passenger holding (waiting) spaces. Dynamic computer modeling was performed using CAST Terminal – a 3-D simulation modeling software that incorporates established passenger attributes, characteristics, and transaction rates to develop dynamic facility requirements with greater accuracy than traditional spreadsheet modeling. Area requirements for other support functions, including airline offices, administration offices, circulation, restrooms, and building systems, were derived using proportional relationships to overall space requirements.

Terminal facility requirements were developed using planning criteria described in **Appendix F**. Planning criteria include transaction times, passenger attributes, and LOS goals for airline and Department of Homeland Security (DHS) functions. Appendix F also includes space templates used to convert unit processor requirements into space requirements.

Four-unit terminals comprise the Airport's terminal complex. **Table 4.3-7** lists the airline terminal assignments that were used to develop discrete requirements for each terminal.

Airline-Operated Facilities

Requirements for airline-operated facilities were developed using methodologies consistent with the International Air Transport Association's (IATA's) *Airport Development Reference Manual*, 10th Edition. These facilities include: ticketing/check-in lobbies, holdrooms, domestic baggage claim facilities, international recheck lobbies, outbound baggage makeup rooms, and inbound baggage rooms.

Computer modeling was used to analyze peak-hour demand for passengers and baggage in conjunction with Airport-specific operational and passenger attributes to determine functional unit requirements. Functional unit requirements (e.g., check-in counters) represent the number of units needed to process passengers to achieve the prescribed LOS objectives. Functional unit requirements were subsequently converted to spatial requirements using facility space templates that define spatial clearances for safe and efficient operations around equipment and holding (queuing) areas for passengers waiting to be processed. Queuing areas were calculated using space-per-passenger factors prescribed by LOS objectives. The IATA LOS framework is discussed in greater detail in Appendix F.

Check-in Hall

The configuration of the Airport's in-line bag drop positions varies greatly among terminals in regards to frontage dimensions, access to bag scales, access to baggage takeaway conveyors, and depth of queue. For purposes of this analysis, 18 frontage feet for a two-position bag drop unit was used to normalize the number of bag drop positions that could be developed along the existing bag drop frontage. The minimum depth (counter back wall to front of the terminal) required for a two-position bag drop unit is 56 feet, per the space template provided in Appendix F. Based on these dimensions, a two-position bag drop unit would require 1,008 square feet to accommodate the following: two bag drop positions; integrated bag induction conveyor and scale for each position; passenger queues; transaction space; and kiosk placements. Appendix F further describes the normalized layout and dimensions for a two-position bag drop unit.

Table 4.3-7: Airline Terminal Assignments

AIRLINE	TERMINAL 1	TERMINAL 2	TERMINAL 3	TERMINAL 4
Air Canada		Check-in/Gates		
Air Transat			Check-in/Gates	
Alaska Airlines	Check-in/Gates			
Allegiant Air	Check-in/Gates			
American Airlines			Check-in/Gates	Gates Only
Avianca				Check-in/Gates
Azul			Check-in/Gates	Gates Only
Bahamasair			Check-in/Gates	
Cape Air				Check-in/Gates
Caribbean Airlines				Check-in/Gates
Copa Airlines				Check-in/Gates
Delta Air Lines		Check-in/Gates		
Dynamic Airways			Check-in/Gates	
Frontier Airlines	Check-in/Gates			
IBC Airways				Check-in/Gates
JetBlue			Check-in/Gates	Gates Only
Norwegian			Check-in/Gates	Gates Only
Silver Airways	Check-in/Gates			
SkyBahamas Airlines				Check-in/Gates
Southwest Airlines	Check-in/Gates			
Spirit Airlines			Gates Only	Check-in/Gates
Sunwing Airlines				Check-in/Gates
TAME				Check-in/Gates
United Airlines	Check-in/Gates			
Virgin America	Check-in/Gates			
Volaris				Check-in/Gates
WestJet	Check-in/Gates			

NOTE: International flights departing out of Terminal 3 arrive at Terminal 4 to process through customs.

SOURCE: Broward County Aviation Department, *FLL Aircraft Gate Parking*, March 11, 2016.
PREPARED BY: Ricondo & Associates, Inc., April 2016.

Check-in facility requirements were developed assuming preferential-use basis, which is consistent with current Airport operating agreements. Simulation modeling was used to correlate passenger demand levels to operating parameters and passenger attributes, including: passenger show-up profiles, check-in transaction times, and LOS goals, as described in Appendix F. Four check-in options were available to passengers on all airlines as part of the simulation modeling:

- **Bypass (Internet) Check-in:** Passengers who do not check bags may check-in remotely prior to arriving at the terminal; they consequently do not use terminal facilities.
- **Self-Service Devices (SSD)**: In-terminal kiosks where passengers acquire boarding passes. Passengers may check their luggage at the kiosk and complete a "self-tag" process. The LOS goal for a SSD is 2 minutes maximum wait time in queue.
- **In-Line Bag Drop Positions**: Locations where airline staff accept bags from passengers who completed the self-tag process at a kiosk. The LOS goal for an in-line bag drop position is 5 minutes maximum wait time in queue.
- **Full Service (Agent) Counter In-Line Bag Drop Positions:** Locations where airline staff may assist passengers in acquiring boarding passes and where checked bags are accepted. May also address customer service issues and concerns. The LOS goal for a full service counter in-line bag drop position is 15 minutes maximum wait time in queue.

Airline Ticket Offices (ATO)

ATOs refer to support areas for the airline staff handling check-in, including airline administrative office spaces for airline station managers or a sales office, as well as support spaces for functions such as skycaps and cart storage. As airlines increasingly require passengers to use SSDs for check-in, the number of customer service agents has decreased, resulting in less demand for ATO space.

Holdrooms

Holdrooms, also called departure lounges, are required to support an active gate position. Active gate positions are defined as any aircraft parking position used to enplane or deplane passengers—regardless of the number of operations. Holdrooms contain seating and standing areas for passengers, airline agent check-in podiums, and boarding/deplaning queuing spaces and aisleways.

The following parameters were used to derive the holdroom area requirements for different aircraft used to provide service to the terminal over the forecast period:

- **Load Factor:** 90 percent applied to aircraft seating capacity to determine number of enplaning passengers within the preboarding area.
- **Seated versus Standing Passengers:** 40 percent seated at 18 square feet per passenger; 30 percent standing at 12 square feet per passenger.
- **Common Area Reduction:** 10 percent reduction in seating area to account for overflow seating between adjoining holdrooms from differences in departure times, the estimated passenger arrival time distribution at the holdroom, and the boarding time prior to departure.
- **Airline Agent Gate Counter:** assumption was made for 1 agent position per 175 seats. Agent position is approximately 165 square feet.
- **Boarding/Deplaning Aisleway:** average assumption was made per holdroom equal to 180 square feet (6 feet by 30 feet).

Holdroom area requirements were based on the seating capacity of the largest aircraft using the gate, as listed on the DDFS, with a minimum holdroom size based on the forecasted predominant ADG III aircraft used by the airlines assigned to the terminal. A listing of the holdroom design aircraft for each gate can be found in Appendix F.

Domestic Bag Claim

Domestic bag claim facilities include: Baggage Claim, which contains facilities used by passengers to claim checked bags; airline baggage service offices; and baggage unload areas, which is discussed under Airline Outbound Bag Makeup and Inbound Bag Unload Facilities. LOS standards prescribe the amount of bag retrieval area provided to passengers waiting to claim checked bags. IATA defines a 12-foot-deep band along the presentation frontage of the claim device as the retrieval area.

Space requirements for domestic bag claim include equipment area, retrieval area, 10-foot-wide circulation corridors between adjacent carousels, and a 10-foot main corridor extending the length of the domestic bag claim area. Bag claim unit requirements were based on a 20-minute accumulation of flight arrivals. Claim units were assigned on a common-use basis.

Baggage Service Offices

Baggage service offices include passenger service counters, waiting areas, and storage for delayed or unclaimed bags. Increasingly, airlines are using self-service kiosks that enable passengers to determine the status of delayed bags and to reduce staff levels. The total area requirements for the baggage service offices were developed to maintain the current ratio of this space to Baggage Claim space.

Airline Outbound Bag Makeup and Inbound Bag Unload Facilities

Outbound Bag Makeup:

Airline outbound baggage makeup facilities contain baggage makeup equipment, areas for staging and loading baggage carts, and baggage cart drive (circulation) aisles. Outbound baggage makeup devices can be configured to use run out piers that extend directly from the baggage conveyance and sortation systems, or carousel units that allow baggage to continuously circulate. Carousels provide higher storage capacity and greater staging area for carts. Carousels can be flat-plate units or sloped-plate units. Sloped-plate units provide greater capacity; however, flat-plate units are preferred by some airlines. Carts can be staged either perpendicular to makeup devices or parallel if the aisles between devices have sufficient dimensions. Appendix F describes operating criteria used to calculate requirements for outbound baggage makeup facilities, including:

- The cart staging profile is considered, specifically the number of carts staged for a departing flight depending on a flight's scheduled time of departure.
- Airlines would have the ability to store checked bags earlier than 180 minutes prior to the scheduled flight departure (proposed scenario for evaluating an early bag storage facility; not an existing condition for most airlines).

The maximum number of cart staging positions allocated to a departing flight ahead of departure is considered. Cart staging positions are primarily dependent on aircraft type. The allocated positions may be fewer than the total number of carts used to make up a flight, particularly widebody aircraft, which means the airline pulls carts to the aircraft gate as a cart is filled.

Inbound Baggage Unload:

Baggage unload areas contain equipment and baggage cart parking spaces used to unload passenger bags onto carousels or conveyors for delivery to baggage claim devices. Each terminal has a different capacity of inbound baggage offload area and total devices, as discussed in the following sections of this document.

International Bag Recheck:

International bag recheck is used to receive bags from passengers clearing the FIS who then connect to a subsequent flight. In most instances, passengers and their checked bags are “checked” through to their final destination airport; as a result, recheck simply involves a connecting passenger presenting their checked bags to an airline agent for loading onto a conveyor without needing a boarding pass or bag-tag transaction. However, minimal provisions were made for check-in counters to accommodate irregular operations. Existing recheck facilities were assumed to be sufficient to accommodate activity levels over the duration of the forecast planning horizon for the following reasons:

- International bag recheck transaction times are very low (primarily just a bag drop to a baggage handler, rarely even agent interaction).
- No information on flight schedule of which percentage of transfer passengers are transferring on to a flight on the same carrier, and which percentage are transferring to a different carrier than the one on which they arrived to FLL.
- Assumed that existing facilities could handle interline transfers, and passengers transferring on to a new carrier would leave the FIS and enter the ticketing hall to drop off their bags (and thus would be considered an O&D passenger).

Airline Support

Airlines require support facilities located on the concourse boarding level for customer service–related functions, such as passenger assistance counters, lounges for VIPs or unaccompanied minors, agent offices, and breakrooms. Airlines also require airside facilities located on the ramp (apron) level that is within the SIDA.

Ramp-level facilities contributing to airside terminal space requirements normally consist of covered enclosed spaces and covered unenclosed spaces. The latter is used for various types of storage not requiring conditioned space, such as vehicle and equipment parts storage. Typical uses for covered enclosed spaces include: offices; breakrooms; lockers and storage areas for terminal service crews; aircraft line maintenance offices, workshops, and storage; pre-flight ready and checkout facilities for flight crews; and airline ramp control centers.

Airline Clubs and Lounges

Airline clubs include exclusive-use membership clubs and premium lounges for international first- and business-class passengers that may be operated by or on behalf of individual airlines or airline alliances.

Department of Homeland Security Facilities

The U.S. DHS maintains in-terminal facilities to conduct passenger security screening, baggage screening, and customs and border inspections. DHS terminal facility requirements were based on three DHS publications:

- The TSA's Recommended Security Guidelines for Airport Planning, Design and Construction, May 1, 2011
- *Checkpoint Design Guide*, Revision 6.0, December 29, 2014
- The DHS/CBP's Airport Technical Design Standards for Passenger Processing Facilities, June 2012 (U.S. CBP facility requirements)

Computer modeling was used to develop DHS-related functional unit requirements. Space requirements needed to accommodate equipment, passenger queuing areas, and support spaces were then developed using DHS-published space templates.

Security Screening Checkpoint

While the TSA has direct responsibility for determining the size and configuration of the passenger security screening checkpoints at the Airport, the TSA typically collaborates with Airport operators to plan checkpoint locations and programs. *Checkpoint Design Guide*, Revision 6.0, December 29, 2014, provides guidelines for developing the requirements for checkpoints in the terminal, along with the following criteria:

- The screening rate is 150 passengers per hour per standard lane and 300 passengers per hour per Pre✓® lane.
- The required number of checkpoint lanes was developed to provide the throughput needed to maintain close to 10-minute wait times during the peak 10-minute demand interval of the peak hour.
- The area allocated for passenger queuing at the checkpoint provides capacity to accommodate demand equal to a 20-minute maximum wait time. The area assumed for each waiting passenger was 11 square feet in accordance with the TSA's guidelines.

The space template for security screening checkpoints is shown in Appendix F. The template module requires an area that is 31 feet in width and 137 feet in depth, or 1,250 square feet to accommodate a unit pair of screening lanes. The unit pair module contains:

- Queue and Document Check
- Main Screening Area, consisting of: divest tables, WTMD, X-ray equipment, AIT devices, secondary search/examination space, and recomposure area
- Supervisor and LEO stations

Baggage Screening

Baggage screening requirements were developed using data from simulation modeling that provided the volume and rate that bags were inducted at check-in. Appendix F describes in detail the TSA formula for calculating EDS unit requirements, including the surge factor and n+1 buffer requirement.

TSA Support Offices

TSA support offices include administrative offices, breakrooms, training rooms, IT support systems, and other related functions. TSA support offices were increased proportionally to the increase in gates required per the 2025 and 2035 DDFS.

Department of Homeland Security – Customs and Border Protection

CBP Port of Entry, also referred to as FIS, is located on the lower (apron) level of Terminal 1 and Terminal 4. All arriving international passengers (other than those arriving from a U.S. Preclearance airport) must be processed by CBP prior to entering the United States, regardless of whether they are terminating their air travel at FLL or connecting to a domestic flight. A "modified bag-first process," which requires all passengers to first interface with an APC kiosk and reclaim checked baggage before presenting themselves and their reclaimed baggage to CBP officers, was modeled to determine FIS facility requirements. Each FIS is a fully independent facility containing CBP administrative offices and facilities used to process arriving international passengers.

Automated Passport Inspections

Automated passport inspection facility requirements were developed using simulation modeling to correlate forecast arriving international passenger demand to passenger attributes, including nationality, applicable processing rates, and LOS goals. APC kiosks are self-service devices used by passengers in lieu of the traditional officer primary processing booths. Passengers receive either a "clear" or a "triage" coupon upon completion of their APC process.

International Bag Claim

After clearing automated passport inspections, arriving international passengers must reclaim checked baggage prior to presenting themselves to CBP officers for document and customs inspections. International Bag Claim facilities consist of:

- Principle Bag Claim area containing bag claim carousels: LOS standards for international bag claim prescribe the amount of bag retrieval area provided to passengers waiting to claim checked bags. The IATA defines a 15-foot-deep band around the presentation face of a claim conveyor as the retrieval area. To achieve "Optimal" LOS, 18 square feet per passenger retrieving bags should be provided within the retrieval area. The minimum spacing between adjoining carousels should be 34 feet to include the retrieval area and circulation, and there should be a 15-foot main exit corridor from the bag claim area.
- Ancillary bag claim areas include: restrooms; general circulation that is not within the principle bag claim area; bag carts storage; and an airline international bag room containing baggage offload facilities used by the airlines to deliver bags onto bag claim carousels and to load rechecked bags back onto bag carts.

- International baggage claim requirements were developed using simulation modeling, which analyzed when passengers arrived to claim bags after clearing automated passport inspections, as well as analyzed bag delivery times.

Exit Control/Inspections

Exit control or inspections requirements were developed using simulation modeling to incorporate metering from upstream APC processing and international baggage claim. The requirements shown in this section's tables were developed to accommodate three passenger queues: one for passengers with a verify or "check-mark" coupon from an APC, one for U.S. Citizens/Legal Permanent Residents with a triage or "X" coupon from an APC, and one for visitors with a triage or "X" coupon. Officers were assumed to be able to process passengers from any of the other two queues when their own queue was empty.

Secondary Processing

Typically, most passengers are cleared to exit FIS after Inspections; however, if an inspections officer requires further search of passenger(s) or baggage(s), then the party must enter into secondary processing. Secondary processing areas screen passengers and baggage for goods, narcotics, or perishables not permissible into the United States. Secondary processing areas may consist of holdrooms for each gender, interview rooms, canine rooms, and other screening support spaces.

Secondary processing space requirements were proportionally increased relative to the current ratio of secondary processing space to the percentage increase in peak-hour arriving international passengers for each DDFS activity level.

CBP Offices/Support

CBP offices and support areas include administrative offices, supervisors' offices, IT support offices, breakrooms, locker rooms, training rooms, and other support functions. CBP offices/support space requirements were proportionally increased relative to the current ratio of CBP offices and support space to the percentage increase in peak-hour arriving international passengers for each DDFS activity level.

Commercial Program

Commercial program (i.e., concessions) spaces include food and beverage, retail, specialty, and duty-free shopping. Future requirements were developed using current commercial program space grown by each terminal's growth in MAP. This future aggregate concessions requirement was then split between the airside and landside terminals using a ratio of 80 percent to 20 percent, respectively. The calculation of commercial program requirements can be found in Appendix F. Support facilities for commercial program space, such as loading docks and in-terminal concessions breakdown and storage areas, were included under building services.

Airport and Other Agencies

Requirements for in-terminal facilities supporting Airport administration, Airport operations, police, and other agencies were developed to maintain the current ratios for these types of spaces relative to the total number of gates. A factor was determined for each terminal based on this ratio, and the Airport and other agencies space was grown by this factor for every three new gates required by the DDFS. The calculation of Airport and other agency requirements are discussed in Appendix F.

Building Services

Building service facilities refer to back-of-house circulation and utility spaces, such as: mechanical, electrical, and plumbing areas; maintenance, janitorial, and storage areas; receiving areas; and loading docks. Requirements for these types of facilities were developed to be consistent with the current ratio for this type of space relative to the overall facility space. The calculation of building services requirements can be found in Appendix F.

Other Common Space

Other common space refers to restrooms and public circulation elements (e.g., lobbies, corridors, and vertical conveyance systems). Space requirements for restroom facilities were developed using methodologies consistent with the Airport Cooperative Research Program's (ACRP's) Report 130, *Guidebook for Airport Terminal Restroom Planning and Design*. Space requirements for public circulation elements were developed to be consistent with the current ratio for this type of space relative to the overall terminal space. The calculations for other common space requirements can be found in Appendix F.

4.3.2.2 Terminal Requirements Summary

Table 4.3-8 through **Table 4.3-11** summarize facility requirements for Terminals 1, 2, 3, and 4. Facility requirements that exceed current facility inventories are discussed in further detail.

Table 4.3-8: Terminal 1 Space Requirements

CATEGORY	EXISTING (SQUARE FEET)	REQUIREMENTS (SQUARE FEET) 41.9 MAP 49,100 DAILY PASSENGERS (2025)	52.4 MAP 58,200 DAILY PASSENGERS (2035)
Airline Facilities	241,600	262,900	283,100
Department of Homeland Security	184,200	147,900	169,000
Commercial Program	93,600	159,000	198,500
Airport and Other Agency	5,400	7,400	8,800
Building Services	128,700	133,900	145,700
Other Common	229,400	227,800	254,900
Total	**882,900**	**940,600**	**1,061,900**

NOTE:

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

SOURCES: ACAI Associates, Inc., April 2016 (Inventory); Ricondo & Associates, Inc., January 2017 (Requirements).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Table 4.3-9: Terminal 2 Space Requirements

CATEGORY	EXISTING (SQUARE FEET)	REQUIREMENTS (SQUARE FEET) 41.9 MAP 15,500 DAILY PASSENGERS (2025)	REQUIREMENTS (SQUARE FEET) 52.4 MAP 17,100 DAILY PASSENGERS (2035)
Airline Facilities	112,900	105,300	111,100
Department of Homeland Security	25,700	21,000	26,100
Commercial Program	37,300	48,100	53,100
Airport and Other Agency	8,400	8,400	8,400
Building Services	16,400	16,200	17,000
Other Common	89,400	85,300	92,300
Total	**290,100**	**284,300**	**307,100**

NOTE:

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

SOURCES: Broward County Aviation Department, January 2016 (Inventory, Existing Terminal Floor Plans); Gresham, Smith and Partners, November 2015 (Terminal 2 Modernization Program Construction Documents); ACAI Associates, Inc., March 2016 (Field Verifications; Ricondo & Associates, Inc., January 2017 (Requirements).

PREPARED BY: Ricondo & Associates, Inc., January 2017.

Table 4.3-10: Terminal 3 Space Requirements

CATEGORY	EXISTING (SQUARE FEET)	REQUIREMENTS (SQUARE FEET) 41.9 MAP 37,000 DAILY PASSENGERS (2025)	REQUIREMENTS (SQUARE FEET) 52.4 MAP 45,400 DAILY PASSENGERS (2035)
Airline Facilities	189,800	174,900	211,200
Department of Homeland Security	55,800	45,600	55,900
Commercial Program	82,100	133,200	175,300
Airport and Other Agency	5,700	5,700	6,300
Building Services	58,000	59,000	63,400
Other Common	123,400	122,700	147,200
Total	**514,800**	**541,100**	**659,300**

NOTE:

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

SOURCES: Broward County Aviation Department, January 2016 (Inventory, Existing Terminal Floor Plans); Gresham, Smith and Partners, November 2015 (Terminal 3 Modernization Program Construction Documents); ACAI Associates, Inc., March 2016 (Field Verifications); Ricondo & Associates, Inc., January 2017 (Requirements).

PREPARED BY: Ricondo & Associates, Inc., January 2017.

Table 4.3-11: Terminal 4 Space Requirements

CATEGORY	EXISTING (SQUARE FEET)	REQUIREMENTS (SQUARE FEET) 41.9 MAP 31,600 DAILY PASSENGERS (2025)	REQUIREMENTS (SQUARE FEET) 52.4 MAP 44,700 DAILY PASSENGERS (2035)
Airline Facilities	125,100	154,600	187,600
Department of Homeland Security	223,900	162,830	201,000
Commercial Program	49,000	79,900	98,900
Airport and Other Agency	91,600	98,200	104,600
Building Services	81,000	83,300	89,000
Other Common	144,200	151,700	176,200
Total	**714,800**	**721,100**	**848,600**

NOTE:

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

SOURCES: PGAL/Zyscovich, July 2013 (Inventory, Terminal 4 Concourse G [West] Construction Documents); PGAL/Zyscovich, July 2015 (Terminal 4 Concourse G [East] Construction Documents); ACAI Associates, Inc., March 2016 (Terminal 4 FIS Design Development Documents); Gresham, Smith and Partners, December 2014 (Terminal 4 Terrazzo Floors and Spirit Baggage Service Offices Relocation, Construction Documents); Gresham, Smith and Partners, July 2015 (Terminal 4 CBIS, Design Criteria Package); ACAI Associates, Inc., March 2016 (Field Verifications); Ricondo & Associates, Inc., January 2017 (Requirements).

PREPARED BY: Ricondo & Associates, Inc., January 2017.

4.3.2.3 Terminal 1 Requirements (Post-Modernization)

Airline Facilities

Check-in Hall

The Terminal 1 Check-in Hall is located on the third level; it contains 72 in-line counter (bag drop) positions and 9 self-serve kiosks. Currently, a two-position bag drop unit, including a shared bag scale, uses 9 feet of counter frontage. Terminal 1 would be normalized to 26 bag drop positions based on the current bag drop frontage. Terminal 1 has sufficient lobby depth to accommodate the recommended bag drop layout. **Table 4.3-12** lists the requirements for 35 bag drop positions and 39 SSDs to accommodate the 52.4 MAP (2035) PAL.

Airline Ticket Offices

ATO functional space requirements are tied to requirements for staffed bag drop positions. The current ratio of leased ATO space to leased bag drop positions was maintained throughout the planning horizon. No new ATO space is required to support airline functions in Terminal 1.

Table 4.3-12: Terminal 1 Airline Facilities Space Requirements (Detail)

CATEGORY	UNITS	EXISTING	REQUIREMENTS 41.9 MAP 15,500 DAILY PASSENGERS (2025)	REQUIREMENTS 52.4 MAP 17,100 DAILY PASSENGERS (2035)
Check-in Hall	sq ft	16,915	15,624	17,640
Bag Drop Positions	each	72	31	35
Self-Serve Kiosks	each	9	35	39
Curbside Counters	sq ft	N/A	N/A	N/A
Bag Drop Positions	each	N/A	N/A	N/A
Airline Ticket Offices	sq ft	7,518	8,172	8,826
Holdroom	sq ft	54,314	66,444	71,796
Gates	each	23	25	27
Domestic Baggage Claim and Baggage Service Offices	sq ft	37,045	37,045	37,045
Devices	each	6	6	6
Bag Claim Area (Devices, Retrieval Area, and Circulation)	sq ft	36,008	36,008	36,008
Baggage Service Offices	sq ft	1,037	1,037	1,037
Airline Bag Operations	sq ft	81,631	93,100	102,200
Outbound Devices	each	6	6	6
Carts Staged	each	86	133	146
Early Bag Storage Room (peak 10-minute count)	bags	N/A	70	90
Inbound Devices	each	N/A	N/A	N/A
Inbound Carts Staged	each	30	30	30
International Arrivals Re-Check	sq ft	1,487	1,487	1,487
Airline Support	sq ft	37,660	40,934	44,209
Airline Clubs	sq ft	5,062	5,062	5,062
Number of Clubs	each	1	1	1
Area Total	**sq ft**	**241,600**	**262,900**	**283,100**

NOTES:

Values may not add due to rounding.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Holdrooms

Terminal 1 contains 23 gate positions and 54,314 square feet of supporting holdrooms. The minimum size for a holdroom in Terminal 1 is 2,600 square feet based on the Southwest Airlines Boeing 737-800 aircraft seat configuration. Table 4.3-12 summarizes the space requirements for holdrooms based on the number of active gates prescribed by the DDFS. Appendix F provides a detailed analysis of the holdroom calculations and requirements. Terminal 1 is projected to need approximately 17,500 additional square feet of holdroom space to accommodate the 52.4 MAP (2035) PAL.

Domestic Bag Claim

Domestic bag claim facilities include: Baggage Claim, which contains facilities used by passengers to claim checked bags; airline baggage service offices; and baggage unload areas, which is discussed under Airline Outbound Bag Makeup and Inbound Bag Unload Facilities.

Baggage Claim:

Arriving domestic passengers claim their checked baggage on Level 1. Terminal 1 Baggage Claim contains 6 through-wall flat-plate bag claim carousels. Each carousel provides 169 linear feet of presentation and approximately 2,535 square feet of retrieval area, equating to a capacity to accommodate 140 passengers at 18 square feet per passenger (Optimal LOS).

Table 4.3-12 summarizes the requirements for domestic bag claim units corresponding to each DDFS planning horizon. The amount of space that contains the existing six devices is sufficient to accommodate forecast activity levels over the duration of the forecast.

The Terminal 1 outbound bag makeup facility is capable of staging up to 86 baggage carts, whereas up to 142 cart positions would be required to accommodate 52.4 MAP (2035) requirements, assuming preferential airline use, or 108 cart positions for shared use. To allow airlines the ability to accept checked bags earlier than 180 minutes prior to flight departure, early bag storage capacity is required to hold up to 90 bags to accommodate the 52.4 MAP (2035) PAL. Early bag storage space requirements were not calculated, since they can vary widely depending on their design, for example, vertical stacking can reduce the footprint of an early bag storage facility.

Table 4.3-12 lists the total area requirements for the Terminal 1 outbound bag makeup area by applying a ratio of 465 square feet per staged cart to the number of required stage cart positions. The ratio represents a prototypical outbound bag makeup configuration space template that is depicted in Appendix F. The template includes equipment, bag carts, work areas, cart staging clearances, and drive aisle clearances. Approximately 20,570 square feet of additional outbound bag makeup space will be required to accommodate the 52.4 MAP (2035) PAL.

In the case of Terminal 1, bags are unloaded directly onto one of six through-wall flat-plate carousels. Each flat-plate carousel can accommodate five baggage carts parked for unloading, and this capacity can accommodate forecast activity levels over the duration of the forecast.

Table 4.3-12 summarizes the requirements for airline support functional space corresponding to each DDFS planning horizon. Airline support functional space total area requirements were proportionally increased relative to the percentage increase in aircraft gate positions. Aircraft gate positions were projected to increase 9 percent by 41.9 MAP and 17 percent by 52.4 MAP.

Airline Clubs

United Airlines operates a United Club on the airside section of Concourse C. No additional requirements for airline clubs and premium class lounges were projected. Airline/premium lounge facilities are mostly at the discretion of an airline or concession program.

Department of Homeland Security – Transportation Security Administration

Security Screening Checkpoint

Security screening checkpoint requirements were developed using simulation modeling to incorporate metering from upstream passenger check-in processes, security checkpoint transaction times, and LOS goals. Checkpoint processing attributes and LOS goals used in this simulation analysis are outlined in Appendix F. The LOS goal maximum wait time in queue was 20 minutes for a standard screening lane and 10 minutes for a Pre✓® lane.12 existing checkpoint lanes in Terminal 1 should be sufficient to accommodate demand over the duration of the forecast horizon, as shown in **Table 4.3-13**.

Table 4.3-13: Terminal 1 Department of Homeland Security Space Requirements (Detail)

CATEGORY	UNITS	EXISTING	REQUIREMENTS 41.9 MAP 5,500 DAILY PASSENGERS (2025)	REQUIREMENTS 52.4 MAP 17,100 DAILY PASSENGERS (2035)
Transportation Security Administration	sq ft	74,218	49,045	58,272
Passenger Security Screening Checkpoint	sq ft	18,625	19,125	21,250
Number of Lanes	quantity	12	9	10
Baggage Screening	sq ft	51,975	25,987	32,484
Number of EDS Machines	quantity	8	4	5
Support Offices	sq ft	3,618	3,933	4,538
Customs and Border Protection (CBP)	sq ft	110,008	95,219	106,464
Sterile Circulation	sq ft	17,077	18,562	20,047
Primary Inspection	sq ft	25,243	4,560	5,320
Global Entry Kiosks	quantity	9	2	2
APC Kiosks	quantity	24	22	26
APC Agent Podiums	quantity	8	N/A	N/A
Piggyback Booths	quantity	9	N/A	N/A
Secondary Processing	sq ft	16,924	16,924	19,883
Number of Inspection Lanes	quantity	2	2	3
Exit Control	sq ft	N/A	4,410	4,900
Number of Podiums	quantity	N/A	18	20
CBP Offices/Support	sq ft	19,591	19,591	23,015
International Bag Claim	sq ft	19,011	19,011	19,011
Devices	quantity	3	3	3
International Bag Room	sq ft	12,162	12,162	14,288
Transfer Devices	quantity	N/A	N/A	N/A
Inbound Devices	quantity	N/A	N/A	N/A
Area Total	**sq ft**	**184,225**	**144,265**	**164,736**

NOTES:

Values may not add due to rounding.

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

EDS = Explosive Detection Systems

APC = Automated Passport Control

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Baggage Screening

Baggage screening requirements were developed using data from simulation modeling that provided the volume and rate that bags were inducted at check-in. Appendix F describes in detail the TSA formula for calculating EDS unit requirements. The eight machines operating in Terminal 1 are capable of processing approximately 505 bags per hour per machine and has the capacity to accommodate demand over the duration of the forecast horizon.

TSA Support Offices

TSA support offices include administrative offices, breakrooms, training rooms, IT support systems, and other related functions. TSA support offices were increased relative to the current ratio of TSA support space to total number of lanes and EDS units required. An additional 920 square feet of support offices will be required to accommodate the 52.4 MAP (2035) activity level.

Department of Homeland Security – Customs and Border Protection

CBP Port of Entry, also referred to as FIS, is located on the lower (apron) level of Terminal 1 and Terminal 4. Each FIS is a fully independent facility containing CBP administrative offices and facilities used to process arriving international passengers.

Automated Passport Inspections

Automated passport inspection facility requirements were developed using simulation modeling to correlate forecast arriving international passenger demand and passenger attributes, including nationality, processing rates, and LOS goals. The LOS goal maximum wait time in queue was 20 minutes for US citizens, Canadian citizens, and Legal Permanent Residents, and 30 minutes for ESTA and non-visa waiver exempt passengers. The existing 24 APC kiosks will accommodate 41.9 MAP (2025) activity; however, an additional 2 APCs will be needed to meet LOS goals at the 52.4 MAP (2035) activity level.

International Bag Claim

International baggage claim requirements were developed using simulation modeling to correlate bag delivery time to the timing of passengers arriving to claim bags after clearing automated passport inspections. As indicated in Table 4.3-10, the existing three baggage claim devices provide a sufficient number of bag claim units and storage capacity and retrieval area over the duration of the planning horizon; however, an additional 4,700 square feet would be needed to provide sufficient clearance for an exit corridor from the bag claim area.

Exit Control/Inspections

The requirements shown in Table 4.3-13 were developed to accommodate three separate passenger queues: passengers with a verify or “check-mark” coupon from an APC; U.S. Citizens/Legal Permanent Residents with a triage or “X” coupon from an APC; and Visitors with a triage or “X” coupon. It was assumed that the officers would process passengers from any of the other two queues once their assigned queue was cleared.

To achieve the prescribed LOS wait times under 45 minutes at the 52.4 MAP (2035) activity level, the number of officer inspection stations (8 stations in 4 piggyback booths) will need to increase to 20 stations (10 piggyback booths).

Secondary Processing

Secondary processing space requirements were proportionally increased relative to the percentage increase in peak-hour arriving international passengers. An additional 490 square feet of secondary processing will be needed to accommodate the 52.4 MAP (2035) activity level.

CBP Offices/Support

CBP offices/support space requirements were proportionally increased relative to the percentage increase in peak-hour arriving international passengers. An additional 3,420 square feet of CBP office/support space will be needed to accommodate the 52.4 MAP (2035) activity level.

Support Functions

Commercial Programs

Commercial program (i.e., concessions) spaces include food and beverage, retail, specialty, and duty-free shopping. Future requirements were developed using current commercial program space grown by Terminal 1's growth in MAP. This future aggregate concessions requirement was then split between the airside and landside terminals using a ratio of 80 percent to 20 percent, respectively. These ratios and the calculation of commercial program requirements can be found in Appendix F, and the square foot requirements are shown in **Table 4.3-14**.

Support facilities for commercial program space, such as loading docks and in-terminal concessions breakdown and storage areas were included under building services. An additional 104,887 square feet of commercial program space will be needed to support the 52.4 MAP (2035) PAL.

Airport Services

Requirements for in-terminal facilities supporting Airport administration, Airport operations, police, and other agencies were developed to maintain the current ratios for these types of spaces relative to the total number of gates. A factor was determined for each terminal based on this ratio and the Airport, and other agencies space was grown by this factor for every three new gates required by the DDFS. The calculation of Airport and other agency requirements are discussed in Appendix F, and the square foot requirements are shown in Table 4.3-14.

An additional 3,454 square feet of Airport services space will be needed to support the 52.4 MAP (2035) activity level.

Other Common Areas

Space requirements for public circulation elements were developed to be consistent with the current ratio for this type of space relative to the overall terminal space. The calculations for other common space requirements can be found in Appendix F, and the square foot requirements are shown in Table 4.3-14.

An additional 25,475 square feet of other common area space will be needed to support the 52.4 MAP (2035) activity level.

Table 4.3-14: Terminal 1 Support Functions Space Requirements (Detail)

CATEGORY	UNITS	EXISTING	REQUIREMENTS 41.9 MAP 15,500 DAILY PASSENGERS (2025)	REQUIREMENTS 52.4 MAP 17,100 DAILY PASSENGERS (2035)
Commercial Program	sq ft	**93,609**	**159,023**	**198,497**
Airside	sq ft	73,542	127,218	158,797
Landside	sq ft	3,160	31,805	39,699
Back of House Storage/Support	sq ft	16,907	28,722	35,851
Airport	sq ft	**5,369**	**7,369**	**8,823**
Administration and Executive	sq ft	5,406	6,760	3,998
Operations and Maintenance	sq ft	1,963	2,063	2,304
Services and Amenities	sq ft	N/A	N/A	N/A
Police	sq ft	N/A	N/A	N/A
Other Agency	sq ft	N/A	N/A	N/A
Building Services	sq ft	**128,731**	**133,871**	**145,715**
Non-Habitable Utility and Equipment	sq ft	86,801	91,941	103,785
Landside	sq ft	N/A	N/A	N/A
Airside	sq ft	86,801	91,941	103,785
Loading Docks	sq ft	N/A	N/A	N/A
Landside	sq ft	N/A	N/A	N/A
Airside	sq ft	N/A	N/A	N/A
Miscellaneous Covered/Unenclosed	sq ft	41,930	41,930	41,930
Other Common Areas	sq ft	**229,433**	**227,824**	**254,907**
Circulation and Seating/Lobbies	sq ft	187,369	198,463	224,030
Landside	sq ft	76,283	80,800	91,209
Airside	sq ft	111,086	117,663	132,821
Restrooms	sq ft	25,916	13,213	14,729
Landside	sq ft	6,973	6,930	7,721
Airside	sq ft	18,943	6,283	7,008
Unassigned	sq ft	16,148	16,148	16,148
Landside	sq ft	N/A	N/A	N/A
Airside	sq ft	16,148	16,148	16,148
Area Total	**sq ft**	**457,142**	**528,086**	**607,942**

NOTES:

Values may not add due to rounding.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Building Services

Requirements for these types of facilities were developed to be consistent with the current ratio for this type of space relative to the overall facility space. The calculation of building services requirements can be found in Appendix F, and the square foot requirements are shown in Table 4.3-14. An additional 16,984 square feet of building services space will be needed to support the 52.4 MAP (2035) activity level.

4.3.2.4 Terminal 2 Requirements

Airline Facilities

Check-in Hall

Departing (originating) passengers check in on the second level check-in lobby. The check-in lobby contains 34 in-line counter (bag drop) positions and 36 self-serve kiosks. Each two-unit position shares a bag scale with an adjacent position and occupies 9 feet of counter frontage. Terminal 2 would be normalized to 15 bag drop positions based on the current bag drop frontage in Terminal 2. Terminal 2 has sufficient lobby depth to accommodate the recommended bag drop template.

Table 4.3-15 lists the requirements for 12 bag drop positions and 14 SSDs to accommodate the 52.4 MAP (2035) activity level.

Airline Ticket Offices

ATO functional space requirements are tied to requirements for staffed bag drop positions. The ratio of available ATO space to existing staffed bag drop positions was maintained throughout the planning horizon. As the inventory lists 34 staffed bag drop positions available for Terminal 2, and the 52.4 MAP (2035) activity level requirement for bag drop positions is 12, no new ATO space is required to support airline functions in Terminal 2.

Holdrooms

Terminal 2 contains nine gate positions and 32,585 square feet of supporting holdrooms. The design aircraft for sizing holdrooms follows the largest aircraft scheduled for each gate per the DDFS, with a minimum size for each holdroom determined to be the most prominent ADG III aircraft scheduled for that terminal. The minimum size for a holdroom in Terminal 2 is 2,850 square feet based on the Air Canada A321 design aircraft. Table 4.3-15 summarizes the space requirements for holdrooms based on the number of active gates prescribed by the DDFS. Appendix F provides a detailed analysis of the holdroom calculations and requirements. Terminal 2 is projected to need approximately 28,520 square feet of holdroom to accommodate the 52.4 MAP (2035) activity level. This represents a surplus in holdroom capacity in Terminal 2 of approximately 4,070 square feet.

Domestic Bag Claim

Domestic Bag Claim facilities include: baggage unload areas and carrousels; facilities used by passengers to claim checked bags; and airline baggage service offices.

Table 4.3-15: Terminal 2 Airline Facilities Space Requirements (Detail)

CATEGORY	UNITS	EXISTING	REQUIREMENTS 41.9 MAP 15,500 DAILY PASSENGERS (2025)	REQUIREMENTS 52.4 MAP 17,100 DAILY PASSENGERS (2035)
Check-in Hall	**sq ft**	**9,073**	**5,040**	**6,048**
Bag Drop Positions	each	34	10	12
Self-Serve Kiosks	each	36	11	14
Curbside Counters	**sq ft**	**620**	**N/A**	**N/A**
Bag Drop Positions	each	3	N/A	N/A
Airline Ticket Offices	**sq ft**	**2,532**	**2,532**	**2,532**
Holdroom	**sq ft**	**32,585**	**28,360**	**28,519**
Gates	each	9	9	9
Domestic Baggage Claim and Baggage Service Offices	**sq ft**	**16,113**	**16,113**	**16,113**
Devices	each	3	3	3
Bag Claim Area (Devices, Retrieval Area, and Circulation)	sq ft	14,582	14,582	14,582
Baggage Service Offices	sq ft	1,531	1,531	1,531
Domestic Airline Bag Operations	**sq ft**	**23,429**	**26,600**	**31,500**
Outbound Devices	each	5	5	5
Carts Staged	each	50	38	45
Early Bag Storage (peak 10-minute count)	bags	N/A	40	50
Inbound Devices	each	3	3	3
Inbound Carts Staged (total)	each	18	18	18
International Arrivals Re-Check	**sq ft**	**N/A**	**N/A**	**N/A**
Airline Support	**sq ft**	**21,635**	**21,635**	**21,635**
Airline Clubs	**sq ft**	**7,522**	**7,522**	**7,522**
Number of Clubs	each	1	1	1
Area Total	**sq ft**	**112,900**	**105,300**	**111,100**

NOTE:

Values may not add due to rounding.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Inbound Baggage Unload:

Space requirements for Baggage Unload are addressed under Airline Outbound Bag Makeup and Inbound Bag Unload Facilities.

<u>Baggage Claim:</u>

Arriving domestic passengers claim their checked baggage on Level 1. LOS standards prescribe the amount of bag retrieval area provided to passengers waiting to claim checked bags. IATA defines a 12-foot band around the presentation face of a claim conveyor as the retrieval area. Terminal 2 Baggage Claim contains three through-wall flat-plate bag claim carousels. Each carousel provides 214 linear feet of presentation and approximately 3,355 square feet of retrieval area, equating to a capacity to accommodate 186 passengers at 18 square feet per passenger (LOS C). Table 4.3-15 summarizes the requirements for domestic bag claim units corresponding to each DDFS planning horizon. The amount of space that contains the existing three devices is sufficient to accommodate forecast activity levels over the duration of the forecast.

<u>Baggage Service Offices:</u>

Baggage service offices include passenger service counters, waiting areas, and storage for delayed or unclaimed bags. Increasingly, airlines are using self-service kiosks that enable passengers to determine the status of delayed bags and to reduce staff levels. The total area requirements for the baggage service offices were proportionally increased relative to the current ratio of this space to total bag claim space.

Airline Outbound Bag Makeup and Inbound Bag Unload Facilities

<u>Outbound Bag Makeup</u>

The Terminal 2 outbound bag makeup facility is capable of staging up to 50 baggage carts, whereas up to 45 cart positions would be required to accommodate 52.4 MAP (2035) requirements, assuming preferential airline use or 36 cart positions for shared use.

To allow airlines the ability to accept checked bags earlier than 180 minutes prior to flight departure, early bag storage capacity is required to hold up to 55 bags to accommodate the 52.4 MAP (2035) activity level. Early bag storage space requirements were not calculated, since they can vary widely depending on their design, for example, vertical stacking can reduce the footprint of an early bag storage facility.

Table 4.3-15 lists the total area requirements for the Terminal 2 outbound bag makeup area by applying a ratio of 465 square feet per staged cart to the number of required staged cart positions. The ratio represents a prototypical outbound bag make up configuration space template that is depicted in Appendix F. The template includes equipment, bag carts, work areas, cart staging clearances, and drive aisle clearances. Approximately 8,070 square feet of additional outbound bag makeup space will be required to accommodate the 52.4 MAP (2035) activity level.

<u>Inbound Baggage Unload:</u>

Baggage unload areas contain equipment and baggage cart parking spaces used to unload passenger bags onto carousels or conveyors for delivery to baggage claim devices. In the case of Terminal 2, bags are unloaded directly onto any one of three through-wall flat-plate carousels. Each flat-plate carousel can accommodate six bag carts parked for unloading and is able to accommodate forecast activity levels over the duration of the forecast.

Airline Support

Table 4.3-15 summarizes the requirements for airline support functional space corresponding to each DDFS planning horizon. Airline support functional space total area requirements were proportionally increased relative to the percentage increase in aircraft gate positions, which was not projected to increase by the 52.4 MAP (2035). As such, no additional Airport support space is required based on the DDFS.

Airline Clubs

No additional requirements for airline clubs and premium class lounges were projected. Airline/premium lounge facilities are mostly at the discretion of an airline or concession program.

Department of Homeland Security – Transportation Security Administration

Security Screening Checkpoint

Security screening checkpoint requirements were developed using simulation modeling to incorporate metering from upstream passenger check-in processes, security checkpoint transaction times, and LOS goals. Checkpoint processing attributes and LOS goals used in this simulation analysis are outlined in Appendix F. The LOS goal maximum wait time in queue was 20 minutes for a standard screening lane and 10 minutes for a Pre✓® lane. The six existing checkpoint lanes in Terminal 2 should be sufficient to accommodate demand over the duration of the forecast horizon, as shown in **Table 4.3-16**.

Table 4.3-16: Terminal 2 Department of Homeland Security Space Requirements (Detail)

CATEGORY	UNITS	EXISTING	REQUIREMENTS 41.9 MAP 15,500 DAILY PASSENGERS (2025)	52.4 MAP 17,100 DAILY PASSENGERS (2035)
Transportation Security Administration	sq ft	15,359	21,006	26,113
Passenger Security Screening Checkpoint	sq ft	10,169	8,500	10,625
Number of Lanes	each	6	4	5
Baggage Screening	sq ft	8,947	5,965	8,947
Number of EDS Machines	each	3	2	3
Support Offices	sq ft	6,541	6,541	8,721
Area Total	**sq ft**	**25,700**	**21,000**	**28,300**

NOTES:

Values may not add due to rounding.

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

EDS = Explosive Detection Systems

SOURCE: Ricondo & Associates, Inc., January 2017.
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Baggage Screening

Baggage screening requirements were developed using data from simulation modeling that provided the volume and rate that bags were inducted at check-in. Appendix F describes in detail the TSA formula for calculating EDS unit requirements, including the surge factor and n+1 buffer requirement. The three machines operating in Terminal 2 are capable of processing approximately 674 bags per hour per machine and should have the capacity to accommodate demand over the duration of the forecast horizon.

TSA Support Offices

TSA support offices include administrative offices, breakrooms, training rooms, IT support systems, and other related functions. TSA support offices were increased proportionally to the increase in gates required per the 2025 and 2035 DDFS. The existing area allocated to TSA support offices will be sufficient to meet the 52.4 MAP (2035) PAL.

Support Functions

Commercial Programs

Commercial program (i.e., concessions) spaces include food and beverage, retail, specialty, and duty-free shopping. Future requirements were developed using current commercial program space grown by Terminal 2's growth in MAP. This future aggregate concessions requirement was then split between the airside and landside terminals using a ratio of 80 percent to 20 percent, respectively. These ratios and the calculation of commercial program requirements can be found in Appendix F, and the square foot requirements are shown in **Table 4.3-17**. Support facilities for commercial program space, such as loading docks and in-terminal concessions breakdown and storage areas, were included under building services. An additional 15,758 square feet of commercial program space will be needed to support the 52.4 MAP (2035) PAL.

Airport Services

Requirements for in-terminal facilities supporting Airport administration, Airport operations, police, and other agencies were developed to maintain the current ratios for these types of spaces relative to the total number of gates. A factor was determined for each terminal based on this ratio, and the Airport and other agencies space was grown by this factor for every three new gates required by the DDFS. The calculation of Airport and other agency requirements are discussed in Appendix F, and the square foot requirements are shown in Table 4.3-17. No additional Airport services space will be needed to support the 52.4 MAP (2035) PAL.

Other Common Areas

Space requirements for public circulation elements were developed to be consistent with the current ratio for this type of space relative to the overall terminal space. The calculations for other common space requirements can be found in Appendix F, and the square foot requirements are shown in Table 4.3-17. An additional 2,881 square feet of other common areas space will be needed to support the 52.4 MAP (2035) PAL.

Table 4.3-17: Terminal 2 Support Functions Space Requirements (Detail)

CATEGORY	UNITS	EXISTING	REQUIREMENTS 41.9 MAP 15,500 DAILY PASSENGERS (2025)	REQUIREMENTS 52.4 MAP 17,100 DAILY PASSENGERS (2035)
Commercial Program	sq ft	**37,321**	**48,103**	**53,079**
Airside	sq ft	20,345	38,482	42,463
Landside	sq ft	3,489	9,621	10,616
Back of House Storage/Support	sq ft	13,487	17,383	19,182
Airport	sq ft	**8,395**	**8,395**	**8,395**
Administration and Executive	sq ft	N/A	N/A	N/A
Operations and Maintenance	sq ft	8,395	8,395	8,395
Services and Amenities	sq ft	N/A	N/A	N/A
Police	sq ft	N/A	N/A	N/A
Other Agency	sq ft	N/A	N/A	N/A
Building Services	sq ft	**16,404**	**16,232**	**17,007**
Non-Habitable Utility and Equipment	sq ft	8,702	8,530	9,305
Landside	sq ft	3,220	3,156	3,443
Airside	sq ft	5,482	5,374	5,862
Loading Docks	sq ft	N/A	N/A	N/A
Landside	sq ft	N/A	N/A	N/A
Airside	sq ft	N/A	N/A	N/A
Miscellaneous Covered/Unenclosed	sq ft	**7,702**	**7,702**	**7,702**
Other Common Areas	sq ft	**89,403**	**85,289**	**92,284**
Circulation and Seating/Lobbies	sq ft	76,278	74,770	81,567
Landside	sq ft	32,499	31,856	34,752
Airside	sq ft	43,779	42,914	46,815
Restrooms	sq ft	8,490	5,884	6,083
Landside	sq ft	4,070	3,124	3,263
Airside	sq ft	4,420	2,760	2,820
Unassigned	sq ft	4,635	4,635	4,635
Landside	sq ft	703	383	414
Airside	sq ft	3,932	3,932	3,932
Area Total	sq ft	**151,500**	**158,000**	**170,800**

NOTES:

Values may not add due to rounding.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Building Services

The calculation of building services requirements can be found in Appendix F, and the square foot requirements are shown in Table 4.3-17. An additional 603 square feet of building services space will be needed to support the 52.4 MAP (2035) PAL.

4.3.2.5 Terminal 3 Requirements

Airline Facilities

Check-in Hall

Departing (originating) passengers check in on the second level check-in lobby. The check-in lobby contains 86 in-line counter (bag drop) positions and 48 self-serve kiosks. Each two-unit position shares a bag scale with an adjacent position and occupies 9 feet of counter frontage.

Table 4.3.18 lists the requirements for 28 bag drop positions and 29 SSDs to accommodate 52.4 MAP (2035) PAL.

Airline Ticket Offices

ATO functional space requirements are tied to requirements for staffed bag drop positions. Terminal 3 contains 6,074 square feet of ATO space. The ratio of available ATO space to existing staffed bag drop positions was maintained throughout the planning horizon; 1,978 square feet of ATO space will be required in Terminal 3 to support the 52.4 MAP (2035) PAL.

Holdrooms

Terminal 3 contains 19 gate positions and 54,231 square feet of supporting holdrooms within Concourses E and F.

The design aircraft for sizing holdrooms follows the largest aircraft scheduled for each gate per the DDFS, with a minimum size for each holdroom determined to be the most prominent ADG III aircraft scheduled for that terminal. The minimum size for a holdroom in Terminal 3 is approximately 3,050 square feet based on the JetBlue A321 design aircraft. Table 4.3-18 summarizes the space requirements for holdrooms based on the number of active gates prescribed by the DDFS. Appendix F provides a detailed analysis of the holdroom calculations and requirements. Terminal 3 is projected to need an additional 28,840 square feet of holdroom space to accommodate the 52.4 MAP (2035) PAL.

Domestic Bag Claim

Domestic Bag Claim facilities include baggage unload areas, facilities used by passengers to claim checked bags, and airline baggage service offices.

<u>Inbound Baggage Unload:</u>

Space requirements for Baggage Unload are addressed under Airline Outbound Bag Makeup and Inbound Bag Unload Facilities.

Table 4.3-18: Terminal 3 Airline Facilities Space Requirements (Detail)

CATEGORY	UNITS	EXISTING	REQUIREMENTS 41.9 MAP 37,000 DAILY PASSENGERS (2025)	REQUIREMENTS 52.4 MAP 45,400 DAILY PASSENGERS (2035)
Check-in Hall	sq ft	**20,683**	**12,096**	**14,112**
Bag Drop Positions	each	86	24	28
Self-Serve Kiosks	each	48	26	29
Curbside Counters	sq ft	**N/A**	**N/A**	**N/A**
Bag Drop Positions	each	4	N/A	N/A
Airline Ticket Offices	sq ft	**6,074**	**6,394**	**8,312**
Holdroom	sq ft	**54,231**	**63,875**	**83,068**
Gates	each	19	20	26
Domestic Baggage Claim and Baggage Service Offices	sq ft	**23,572**	**13,470**	**16,837**
Devices	each	7	4	5
Bag Claim Area (Devices, Retrieval Area, and Circulation)	sq ft	21,333	12,190	15,238
Baggage Service Offices	sq ft	2,239	1,279	1,599
Domestic Airline Bag Operations	sq ft	**39,482**	**36,800**	**40,000**
Outbound Devices	sq ft	7	7	7
Carts Staged	each	N/A95	92	100
Early Bag Storage (peak 10-minute count)	bags	N/A	120	140
Inbound Devices	each	7	7	7
Inbound Carts Staged (total)	each	30	30	30
International Arrivals Re-Check	sq ft	**N/A**	**N/A**	**N/A**
Airline Support	sq ft	**25,748**	**27,103**	**35,234**
Airline Clubs	sq ft	**20,019**	**20,019**	**20,019**
Number of Clubs	each	1	1	1
Area Total	**sq ft**	189,900	174,900	211,200

NOTES:

Values may not add due to rounding.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Baggage Claim:

Arriving domestic passengers claim their checked baggage on Level 1. Terminal 3 Baggage Claim contains seven through-wall flat-plate bag claim carousels of several different lengths. Each carousel provides between 94 and 187 linear feet of presentation and approximately 3,089 square feet of retrieval area, equating to a capacity to accommodate 172 passengers at 18 square feet per passenger (LOS C).

Claim units were assigned on a common-use basis within each terminal. Table 4.3-18 summarizes the requirements for domestic bag claim units corresponding to each DDFS planning horizon. The amount of space that contains the existing seven devices is sufficient to accommodate forecast activity levels over the duration of the forecast.

Baggage Service Offices:

Baggage service offices include passenger service counters, waiting areas, and storage for delayed or unclaimed bags. Increasingly, airlines are using self-service kiosks to enable passengers to determine the status of delayed bags and to reduce staff levels. The total area requirements for the baggage service offices were proportionally increased relative to the current ratio of this space to total bag claim space.

Airline Outbound Bag Makeup and Inbound Bag Unload Facilities

Outbound Bag Makeup

The Terminal 3 outbound bag makeup facility is capable of staging up to 95 baggage carts, whereas up to 100 cart positions would be required to accommodate 52.4 MAP (2035) activity level requirements, assuming preferential airline use or 80 cart positions for shared use. To allow airlines the ability to accept checked bags earlier than 180 minutes prior to flight departure, early bag storage capacity is required to hold up to 140 bags to accommodate the 52.4 MAP (2035) activity level. Early bag storage space requirements were not calculated, since they can vary widely depending on their design, for example, vertical stacking can reduce the footprint of an early bag storage facility.

Table 4.3-18 lists the total area requirements for the Terminal 3 outbound bag makeup area by applying a ratio of 465 square feet per staged cart to the number of required staged cart positions. The ratio represents a prototypical outbound bag makeup configuration space template that is depicted in Appendix F. The template includes equipment, bag carts, work areas, cart staging clearances, and drive aisle clearances. Approximately 518 square feet of additional outbound bag makeup space will be required to accommodate the 52.4 MAP (2035) activity level.

Inbound Baggage Unload:

In Terminal 3 bags are unloaded directly onto any one of seven through-wall flat-plate carousels. Each flat-plate carousel is able to accommodate between three to six bag carts (depending on the size of the device) parked for unloading and is able to accommodate forecast activity levels over the duration of the forecast.

Airline Support

Table 4.3-18 summarizes the requirements for airline support functional space corresponding to each DDFS planning horizon. Airline support functional space total area requirements were proportionally increased relative to the percentage increase in aircraft gate positions, which was projected to increase by 1,355 square feet by 41.9 MAP (2025) activity level and by 9,486 square feet by 52.4 MAP (2035) activity level.

Airline Clubs

Delta operates a Delta Sky Club on the airside section of Concourse D. No additional requirements for airline clubs and premium class lounges were projected. Airline/premium lounge facilities are mostly at the discretion of an airline or concession program.

Department of Homeland Security – Transportation Security Administration

Security screening checkpoint requirements were developed using simulation modeling to incorporate metering from upstream passenger check-in processes, security checkpoint transaction times, and LOS goals. Checkpoint processing attributes and LOS goals used in this simulation analysis are outlined in Appendix F. The LOS goal maximum wait time in queue was 20 minutes for a standard screening lane and 10 minutes for a Pre✓® lane. The 12 existing checkpoint lanes in Terminal 3 should be sufficient to accommodate demand through the planning horizon, as shown in **Table 4.3-19**.

Table 4.3-19: Terminal 3 Department of Homeland Security Space Requirements (Detail)

			REQUIREMENTS	
CATEGORY	UNITS	EXISTING	41.9 MAP 37,000 DAILY PASSENGERS (2025)	52.4 MAP 45,400 DAILY PASSENGERS (2035)
Transportation Security Administration				
Passenger Security Screening Checkpoint	sq ft	21,086	17,000	19,125
Number of Lanes	each	12	8	9
Baggage Screening	sq ft	26,285	19,714	26,285
Number of EDS Machines	each	6	3	4
Support Offices	sq ft	8,395	8,837	10,444
Area Total	**sq ft**	**55,800**	**45,600**	**55,900**

NOTES:

Values may not add due to rounding.

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

EDS = Explosive Detection Systems

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Baggage Screening

The six machines operating in Terminal 3 are capable of processing approximately 674 bags per hour per machine and should have the capacity to accommodate demand over the duration of the forecast horizon.

TSA Support Offices

TSA support offices include administrative offices, breakrooms, training rooms, IT support systems, and other related functions. TSA support offices were increased proportionally to the increase in gates required per the 2025 and 2035 DDFS. An additional 2,049 square feet of support offices will be required to accommodate the 52.4 MAP (2035) PAL.

Support Functions

Commercial Programs

This future aggregate concessions requirement was then split between the airside and landside terminals using a ratio of 80 percent to 20 percent, respectively. These ratios and the calculation of commercial program requirements can be found in Appendix F, and the square foot requirements are shown in **Table 4.3-20**.

Support facilities for commercial program space, such as loading docks and in-terminal concessions breakdown and storage areas, were included under building services. An additional 93,164 square feet of commercial program space will be needed to support the 52.4 MAP (2035) activity level.

Airport Services

Requirements for in-terminal facilities supporting Airport administration, Airport operations, police, and other agencies were developed to maintain the current ratios for these types of spaces relative to the total number of gates. A factor was determined for each terminal based on this ratio, and the Airport and other agencies space was grown by this factor for every three new gates required by the DDFS. The calculation of Airport and other agency requirements is discussed in Appendix F, and the square foot requirements are shown in Table 4.3-20. An additional 600 square feet of Airport services space will be needed to support the 52.4 MAP (2035) activity level.

Other Common Areas

The calculations for other common space requirements can be found in Appendix F, and the square foot requirements are shown in Table 4.3-20. An additional 23,748 square feet of other common areas space will be needed to support the 52.4 MAP (2035) activity level.

Building Services

The calculation of building services requirements can be found in Appendix F, and the square foot requirements are shown in Table 4.3-20. An additional 5,400 square feet of building services space will be needed to support the 52.4 MAP (2035) activity level.

Table 4.3-20: Terminal 3 Support Functions Space Requirements (Detail)

			REQUIREMENTS	
CATEGORY	UNITS	EXISTING	41.9 MAP (2025) 37,000 DAILY PASSENGERS	52.4 MAP (2035) 45,400 DAILY PASSENGERS
Commercial Program	sq ft	**82,144**	**133,234**	**175,308**
Airside	sq ft	46,471	106,587	140,246
Landside	sq ft	1,319	26,647	35,062
Back of House Storage/Support	sq ft	34,354	44,279	48,859
Airport	sq ft	**5,689**	**5,689**	**6,289**
Administration and Executive	sq ft	N/A	N/A	N/A
Operations and Maintenance	sq ft	5,689	5,689	6,289
Services and Amenities	sq ft	N/A	N/A	N/A
Police	sq ft	N/A	N/A	N/A
Other Agency	sq ft	N/A	N/A	N/A
Building Services	sq ft	**58,000**	**58,982**	**63,400**
Non-Habitable Utility and Equipment	sq ft	19,248	20,230	24,648
Landside	sq ft	18,446	19,387	23,621
Airside	sq ft	802	843	1,027
Loading Docks	sq ft	N/A	N/A	N/A
Landside	sq ft	N/A	N/A	N/A
Airside	sq ft	N/A	N/A	N/A
Miscellaneous Covered/Unenclosed	sq ft	38,752	38,752	38,752
Other Common Areas	sq ft	**123,408**	**122,721**	**147,156**
Circulation and Seating/Lobbies	sq ft	99,272	104,339	127,123
Landside	sq ft	48,936	51,433	62,665
Airside	sq ft	50,336	52,905	64,458
Restrooms	sq ft	15,312	9,557	11,208
Landside	sq ft	4,926	4,797	5,663
Airside	sq ft	12,136	4,760	5,545
Unassigned	sq ft	8,825	8,825	8,825
Landside	sq ft	519	323	395
Airside	sq ft	8,306	8,306	8,306
Area Total	**sq ft**	**269,200**	**320,700**	**392,200**

NOTES:

Values may not add due to rounding.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100.

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

4.3.2.6 Terminal 4 Requirements

Airline Facilities

Check-in Hall

Departing (originating) passengers check in on the second level check-in lobby. The check-in lobby contains 74 in-line counter (bag drop) positions and 16 self-serve kiosks. Each two-unit position shares a bag scale with an adjacent position and occupies 9 feet of counter frontage. Terminal 4 would be normalized to 36 bag drop positions based on the current bag drop frontage in Terminal 4. The lobby of the terminal is split into a western and eastern bank of in-line counter positions. The eastern bank of positions has insufficient lobby depth to accommodate the recommended bag drop template, while the western bank has sufficient lobby depth.

Table 4.3-21 lists the requirements for 38 bag drop positions and 36 SSDs to accommodate the 52.4 MAP (2035) PAL.

Airline Ticket Offices

ATO functional space requirements are tied to requirements for staffed bag drop positions. The ratio of available ATO space to existing staffed bag drop positions was maintained throughout the planning horizon; 4,553 square feet of ATO space will be required in Terminal 4 to support the 52.4 MAP (2035) PAL.

Holdrooms

Terminal 4 contains 14 gate positions and 39,498 square feet of supporting holdrooms. The design aircraft for sizing holdrooms follows the largest aircraft scheduled for each gate per the DDFS, with a minimum size for each holdroom determined to be the most prominent ADG III aircraft scheduled for that terminal. The minimum size for a holdroom in Terminal 4 is approximately 3,050 square feet based on the JetBlue A321 design aircraft. Table 4.3-21 summarizes the space requirements for holdrooms based on the number of active gates prescribed by the DDFS. Appendix F provides a detailed analysis of the holdroom calculations and requirements. Terminal 4 is projected to need an additional 35,060 square feet of holdroom area to accommodate the 52.4 MAP (2035) PAL.

<u>Domestic Bag Claim</u>

Domestic Bag Claim facilities include baggage unload areas, facilities used by passengers to claim checked bags, and airline baggage service offices.

<u>Inbound Baggage Unload:</u>

Space requirements for Baggage Unload are addressed under Airline Outbound Bag Makeup and Inbound Bag Unload Facilities.

Table 4.3-21: Terminal 4 Airline Facilities Space Requirements (Detail)

CATEGORY	UNITS	EXISTING	REQUIREMENTS 41.9 MAP 31,600 DAILY PASSENGERS (2025)	REQUIREMENTS 52.4 MAP 44,700 DAILY PASSENGERS (2035)
Check-in Hall	sq ft	**9,456**	**15,120**	**19,152**
Bag Drop Positions	each	74	30	38
Self-Serve Kiosks	each	16	34	36
Curbside Counters	sq ft	-	-	-
Bag Drop Positions	each	-	-	-
Airline Ticket Offices	sq ft	**8,867**	**10,767**	**13,301**
Holdroom	sq ft	**39,498**	**59,724**	**74,560**
Gates	each	14	17	21
Domestic Baggage Claim and Baggage Service Offices	sq ft	**8,811**	**32,613**	**32,613**
Devices	each	3	6	6
Bag Claim Area (Devices, Retrieval Area, and Circulation)	sq ft	8,500	29,920	29,920
Baggage Service Offices 1/	sq ft	311	2,693 1/	2,693 1/
Domestic Airline Bag Operations	sq ft	**50,391**	**34,000**	**44,800**
Outbound Devices	sq ft	3	34,000	44,800
Carts Staged	each	88	85	112
Early Bag Storage (peak 10-minute count)	bags	-	75	95
Inbound Devices	each	3	3	3
Inbound Carts Staged (total)	each	12	12	12
International Arrivals Re-Check	sq ft	**1,433**	**1,433**	**1,914**
Airline Support	sq ft	**6,660**	**8,088**	**9,990**
Airline Clubs	sq ft	-	-	-
Number of Clubs	each	-	-	-
Area Total	**sq ft**	125,116	164,800	197,810

NOTES:

Values may not add due to rounding.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

1/ With growth in domestic arrivals at Terminal 4, requirements for the ratio of baggage service offices space to overall bag claim area increased to 9 percent to match the baggage service offices ratio established in Terminal 3. Additional discussion in section 4.3.6.1.

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Baggage Claim:

Table 4.3-21 summarizes the requirements for domestic bag claim units corresponding to each DDFS planning horizon. The amount of space that contains the existing three devices is insufficient to accommodate forecast activity levels over the duration of the forecast. Three additional sloped-plate claim devices with 180 linear feet of presentation and approximately 3,200 square feet of retrieval area are required to meet the 52.4 MAP (2035) PAL. The 180-lineal-foot claim devices, as described in Appendix F as the standardized template for new bag claim devices, are sloped-plate and have a capacity to accommodate 178 passengers at 18 square feet per passenger (LOS C).

Baggage Service Offices:

For all other terminals, the total area requirements for baggage service offices were proportionally increased relative to the current ratio of this space to total bag claim space. As Terminal 4 drastically increases domestic arrivals, however, the existing ratio of baggage service offices space to total bag claim space should more closely resemble the ratio observed in Terminal 3 in order to provide a sufficient LOS. Thus, in determining the requirements for Terminal 4, the Terminal 3 ratio of 9 percent of total bag claim space was used.

Airline Outbound Bag Makeup and Inbound Bag Unload Facilities

Outbound Bag Makeup

The Terminal 4 outbound bag makeup facility is capable of staging up to 88 baggage carts, whereas up to 112 cart positions would be required to accommodate 52.4 MAP (2035) requirements, assuming preferential airline use or 72 cart positions for shared use. To allow airlines the ability to accept checked bags earlier than 180 minutes prior to flight departure, early bag storage capacity is required to hold up to 95 bags to accommodate the 52.4 MAP (2035) PAL. Early bag storage space requirements were not calculated, since they can vary widely depending on their design, for example, vertical stacking can reduce the footprint of an early bag storage facility.

Table 4.3-21 lists the total area requirements for the Terminal 4 outbound bag makeup area by applying a ratio of 465 square feet per staged cart to the number of required stage cart positions. The ratio represents a prototypical outbound bag makeup configuration space template that is depicted in Appendix F. The template includes equipment, bag carts, work areas, cart staging clearances, and drive aisle clearances. No additional outbound bag makeup space will be required to accommodate the 52.4 MAP (2035) PAL.

Inbound Baggage Unload:

In Terminal 4 bags are unloaded directly onto one of three through-wall flat-plate carousels. Each flat-plate carousel can accommodate four bag carts parked for unloading and is able to accommodate forecast activity levels over the duration of the forecast.

International Bag Recheck

Existing recheck facilities were assumed to be sufficient to accommodate activity levels over the duration of the forecast planning horizon.

Airline Support

Table 4.3-21 summarizes the requirements for airline support functional space corresponding to each DDFS planning horizon. Airline support functional space total area requirements were proportionally increased relative to the percentage increase in aircraft gate positions, which was projected to increase by 1,427 square feet by 41.9 MAP activity level and by 3,330 square feet by 52.4 MAP activity level.

Airline Clubs

No additional requirements for airline clubs and premium class lounges were projected. Airline/premium lounge facilities are mostly at the discretion of an airline or concession program.

Department of Homeland Security – Transportation Security Administration

Security Screening Checkpoint

Security screening checkpoint requirements were developed using simulation modeling to incorporate metering from upstream passenger check-in processes, security checkpoint transaction times, and LOS goals. Checkpoint processing attributes and LOS goals used in this simulation analysis are outlined in Appendix F. The LOS goal maximum wait time in queue was 20 minutes for a standard screening lane and 10 minutes for a Pre✓® lane. The 10 existing checkpoint lanes in Terminal 4 are sufficient to accommodate demand over the duration of the forecast horizon, as shown in **Table 4.3-22**.

The six machines operating in Terminal 4 are capable of processing approximately 674 bags per hour per machine and should have the capacity to accommodate demand over the duration of the forecast horizon.

TSA Support Offices

TSA support offices include administrative offices, breakrooms, training rooms, IT support systems, and other related functions. TSA support offices were increased proportionally to the increase in gates required per the 2025 and 2035 DDFS. An additional 2,979 square feet of support offices will be required to support the 52.4 MAP (2035) PAL.

Department of Homeland Security – Customs and Border Protection

Automated Passport Inspections

Automated passport inspection facility requirements were developed using simulation modeling to correlate forecast arriving international passenger demand to passenger attributes, including nationality, applicable processing rates, and LOS goals. The existing 40 APC kiosks can accommodate the 41.9 MAP (2025) PAL, with an additional 4 APC kiosks required to accommodate the 52.4 MAP (2035) PAL.

International Bag Claim

International baggage claim requirements were developed using simulation modeling, which analyzed when passengers arrived to claim bags after clearing automated passport inspections, as well as analyzed bag delivery times. The existing four baggage claim devices provide sufficient number of bag claim units and retrieval area over the duration of the planning horizon, as indicated in Table 4.3-22.

Table 4.3-22: Terminal 4 Department of Homeland Security Space Requirements (Detail)

CATEGORY	UNITS	EXISTING	REQUIREMENTS 41.9 MAP 31,600 DAILY PASSENGERS (2025)	REQUIREMENTS 52.4 MAP 44,700 DAILY PASSENGERS (2035)
Transportation Security Administration	**sq ft**	**59,983**	**28,793**	**37,115**
Passenger Security Screening Checkpoint	**sq ft**	23,820	12,750	19,125
Number of Lanes	each	10	6	9
Baggage Screening	**sq ft**	20,400	10,200	10,200
Number of EDS Machines	each	6	3	3
Support Offices	**sq ft**	4,812	5,843	7,790
Customs and Border Protection (CBP)	**sq ft**	**163,941**	**128,413**	**156,787**
Sterile Circulation	**sq ft**	N/A	N/A	N/A
Primary Inspection	**sq ft**	48,193	12,654	16,074
Global Entry Kiosks	each	6	3	3
APC Kiosks	each	40	34	44
APC Agent Podiums	each	16	N/A	N/A
Piggyback Booths	each	21	N/A	N/A
Secondary Processing	**sq ft**	18,535	18,535	24,755
Number of Inspection Lanes	each	4	4	5
Exit Control	**sq ft**	N/A	5,635	6,860
Number of Podiums	each	30	23	28
CBP Offices/Support	**sq ft**	45,585	45,585	60,883
International Bag Claim	**sq ft**	40,510	40,510	40,510
Devices	each	4	4	4
International Bag Room	**sq ft**	11,119	11,119	14,850
Transfer Devices	each	N/A	N/A	N/A
Inbound Devices	each	6	6	8
Area Total	**sq ft**	**223,924**	**157,206**	**193,903**

NOTES:

Values may not add due to rounding.

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

EDS = Explosive Detection Systems

APC = Automated Passport Control

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Exit Control/Inspections

The requirements shown in Table 4.3-22 were developed to accommodate three passenger queues: one for passengers with a verify or "check-mark" coupon from an APC, one for U.S. Citizens/Legal Permanent Residents with a triage or "X" coupon from an APC, and one for visitors with a triage or "X" coupon. Officers were assumed to be able to process passengers from any of the other two queues when their own queue was empty. The existing inventory of 30 officer inspection stations (15 piggyback booths) will be sufficient to achieve the prescribed LOS wait times under 45 minutes at the 52.4 MAP (2035) PAL.

Secondary Processing

Secondary processing space requirements were proportionally increased relative to the current ratio of secondary processing space to the percentage increase in peak-hour arriving international passengers for each DDFS activity level. An additional 6,220 square feet of secondary processing will be needed to accommodate the 52.4 MAP (2035) PAL.

CBP Offices/Support

CBP offices/support space requirements were proportionally increased relative to the current ratio of CBP offices and support space to the percentage increase in peak-hour arriving international passengers for each DDFS activity level. An additional 15,298 square feet of CBP office/support space will be needed to accommodate the 52.4 MAP (2035) PAL.

Support Functions

Commercial Programs

Commercial program (i.e., concessions) spaces include food and beverage, retail, specialty, and duty-free shopping. Future requirements were developed using current commercial program space grown by Terminal 4's growth in MAP. This future aggregate concessions requirement was then split between the airside and landside terminals using a ratio of 80 percent to 20 percent, respectively. These ratios and the calculation of commercial program requirements can be found in Appendix F, and the square foot requirements are shown in **Table 4.3-23**.

Support facilities for commercial program space, such as loading docks and in-terminal concessions breakdown and storage areas, were included under building services. An additional 49,913 square feet of commercial program space will be needed to support the 52.4 MAP (2035) PAL.

Airport Services

Requirements for in-terminal facilities supporting Airport administration, Airport operations, police, and other agencies were developed to maintain the current ratios for these types of spaces relative to the total number of gates. A factor was determined for each terminal based on this ratio, and the Airport and other agencies space was grown by this factor for every three new gates required by the DDFS. The calculation of Airport and other agency requirements are discussed in Appendix F, and the square foot requirements are shown in Table 4.3-23. An additional 13,200 square feet of Airport services space will be needed to support the 52.4 MAP (2035) PAL.

Table 4.3-23: Terminal 4 Support Functions Space Requirements (Detail)

			REQUIREMENTS	
CATEGORY	UNITS	EXISTING	41.9 MAP 31,600 DAILY PASSENGERS (2025)	52.4 MAP 44,700 DAILY PASSENGERS (2035)
Commercial Program	sq ft	49,006	79,861	98,919
Airside	sq ft	30,283	63,889	79,135
Landside	sq ft	2,956	15,972	19,784
Back of House Storage/Support	sq ft	15,767	25,695	31,827
Airport	sq ft	91,551	98,151	104,751
Administration and Executive	sq ft	73,788	79,088	84,388
Operations and Maintenance	sq ft	17,763	19,063	20,363
Services and Amenities	sq ft	N/A	N/A	N/A
Police	sq ft	N/A	N/A	N/A
Other Agency	sq ft	N/A	N/A	N/A
Building Services	sq ft	81,076	83,338	88,970
Non-Habitable Utility and Equipment	sq ft	32,070	34,332	39,965
Landside	sq ft	N/A	N/A	N/A
Airside	sq ft	38,140	40,830	47,528
Loading Docks	sq ft	N/A	N/A	N/A
Landside	sq ft	N/A	N/A	N/A
Airside	sq ft	N/A	N/A	N/A
Miscellaneous Covered/Unenclosed	sq ft	49,006	49,006	49,006
Other Common Areas	sq ft	144,226	151,676	176,239
Circulation and Seating/Lobbies	sq ft	118,401	126,751	147,546
Landside	sq ft	35,885	38,416	44,718
Airside	sq ft	90,412	96,788	112,667
Restrooms	sq ft	12,819	11,919	15,687
Landside	sq ft	3,729	6,391	8,514
Airside	sq ft	9,090	5,528	7,173
Unassigned	sq ft	13,006	13,006	13,006
Landside	sq ft	N/A	N/A	N/A
Airside	sq ft	13,006	13,006	13,006
Area Total	**sq ft**	365,900	413,000	468,900

NOTE:

Values may not add due to rounding.

Gate requirements exclude demand for gates by new entrants. Spare gates are common use gates.

MAP = Million Annual Passengers

Daily passengers = sum of DDFS total enplanements and deplanements rounded to nearest 100

SOURCE: Ricondo & Associates, Inc., January 2017 (Analysis).
PREPARED BY: Ricondo & Associates, Inc., January 2017.

Other Common Areas

The calculations for other common space requirements can be found in Appendix F, and the square foot requirements are shown in Table 4.3-23. An additional 32,013 square feet of other common areas space will be needed to support the 52.4 MAP (2035) activity level.

Building Services

The calculation of building services requirements can be found in Appendix F, and the square foot requirements are shown in Table 4.3-23. An additional 7,894 square feet of building services space will be needed to support the 52.4 MAP (2035) activity level.

4.4 Terminal Roadways

This section focuses on the terminal roadway system, which consists of the curbfronts and traveling lanes in front of each terminal. The following subsections include a summary of the demand forecasts, the assessment of terminal roadways demand/capacity, and the resulting LOS and requirements based on the demand/capacity analysis. Per the *Quality/Level of Service Handbook* by the Florida Department of Transportation, LOS is a quantitative stratification of quality service into six letter grades that provides a generalized and conceptual planning measure that assesses multimodal service inside the roadway environment. The LOS results identified in this report will be used to focus the development and implementation of long-term improvements on identified congestion points in order to alleviate the forecast airport traffic. The recommended improvements and alternatives will be documented in Chapter 5, *Alternatives Definition and Evaluation* analysis.

4.4.1 METHODOLOGY AND ASSUMPTIONS

This section describes the methodologies and assumptions used to calculate and forecast vehicle demands for the terminal roadways at FLL. As summarized in Chapter 2, Existing Conditions Inventory, the terminal roadways refer to the curbfronts and traveling lanes in front of each terminal. Demands for the terminal roadways at FLL, including curbfront, pedestrian, and transit operations, were developed using the Advanced Land-Transportation Performance Simulation (ALPS) set of computer simulation tools.

ALPS is a suite of modeling and analysis programs that have been under development with ongoing refinements for over 30 years. It allows the user to create simulations that encompass the various pedestrian and vehicular movements within the terminal roadway system and inside the terminal building itself. ALPS creates a microsimulation model that combines a variety of travel modes (e.g., private autos, buses, shuttles, pedestrians) in a single comprehensive model—portraying the effects each mode has upon the others. Using ALPS, a facility is evaluated as a comprehensive system rather than as a group of unrelated parts.

Fundamental to the ALPS concept is the ability to generate passenger demands based on the existing and anticipated flight schedules. Passenger characteristics, such as time of arrival at the Airport and accompanying visitors, are applied to the flight activity to generate the passenger demands throughout a 24-hour period. Vehicular characteristics, such as mode split and vehicle occupancy, are then applied to the passenger demands to generate vehicular activity by vehicle type and trip type (shuttle, personal car, taxi, bus, etc.). Once the vehicular activity is generated, the individual vehicles are routed through the modeled roadway network and stop at their respective curbfronts or destinations. Through the simulation capabilities of ALPS, the curbfront operations and pedestrian movements are visualized to observe the congestion at the curbfronts and roadways. In addition to the visual representation of curbfront congestion, quantitative results are also captured within the ALPS program.

To generate the unique peak hours for FLL, the demands generated from the model are based on FLL flight schedules, aircraft size, and passenger loads. The calibrated baseline simulation model was used to evaluate the characteristics and to forecast the demands into established horizons. ALPS models were developed to forecast roadway demands for the following four scenarios in regards to PMAD:

- 2015 PMAD
- 2020 PMAD
- 2025 PMAD
- 2035 PMAD

The 2015 PMAD scenario represents Friday, March 27, 2015 conditions, and is based on the peak month identified for this MPU. The 2015 (actual), 2020, 2025, and 2035 PMAD models represent an average day during March in those years, consistent with the Accelerated Baseline Forecasts. The three forecast scenarios assume that the short-term (5-year) improvements recommended in the *Landside Analysis – Terminal Access Roadways, Curbfront, and Parking Short-Term Improvement Study*[3] (the Landside Analysis Study) are in place. The short-term improvements include the following:

- exit roadway enhancements, e.g., Cypress helix exit lanes removal, widening, and mitigating weave issues
- technology improvements to flex the use of the upper and lower levels
- removal of curbfront access impediments, e.g., extensive cone usage
- signalized pedestrian crosswalks as an enhancement not recommended by the study, but adopted as part of the short-term improvements
- relocated BCAD/BSO designated parking areas across the terminal roadway
- temporary Cell Phone Lot relocation to old Avis lot on Perimeter Road
- enforcement on lower level crosswalks with cross guards
- relocation of Employee Parking to existing Economy Lot
- valet relocation and new valet slip ramp from main exit roadway

---

3 Kimley-Horn and Associates, Landside Analysis – Terminal Access Roadways, Curbfront, and Parking Short-Term Improvement Study, May 2016.

Detailed descriptions of the short-term improvements can be found in the Summary Memorandum (Volume III) from the Landside Analysis Study.

4.4.2 EXISTING AND FORECAST DEMANDS

The existing and forecast demands for the established planning year horizons (2015, 2020, 2025, and 2035) are tabulated and summarized in the following subsections.

4.4.2.1 Level of Service

Vehicle and pedestrian volumes and activity were used to calculate the demand/capacity and resulting LOS for the terminal roadways in the four demand scenarios: 2015, 2020, 2025, and 2035. Specifically, for the terminal roadways, the methodology from ACRP Report 40, *Airport Curbside and Terminal Area Roadway Operations*, was applied to the ALPS-generated demands to calculate LOS. This section describes the LOS methodologies, the definitions, and the resources used to obtain the terminal LOS estimates.

The terminal LOS consists of two components: curbfront LOS and road LOS. Ultimately, the ACRP requires the resulting LOS classification of the terminal roadways to reflect the worst-case scenarios associated with the curbfront LOS and the road LOS.

Table 4.4-1 and **Table 4.4-2** summarize the vehicular demands expected at the lower level and upper level terminal curbfronts throughout the four PMAD scenarios.

4.4.2.2 Curbfront Level of Service

The curbfront LOS is based on several factors, including available curbfront length, vehicle size (i.e., how much curbing space the vehicle occupies), and average vehicle dwell time (i.e., how long each vehicle remains at the curbfront). The curbfront length is calculated based on how the curbfront positions are designated, such as private autos, BCAD operations vehicle, BSO vehicle. Dwell times, especially on the arrivals level, are typically different for vehicles curbing in the second lane compared to the first lane, and they were accounted for in the capacity calculations. Transit-specific dwell times, vehicle size, and lane choice are generally different for buses and shuttles, compared to private autos, and were captured separately. Additionally, the curb LOS accounts for the presence of crosswalks, which may negatively impact capacity (primarily due to added delay).

- Curbfront Capacity: At FLL, vehicles are permitted to use the first two lanes for curbfront activity; however, at times, three lanes were observed as being used for curbfront activity. For the purposes of determining curb capacity per terminal building, two curb lanes were assumed as the curb capacity, as use of a third lane for curb functions is not the intended purpose of this lane at FLL. Vehicle size and lane-specific dwell times based on collected data were assigned to each curb lane as inputs to the curbfront capacity calculations.

Table 4.4-1: Terminal Curbfront Demands (2015 and 2020)

		CURBFRONT DEMAND (VEHICLES)		TOTAL LOOP VOLUME (VEHICLES)	
CURBFRONT	PEAK TIME	DAILY CURBING DEMAND	PEAK-HOUR CURBING DEMAND	DAILY	PEAK HOUR
PEAK MONTH AVERAGE DAY 2015 SCENARIO					
T1 Upper	6:45 a.m.	4,185	409	16,281	1,238
T2 Upper	10:00 a.m.	2,214	284		
T3 Upper	5:00 p.m.	4,231	426		
T4 Upper	8:15 a.m.	1,835	255		
T1 Lower	11:00 a.m.	3,284	445	17,989	1,502
T2 Lower	2:30 p.m.	1,368	209		
T3 Lower	6:30 p.m.	3,320	477		
T4 Lower	10:00 a.m.	2,552	440		
PEAK MONTH AVERAGE DAY 2020 SCENARIO					
T1 Upper	9:30 a.m.	5,916	525	20,681	1,445
T2 Upper	9:00 a.m.	2,440	296		
T3 Upper	6:00 a.m.	5,615	483		
T4 Upper	5:00 p.m.	2,308	296		
T1 Lower	11:00 a.m.	4,624	511	24,591	1,804
T2 Lower	2:30 p.m.	1,599	233		
T3 Lower	6:00 p.m.	4,789	622		
T4 Lower	7:15 p.m.	3,065	272 1/		

NOTE:

1/ Peak-hour volume is lower than the previous scenario due to a sharper peak in activity within the peak hour in the previous scenario, which creates a smoother activity/demand peak hour in the future.

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).

PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Table 4.4-2: Terminal Curbfront Demands (2025 and 2035)

CURBFRONT	PEAK TIME	CURBFRONT DEMAND (VEHICLES)		TOTAL LOOP VOLUME (VEHICLES)	
		DAILY CURBING DEMAND	PEAK-HOUR CURBING DEMAND	DAILY	PEAK HOUR
PEAK MONTH AVERAGE DAY 2025 SCENARIO					
T1 Upper	5:30 a.m.	6,179	681	22,620	1,676
T2 Upper	9:45 a.m.	2,735	302		
T3 Upper	9:15 a.m.	6,658	587		
T4 Upper	5:45 a.m.	2,665	329		
T1 Lower	11:00 a.m.	4,571 1/	514	26,558	1,894
T2 Lower	2:30 p.m.	1,726	240		
T3 Lower	8:45 p.m.	6,032	742		
T4 Lower	10:00 a.m.	3,531	508		
PEAK MONTH AVERAGE DAY 2035 SCENARIO					
T1 Upper	5:30 a.m.	7,330	835	26,938	1,750
T2 Upper	9:15 a.m.	3,125	353		
T3 Upper	6:00 a.m.	8,167	600		
T4 Upper	8:45 a.m.	3,570	365		
T1 Lower	5:30 p.m.	5,361	504 2/	31,661	2,244
T2 Lower	2:45 p.m.	1,967	276		
T3 Lower	8:45 p.m.	7,392	827		
T4 Lower	10:00 a.m.	5,126	754		

NOTES:

1/ The daily volume report is lower compared to its previous scenario due to differing flight schedule activity between terminals, resulting in a different distribution of curbing demands.

2/ The peak-hour volume report is lower compared to its previous scenario due to smoother activity/demand; its preceding scenario contains sharper peaks in activity.

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).

PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

- Curbfront Demand: Demand for each of the terminal curbfronts, in terms of private auto and transit vehicle volumes, were obtained from the ALPS model and were reported in Section 4.4.2. Each terminal curbfront area was analyzed for its respective peak hour of curbing demand. For the purposes of acquiring accurate curbfront demands from the microsimulation model, an artificially unconstrained version of the model was run to minimize metering and loss of demand (number of vehicles that desire to utilize the curbfront) due to congestion.

- Curbfront Utilization Ratio: To calculate the LOS, demand was compared to the available capacity. Consistent with ACRP methodology, the curbfront analysis calculated a utilization ratio (CUR) for a given curbfront, which is a measure of the average saturation of one curbing lane for the analysis time period (peak hour). For example, a CUR of 1.0 means one curbing lane is at full utilization, or two curbing lanes are each half utilized, which corresponds to LOS B. A CUR of 2.0 means two curbing lanes are fully utilized, which corresponds to LOS F. The CUR for each LOS classification is provided in **Table 4.4-3**.

Table 4.4-3: Curb Level of Service by Curb Utilization Ratio (Dual Curb Lanes)

LEVEL OF SERVICE METRIC	CURB
A	< 0.90
B	0.90 – 1.10
C	1.10 – 1.30
D	1.30 – 1.70
E	1.70 – 2.00
F	> 2.00

NOTE: The curb utilization ratio (CUR) is a measure of the average saturation of one curbing lane for the analysis time period (peak hour). It is a comparison of the vehicular demand (in linear feet) to available curbfront length.

SOURCE: Airport Cooperative Research Program Report 40, *Airport Curbside and Terminal Area Roadway Operations*, 2010.

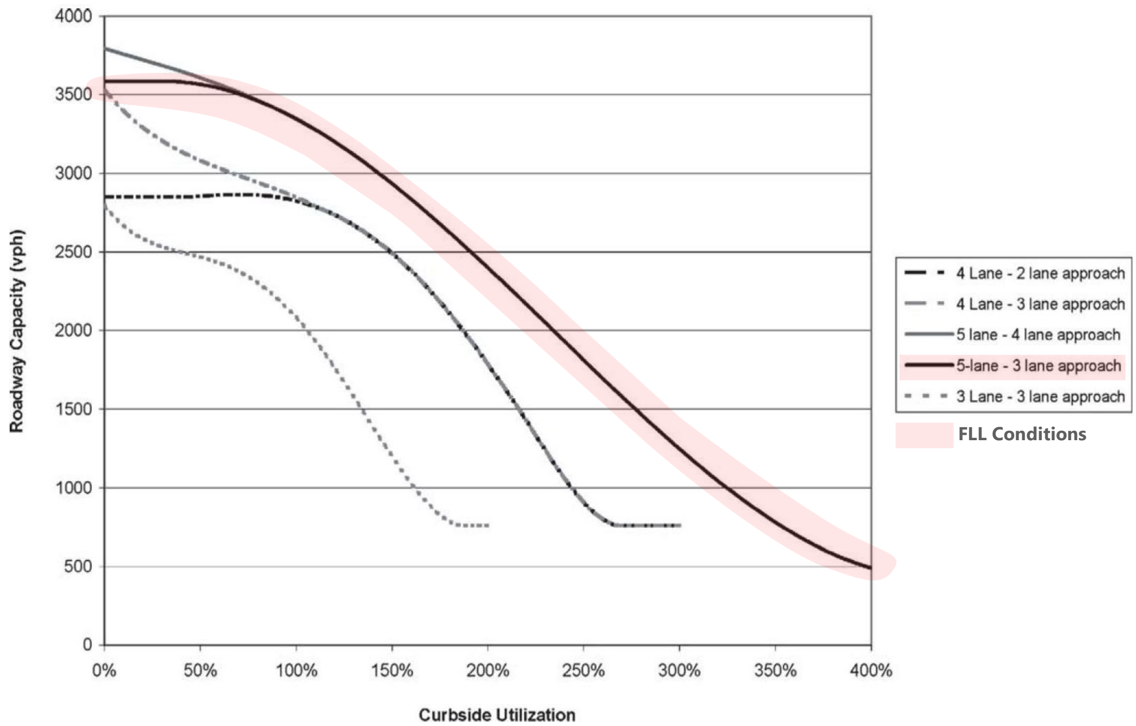
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

4.4.2.3 Road Level of Service

Road LOS is calculated for terminal roadways serving vehicles traveling past a section of curbfront lanes, or curbfront through lanes. The road LOS is based on several factors, including total number of lanes, number of lanes reserved for curbfront activity, and level of curbfront activity. The road LOS is impacted by the number of vehicles stopping at the adjacent curbfront lanes and the "friction" caused by curbfront activity. In addition to the curbfront activity, pedestrians also impact the resulting average travel speeds of the curbfront through lanes.

- Road Capacity: Consistent with ACRP methodology, the road capacity for curbfront through (non-curbing) traffic in front of the curbfront is dependent on lane configuration and the CUR. The result is a dynamic capacity that varies based on curbfront activity and pedestrian/vehicle interaction, which is illustrated on **Exhibit 4.4-1,** where FLL conditions are highlighted in red. As the curbfront becomes more heavily utilized and the CUR increases, there is a corresponding decrease in the available roadway capacity.
- Curbfront Traffic Demand: Curbfront through (non-curbing) traffic demand, in terms of total vehicular volumes, were obtained from the ALPS model. This traffic primarily consists of vehicles destined for one of the other three terminal curbfronts, as well as a mix of additional circulating traffic. Each terminal curbfront's adjacent roadway was analyzed for the peak hour of terminal road activity. Demand/Capacity ratios were calculated to determine their corresponding LOS, per ACRP methodology.

Exhibit 4.4-1: Curbfront Utilization versus Roadway Capacity



NOTE:

vph = Vehicles per Hour

SOURCE: Airport Cooperative Research Program Report 40, *Airport Curbside and Terminal Area Roadway Operations*, 2010.
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

4.4.2.4 Final Level of Service

Given that the terminal roadways are composed of curbfront lanes and traveling lanes, the CUR directly determined the curbfront LOS and contributed to the road LOS calculation, per ACRP methodology. Ultimately, the ACRP requires the resulting LOS classification of the terminal roadways to reflect the worst-case scenarios between the curbfront LOS and the road LOS.

Representative conditions for typical terminal LOS conditions are illustrated with photos and summary descriptions on **Exhibit 4.4-2**. Typically, LOS C is considered the standard for planning new airport facilities; although, at large-hub airports with existing facilities (like FLL), LOS D is sometimes considered acceptable. The LOS target for FLL was defined as LOS D; however, in the short-term, this LOS may not be achievable in all areas.

Exhibit 4.4-2: Level of Service Representation

Drivers experience no interference from other vehicles or pedestrians. Motorists arriving at the airport terminal can stop adjacent to the curb at preferred locations. Demand is equal to or less than 0.50 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is unaffected.

Relatively free-flow conditions, although double-parking can be observed at some curbside locations (i.e., baggage check-in, major entrance/exit points). Demand is between 0.5 and 0.55 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is virtually unaffected.

Double-parking near doors is common and some intermittent triple-parking may occur. This level of service is appropriate for peak period design conditions at major airports. Demand is between 0.55 and 0.65 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is reduced by approximately 5% due to the increased frequency of double-parking.

Triple-parking occurs more frequently and vehicle maneuverability is somewhat restricted. Intermittent vehicle queues may form both in the through lanes and at the entrance to the curbside area. Demand is between 0.65 and 0.85 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is reduced by over 20% due to the increased frequency of double- and triple-parking.

LOS E—Motorists experience delays and queues along the length of the curbside. Both congestion and double- or triple-parking are evident throughout the curbside area. Momentary breakdowns in operation occur as traffic in the through lanes is increasingly delayed by vehicle maneuvering in and out of the parking lanes. Demand is between 0.85 and 1.0 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is reduced by over 35% due to the increased frequency of double- and triple-parking.

LOS F—Motorists experience significant delays at the curbside entrance and along the length of the curbside. Parked vehicles are unable to leave the curbside due to stopped vehicles in adjacent lanes. Demand exceeds 1.0 of the double-parking capacity of the curbside. The flow of vehicles in all lanes frequently comes to a halt.

SOURCE: Airport Cooperative Research Program Report 40, *Airport Curbside and Terminal Area Roadway Operations*, 2010.
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

4.4.3 RESULTS AND REQUIREMENTS

Based on the resulting demands and LOS, long-term requirements were identified and are discussed in this section. The terminal curbfronts include the roadways in front of the four terminal buildings on the upper level (departures) and the lower level (arrivals). This section describes the capacity available and the demand that resulted from the ALPS models along each of the terminal curbfronts. Unlike other multimodal simulation software, in the ALPS model, the generation of vehicular and pedestrian traffic starts with a 24-hour flight schedule. In addition, ALPS has the ability to calculate true demand for a given curbfront during a given period of time (not just volume that actually passes through), even if the system is over capacity. With this information, the demand/capacity ratios were calculated, and they are reflected as LOS. The LOS results are used to identify congested locations and target areas for recommended improvements.

The following graphics represent the volume demands, LOS conditions (color-coded), and requirements on each terminal under each PMAD scenario. **Exhibits 4.4-3** through **4.4-6** represent the upper level terminal curbfronts, and **Exhibits 4.4-7** through **4.4-10** represent the lower level terminal curbfronts. **Table 4.4-4** summarizes the curbfront LOS (color-coded) in terms of available curb length per lane for each terminal and each forecast scenario, and it compares the LOS to the required curb length per lane necessary to achieve adequate LOS.

4.4.4 SUMMARY

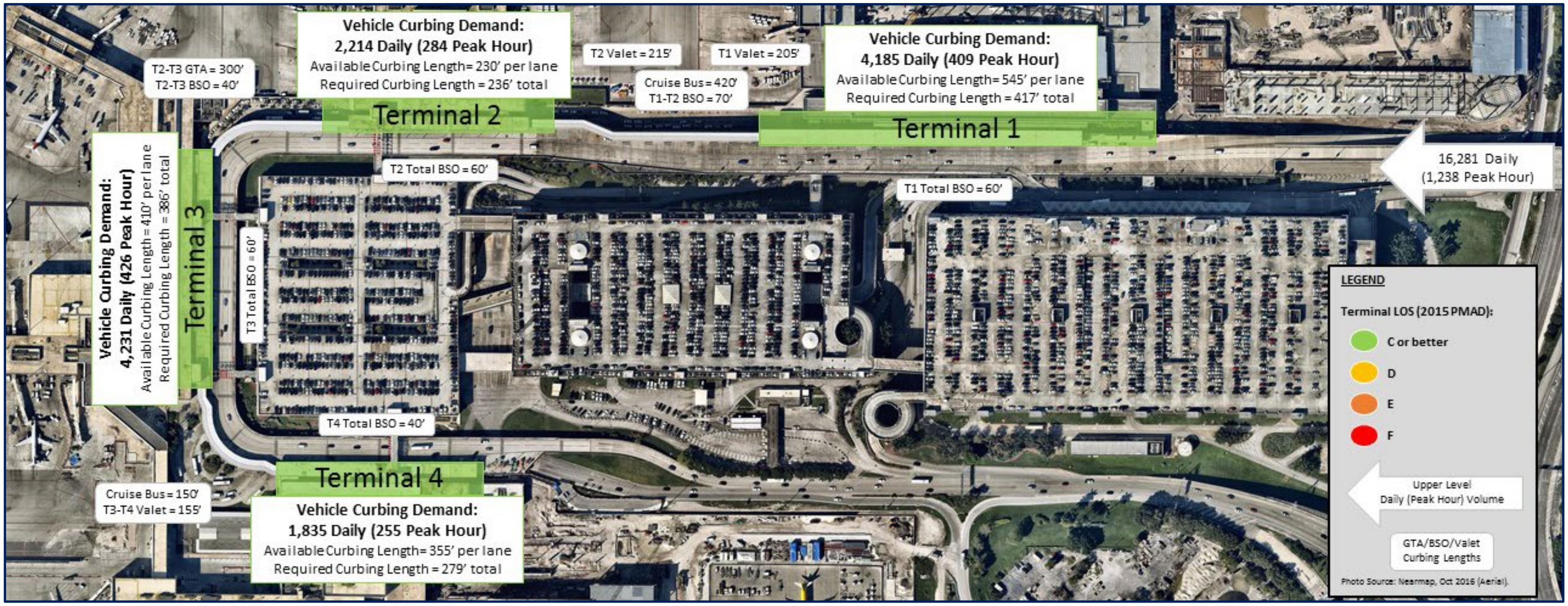
The LOS results for the terminal roadways, with the short-term improvements applied, still show some areas of poor LOS that need to be addressed. The following results will be used to focus the development and implementation of long-term improvements on the identified congestion points to alleviate the forecast Airport traffic:

- Terminal roadways and curbfronts, particularly Terminals 3 and 4, are forecast to be over capacity.
- Terminal 3 shows LOS F in the lower level on all PMAD scenarios.
- Terminal 4 shows LOS F in the lower level from 2025 and on.
- Terminal 1 shows LOS E in the lower level from 2025 and on and in the upper level for 2035.

Terminal roadway congestion and curbfront operations may be improved by lengthening available curbfront areas, reducing (or relocating) curbfront vehicular demand, supplemental curbfronts and/or minimizing vehicular conflicts and traffic control devices, such as pedestrian crossings, or a combination of these.

BROWARD COUNTY FLORIDA — FORT LAUDERDALE-HOLLYWOOD INTERNATIONAL AIRPORT, BROWARD COUNTY, FLORIDA

Exhibit 4.4-3: Peak Month Average Day 2015 Upper Level Conditions.



NOTES:

GTA = Ground Transportation Areas

BSO = Broward Sherriff's Office

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

BROWARD COUNTY FLORIDA | FORT LAUDERDALE-HOLLYWOOD INTERNATIONAL AIRPORT BROWARD COUNTY, FLORIDA

Exhibit 4.4-4: Peak Month Average Day 2020 Upper Level Conditions

NOTES:

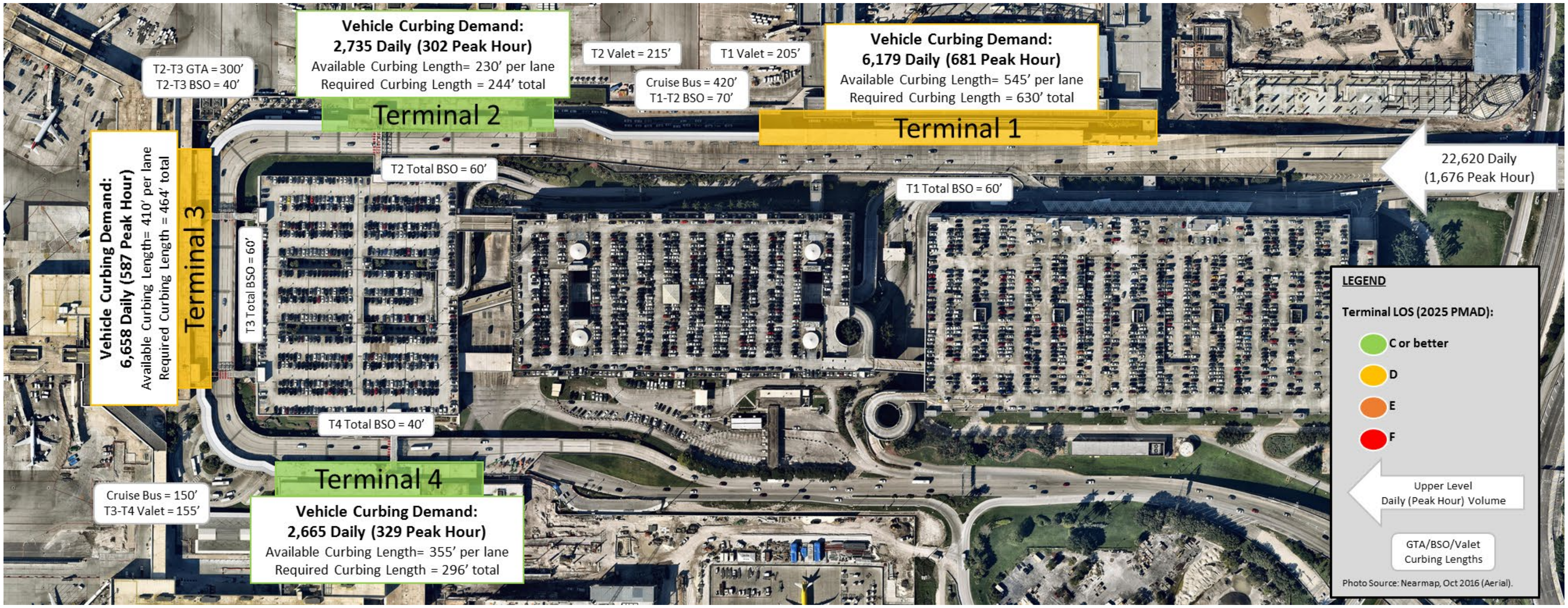
Includes short-term improvements.

GTA = Ground Transportation Areas

BSO = Broward Sherriff's Office

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.4-5: Peak Month Average Day 2025 Upper Level Conditions



NOTES:

Includes short-term improvements.

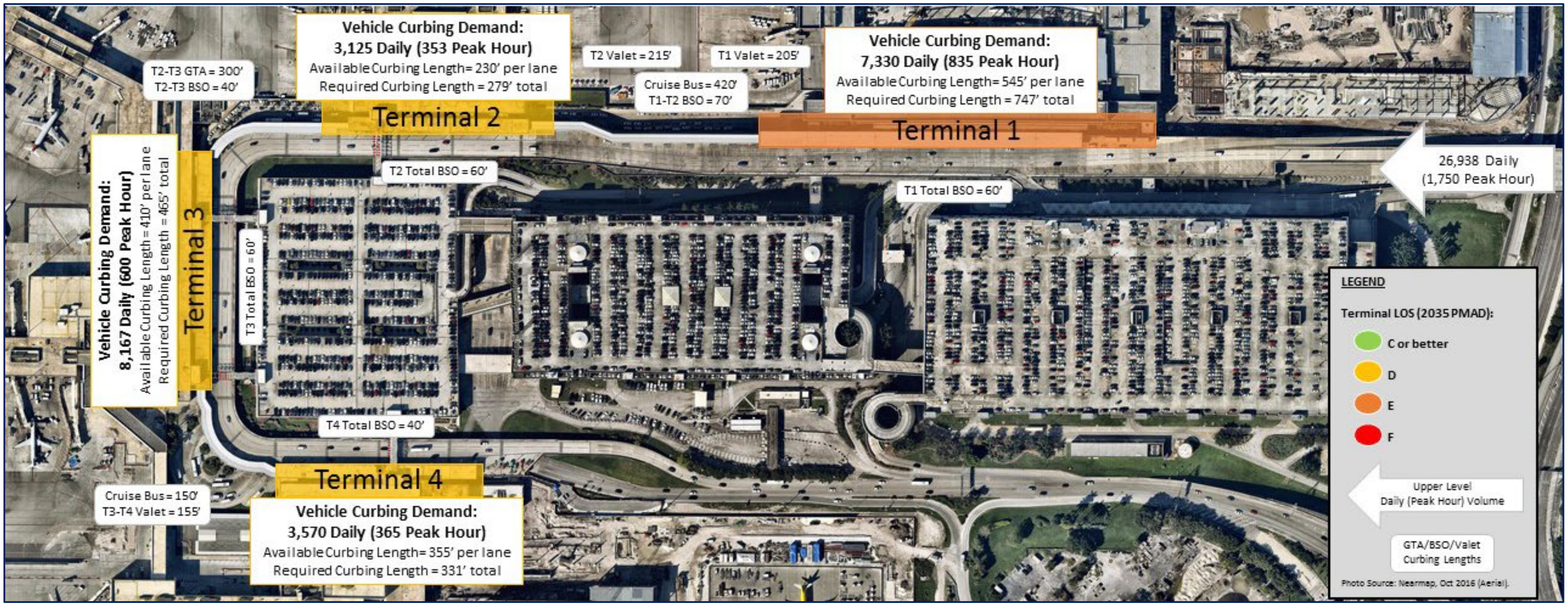
GTA = Ground Transportation Areas

BSO = Broward Sherriff's Office

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

BROWARD COUNTY FLORIDA
FORT LAUDERDALE-HOLLYWOOD INTERNATIONAL AIRPORT
BROWARD COUNTY, FLORIDA

Exhibit 4.4-6: Peak Month Average Day 2035 Upper Level Conditions



NOTES:

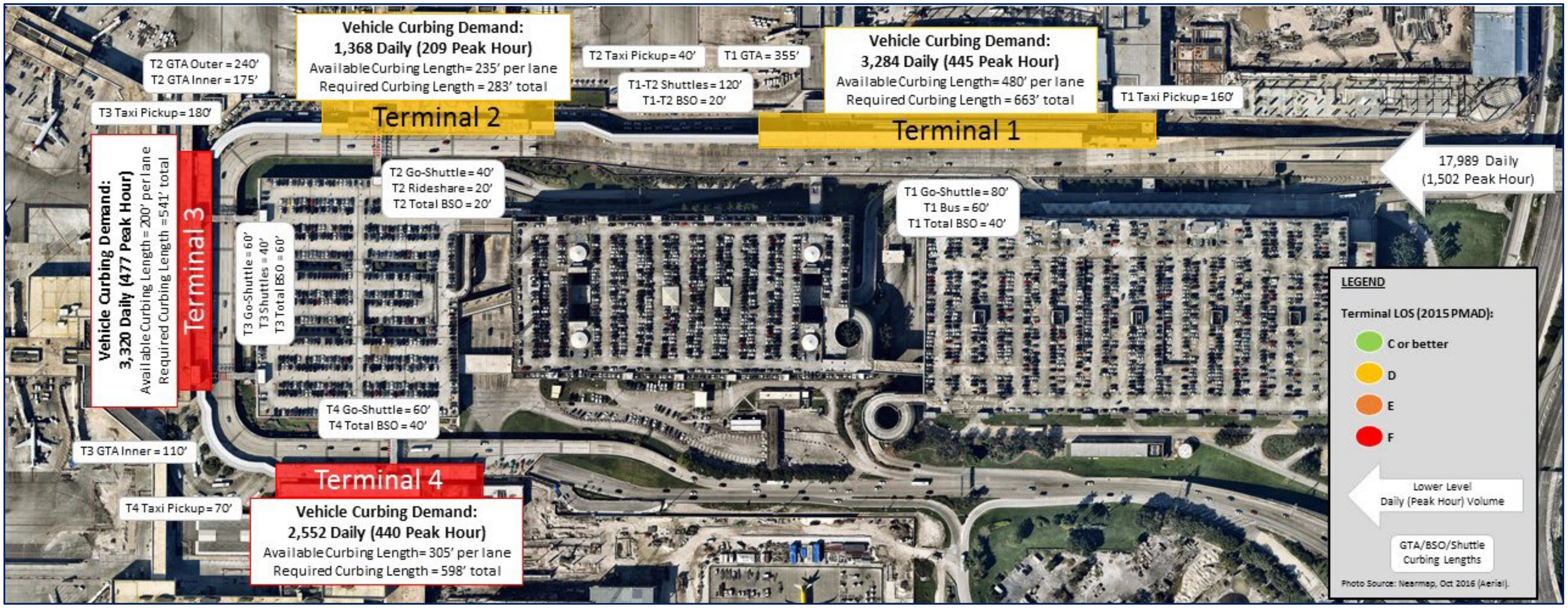
Includes short-term improvements.

GTA = Ground Transportation Areas

BSO = Broward Sherriff's Office

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.4-7: Peak Month Average Day 2015 Lower Level Conditions



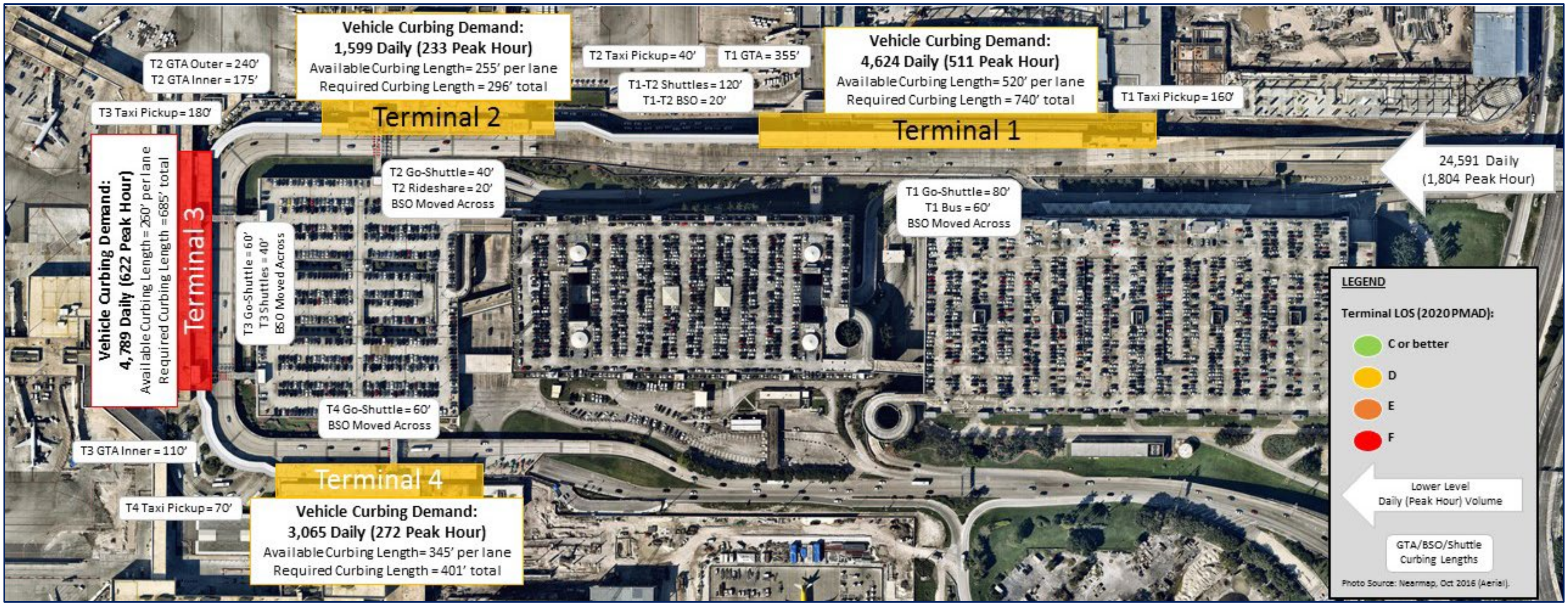
NOTES:

GTA = Ground Transportation Areas

BSO = Broward Sherriff's Office

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.4-8: Peak Month Average Day 2020 Lower Level Conditions



NOTES:

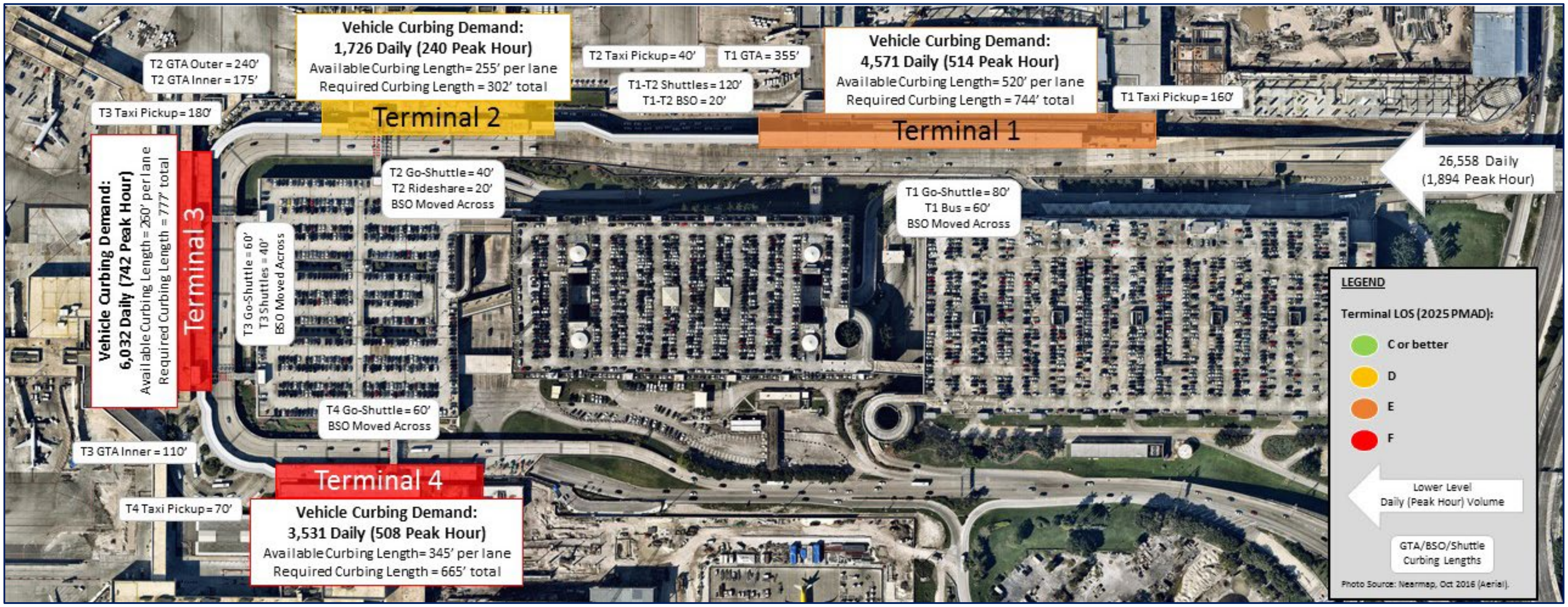
Includes short-term improvements.

GTA = Ground Transportation Areas

BSO = Broward Sherriff's Office

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.4-9: Peak Month Average Day 2025 Lower Level Conditions



NOTES:

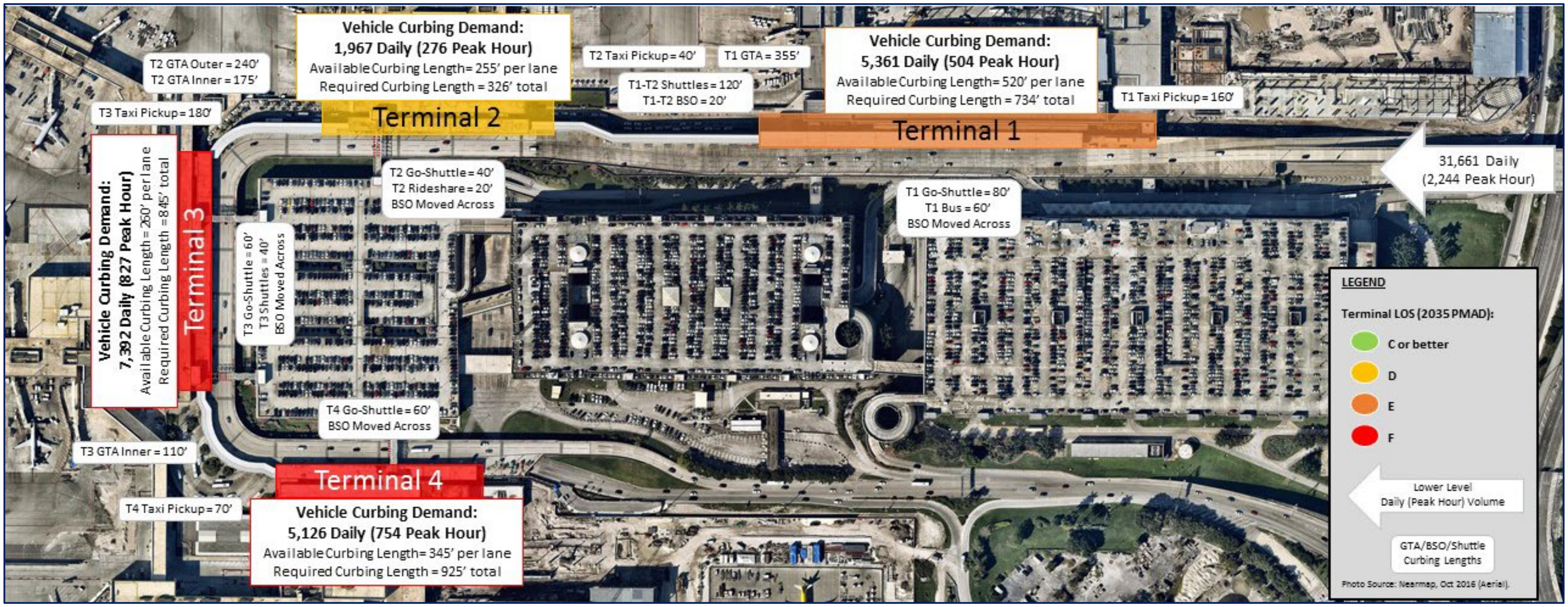
Includes short-term improvements.

GTA = Ground Transportation Areas

BSO = Broward Sherriff's Office

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.4-10: Peak Month Average Day 2035 Lower Level Conditions



NOTES:

Includes short-term improvements.

GTA = Ground Transportation Areas

BSO = Broward Sherriff's Office

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Table 4.4-4: Terminal Level of Service and Requirements Summary

CURBFRONT	2015 LEVEL OF SERVICE	2015 CURB LENGTH AVAILABLE (FEET)	2015 CURB LENGTH REQUIRED (TOTAL FEET)	2020 LEVEL OF SERVICE	2020 CURB LENGTH AVAILABLE (FEET)	2020 CURB LENGTH REQUIRED (TOTAL FEET)	2025 LEVEL OF SERVICE	2025 CURB LENGTH AVAILABLE (FEET)	2025 CURB LENGTH REQUIRED (TOTAL FEET)	2035 LEVEL OF SERVICE	2035 CURB LENGTH AVAILABLE (FEET)	2035 CURB LENGTH REQUIRED (TOTAL FEET)
T1 Upper	C or better	545	417	C or better	545*	504	D	545*	630	E	545*	747
T2 Upper	C or better	230	236	C or better	230*	248	C or better	230*	244	D	230*	279
T3 Upper	C or better	410	386	C or better	410*	396	D	410*	464	D	410*	465
T4 Upper	C or better	355	279	C or better	355*	294	C or better	355*	296	D	355*	331
T1 Lower	D	480	663	D	520*	740	E	520*	744	E	520*	734
T2 Lower	D	235	283	D	255*	296	D	255*	302	D	255*	326
T3 Lower	F	200	541	F	260*	685	F	260*	777	F	260*	845
T4 Lower	F	305	598	D	345*	401	F	345*	665	F	345*	925

NOTE:

* Number of lanes modeled per short-term improvements.

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

4.5 Nonterminal Roadways

The nonterminal roadways consist of the Airport's primary access and egress roadways, particularly those that connect to/from I-595 and U.S. 1. Nonterminal roadways also include Perimeter Road and the exit roadways where the upper level, lower level, and parking traffic merge. This section includes a summary of the demand forecasts, the assessment of nonterminal roadways demand/capacity, and the resulting LOS and requirements based on the demand/capacity analysis. The LOS results identified in this MPU will be used to focus the development and implementation of long-term improvements on identified congestion points.

4.5.1 METHODOLOGY AND ASSUMPTIONS

The same methodologies and assumptions detailed in Section 4.4.1 were used to assess the demand/capacity of the nonterminal roadways, except for Perimeter Road, which was assessed using the off-Airport roadways methodologies and assumptions detailed in Section 4.6.1.

4.5.2 EXISTING AND FORECAST DEMANDS

As previously presented in Section 2 - Existing Conditions Inventory, 1-day vehicular traffic and intersection counts were conducted at various locations along the nonterminal roadway/ramps and Perimeter Road. **Exhibits 4.5-1** and **4.5-2** illustrate the associated count locations of these segments. These traffic counts from Section 2 serve as the basis for generating future vehicular demand. **Tables 4.5-1** and **4.5-2** summarize the vehicular demand for the four PMAD scenarios on the nonterminal roadway/ramp segments and for Perimeter Road, respectively.

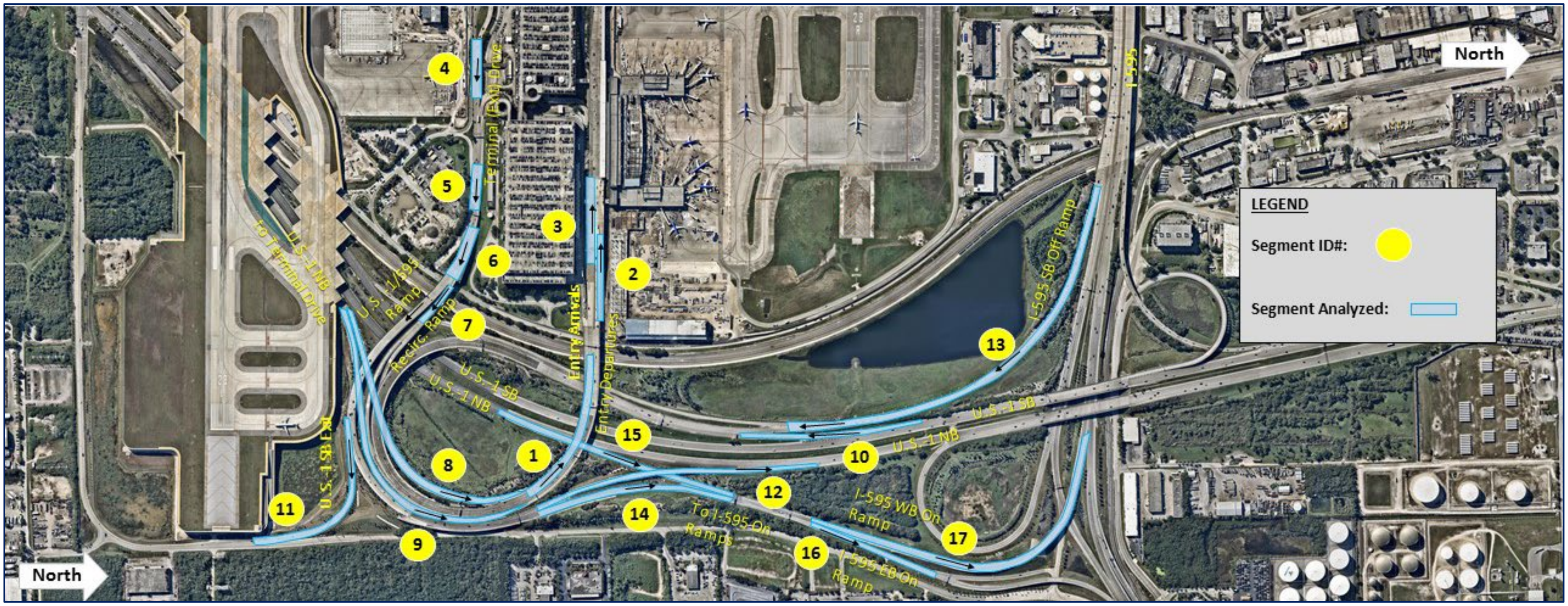
It is important to note that the methodology used to obtain the majority of the forecast demands for Perimeter Road and the Airport's surrounding roadways (depicted in Table 4.5-2) is not the same as the ALPS methodology used for the nonterminal ramps/roadways (depicted in Table 4.5-1). The ALPS model focused on terminal roadways and primary access/egress roadway segments, while the FDOT methodology for the off-Airport roadways was used for Perimeter Road. To obtain the forecast demands for the established planning year horizons, a background traffic growth was calculated utilizing information from the Southeast Regional Planning Model (SERPM) Version 7, which was utilized to obtain Base 2010 and Future 2040 traffic volumes and calibrated with the existing volumes collected. The Perimeter Road demands were converted to LOS using the data shown in **Exhibit 4.5-3**.

4.5.3 LEVEL OF SERVICE

The nonterminal LOS methodologies described herein are based on ACRP Report 40. Airport access and egress (nonterminal) roadways at FLL can be analyzed as uninterrupted flow segments. Uninterrupted flow segments are roadways where vehicles are not required to stop for traffic signals, pedestrian crossings, or other traffic control devices. The capacity and LOS thresholds for the nonterminal, uninterrupted flow segments are summarized in this section.

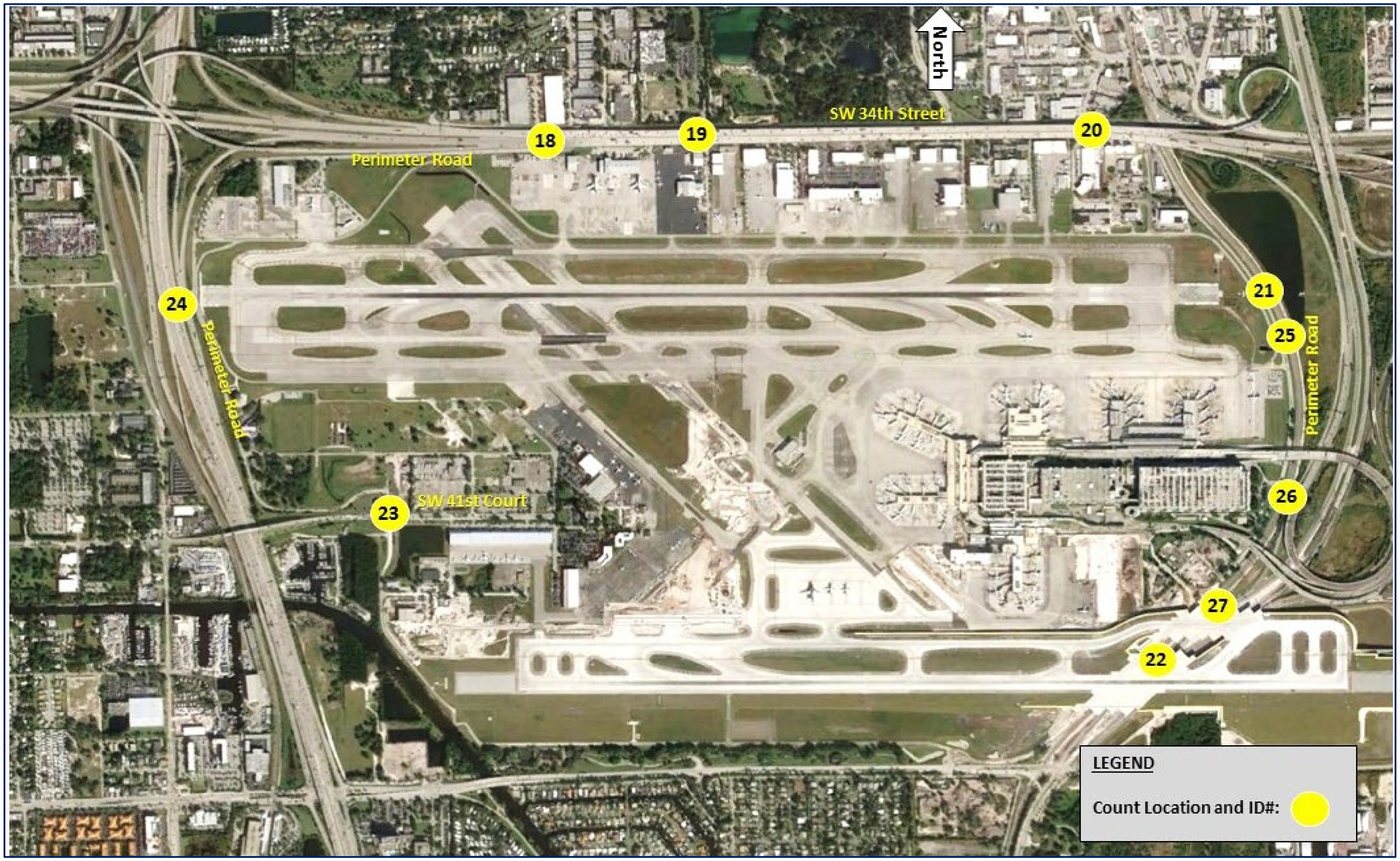
BROWARD COUNTY FLORIDA | FORT LAUDERDALE-HOLLYWOOD INTERNATIONAL AIRPORT BROWARD COUNTY, FLORIDA

Exhibit 4.5-1: Nonterminal Roadways Traffic Count Locations



SOURCE: Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.5-2: Perimeter Road Traffic Count Locations



SOURCE: R.J. Behar & Company, Inc., March 2010 (Traffic Counts).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Table 4.5-1: Nonterminal Roadway Vehicular Demand

		SEGMENT'S DAILY VEHICLE VOLUME (SEGMENT'S PEAK-HOUR VOLUME)			
ID#	SEGMENT DESCRIPTION	PMAD 2015	PMAD 2020	PMAD 2025	PMAD 2035
1	Entry Loop Ramp to FLL (before UL and Cypress division)	27,896 (1,942)	28,752 (2,198)	31,293 (2,359)	38,029 (2,869)
2	Entrance to UL Roadways (before T1)	14,926 (1,180)	18,437 (1,308)	20,310 (1,494)	24,212 (1,691)
3	Entrance to LL Roadways (before T1)	11,219 (965)	14,598 (1,112)	15,838 (1,168)	19,381 (1,400)
4	Terminal Exit Roadways (Merging Area, LL and UL)	39,069 (2,942)	52,711 (3,843)	57,379 (4,211)	68,659 (4,924)
5	Terminal Exit Roadways (Merging Area with Helix)	47,490 (3,273)	60,897 (4,439) 1/	66,365 (4,883) 1/	79,393 (5,651) 1/
6	Terminal Exit Roadways (Ramp Entrance)	47,484 (3,273)	58,011 (3,941) 1/	59,037 (4,306) 1/	70,516 (5,009) 1/
7	Entrance to Recirculation Ramp	9,367 (682)	10,267 (818) 1/	11,098 (871) 1/	13,322 (999) 1/
8	U.S. 1 NB Entry Loop Ramp to LL	3,768 (277)	4,540 (337)	4,952 (364)	5,802 (417)
9	U.S. 1 NB Entry Loop Ramp to UL	1,945 (145)	1,868 (133) 2/	2,135 (163)	2,580 (207)
10	U.S. 1 SB Entry Ramp to FLL	5,562 (421)	6,266 (451)	6,815 (471)	8,356 (583)
11	U.S. 1 SB Exit Ramp from FLL (New Ramp G)	6,245 (452)	7,431 (540)	8,284 (599)	9,677 (709)
12	U.S. 1 NB Exit Ramp from FLL	6,573 (478)	7,670 (560)	8,416 (630)	10,051 (755)
13	I-595 SB Off-Ramp	30,348 (2,293)	30,535 (2,324)	33,542 (2,534)	40,612 (3,115)
14	I-595 EB/WB On-Ramp from FLL	25,265 (1,761)	28,655 (2,136)	31,202 (2,347)	37,403 (2,752)
15	I-595 EB/WB On-Ramps from U.S. 1 NB	3,729 (319)	3,110 (244) 2/	3,425 (268)	4,180 (330)
16	I-595 EB On-Ramp	1,989 (127)	2,280 (154)	2,485 (162)	2,902 (187)
17	I-595 WB On-Ramp	26,995 (1,916)	29,476 (2,199)	32,131 (2,353)	38,675 (2,774)

NOTES:

PMAD = Peak Month Average Day

1/ The exit roadway improvements (short-term) directly impact these segments.

2/ The volumes decrease from the 2015 demand levels because of the employee parking relocation, which is higher than the growth of traffic on the specific segment.

SOURCES: Ricondo & Associates, Inc., November 2016 (Design Day Flight Schedules – Accelerated Baseline Activity Forecast); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).

PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Table 4.5-2: Perimeter Road – Vehicular Demand

			DAILY TRAFFIC (VEHICLES)			
ID#	SEGMENT DESCRIPTION	ANNUAL GROWTH RATE	PMAD 2015	PMAD 2020	PMAD 2025	PMAD 2035
18	W Perimeter Rd - Northwest of FLL (west of SW 12th Avenue)	0.56%	9,273	9,533	9,792	10,312
19	SW 34th Street - North of FLL (west of SW 9th Avenue)	0.50%1/	11,563	11,852	12,141	12,719
20	SW 34th Street - Northeast of FLL (west of SW 4th Avenue)	0.50%1/	11,223	11,504	11,784	12,345
21	Perimeter Road - East of FLL (North of Entry Bridge)	0.87%	11,640	12,146	12,653	13,665
22	Perimeter Road - Southeast of FLL (under S. Runway Bridge)	3.20%	7,320	8,491	9,662	12,005
23	SW 41st Street - West of FLL (west of SW 16th Avenue)	0.50%1/	6,697	6,864	7,032	7,367
24	Perimeter Road - West of FLL (directly west of the N. Runway)	0.86%	4,574	4,771	4,967	5,361
25	Perimeter Road - East of FLL (North of Entry Bridge)	2/	8,720 1/	11,153 1/	11,939 1/	13,900 1/
26	Perimeter Road - East of FLL (Between Bridges)	2/	6,051 1/	9,601 1/	10,398 1/	12,394 1/
27	Perimeter Road - East of FLL (South of Exit Bridge)	2/	5,416 1/	7,632 1/	8,107 1/	9,775 1/

NOTES:

PMAD = Peak Month Average Day

1/ A minimum growth rate of 0.5 percent was applied to all segments, since it is standard practice for the KHA/industry when growth rates are calculated to be less than 0.5 percent.

2/ These demands and growth rates were predicted in ALPS as they have direct access/egress from/to the Airport's terminals.

SOURCES: FSUTMS, Southeast Florida Regional Planning Model (SERPM), Version 7, 2016; Florida Department of Transportation, Highway and Traffic Data, 2015; Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).

PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.5-3: Florida Department of Transportation – Level of Service Guidelines

TABLE 1

Generalized Annual Average Daily Volumes for Florida's Urbanized Areas

12/18/12

INTERRUPTED FLOW FACILITIES

STATE SIGNALIZED ARTERIALS

Class I (40 mph or higher posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	16,800	17,700	**
4	Divided	*	37,900	39,800	**
6	Divided	*	58,400	59,900	**
8	Divided	*	78,800	80,100	**

Class II (35 mph or slower posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	7,300	14,800	15,600
4	Divided	*	14,500	32,400	33,800
6	Divided	*	23,300	50,000	50,900
8	Divided	*	32,000	67,300	68,100

Non-State Signalized Roadway Adjustments

(Alter corresponding state volumes by the indicated percent.)

Non-State Signalized Roadways - 10%

Median & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 5%

One-Way Facility Adjustment

Multiply the corresponding two-directional volumes in this table by 0.6

UNINTERRUPTED FLOW FACILITIES

FREEWAYS

Core Urbanized

Lanes	B	C	D	E
4	47,400	64,000	77,900	84,600
6	69,900	95,200	116,600	130,600
8	92,500	126,400	154,300	176,600
10	115,100	159,700	194,500	222,700
12	162,400	216,700	256,600	268,900

Urbanized

Lanes	B	C	D	E
4	45,800	61,500	74,400	79,900
6	68,100	93,000	111,800	123,300
8	91,500	123,500	148,700	166,800
10	114,800	156,000	187,100	210,300

Freeway Adjustments

Auxiliary Lanes Present in Both Directions	Ramp Metering
+ 20,000	+ 5%

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Median	B	C	D	E
2	Undivided	8,600	17,000	24,200	33,300
4	Divided	36,700	51,800	65,600	72,600
6	Divided	55,000	77,700	98,300	108,800

Uninterrupted Flow Highway Adjustments

Lanes	Median	Exclusive left lanes	Adjustment factors
2	Divided	Yes	+5%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

BICYCLE MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder/Bicycle Lane Coverage	B	C	D	E
0-49%	*	2,900	7,600	19,700
50-84%	2,100	6,700	19,700	>19,700
85-100%	9,300	19,700	>19,700	**

PEDESTRIAN MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	B	C	D	E
0-49%	*	*	2,800	9,500
50-84%	*	1,600	8,700	15,800
85-100%	3,800	10,700	17,400	>19,700

BUS MODE (Scheduled Fixed Route)[3]

(Buses in peak hour in peak direction)

Sidewalk Coverage	B	C	D	E
0-84%	> 5	≥ 4	≥ 3	≥ 2
85-100%	> 4	≥ 3	≥ 2	≥ 1

[1] Values shown are presented as two-way annual average daily volumes for levels of service and are for the automobile/truck modes unless specifically stated. This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Calculations are based on planning applications of the Highway Capacity Manual and the Transit Capacity and Quality of Service Manual.

[2] Level of service for the bicycle and pedestrian modes in this table is based on number of motorized vehicles, not number of bicyclists or pedestrians using the facility.

[3] Buses per hour shown are only for the peak hour in the single direction of the higher traffic flow.

* Cannot be achieved using table input value defaults.

** Not applicable for that level of service letter grade. For the automobile mode, volumes greater than level of service D become F because intersection capacities have been reached. For the bicycle mode, the level of service letter grade (including F) is not achievable because there is no maximum vehicle volume threshold using table input value defaults.

Source:
Florida Department of Transportation
Systems Planning Office
www.dot.state.fl.us/planning/systems/sm/los/default.shtm

SOURCE: Florida Department of Transportation, *Quality/Level of Service Handbook*, Table 1, 2012.
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Roadway demands for each of the nonterminal road segments, in terms of private auto and transit vehicle volumes, were obtained from the ALPS microsimulation models. Each of the nonterminal roadway segments was analyzed for its respective peak hour of vehicular demand. Capacity for uninterrupted-flow roadways is based on the free-flow speed in miles per hour (mph) of the roadway, per ACRP guidelines, as identified in **Table 4.5-3**. The number of lanes for a given roadway segment then determines that segment's capacity (maximum flow) in vehicles per hour.

Table 4.5-3: Nonterminal Free-Flow Speed/Capacity Chart

FREE-FLOW SPEED (MILES PER HOUR)	CAPACITY (VEHICLES PER HOUR PER LANE)
25	1,010
30	1,170
35	1,290
40	1,410
45	1,530
50	1,620

SOURCE: Airport Cooperative Research Program Report 40, *Airport Curbside and Terminal Area Roadway Operations*, 2010.
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

LOS for uninterrupted-flow roadways is based on the volume to capacity, or V/C ratio, which is obtained by dividing the volume (demand) on a roadway by that roadway's capacity. The LOS thresholds are based on these calculated V/C ratios, as defined by ACRP. These LOS thresholds, which are summarized in **Table 4.5-4**, vary based on free-flow speed along a roadway or roadway segment.

Table 4.5-4: Nonterminal Roadway Level of Service by Free-Flow Speed and Volume-to-Capacity Ratio

LEVEL OF SERVICE	FREE-FLOW SPEED					
	25 MPH	30 MPH	35 MPH	40 MPH	45 MPH	50 MPH
A	< 0.25	< 0.26	< 0.26	< 0.26	< 0.26	< 0.28
B	0.25 – 0.40	0.26 – 0.41	0.26 – 0.42	0.26 – 0.42	0.26 – 0.43	0.28 – 0.45
C	0.40 – 0.59	0.41 – 0.60	0.42 – 0.61	0.42 – 0.61	0.43 – 0.62	0.45 – 0.65
D	0.59 – 0.79	0.60 – 0.79	0.61 – 0.80	0.61 – 0.82	0.62 – 0.82	0.65 – 0.86
E	0.79 – 1.00	0.79 – 1.00	0.80 – 1.00	0.82 – 1.00	0.82 – 1.00	0.86 – 1.00
F	> 1.00	> 1.00	> 1.00	> 1.00	> 1.00	> 1.00

NOTE:

MPH = Miles per Hour

SOURCE: Airport Cooperative Research Program Report 40, *Airport Curbside and Terminal Area Roadway Operations*, 2010.
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

4.5.4 RESULTS AND REQUIREMENTS

This section summarizes the available capacity and generated peak-hour demand volumes from the ALPS microsimulation models for the nonterminal roadway segments entering/exiting the Airport's terminals. True demands for a given roadway segment during a given period of time were determined (not just volume that actually passes through), even if the system were over capacity. With this information, V/C ratios for the major nonterminal roadway segments that provide access/egress to the Airport's terminals were calculated and reflected as LOS. The nonterminal Perimeter Road segment daily demands and expected LOS are also provided in this section.

The LOS results are used to identify congested locations and to target areas for recommended improvements. Furthermore, facility requirements for the nonterminal roadways, in terms of number of lanes required, were calculated such that LOS D could be achieved under forecast 2035 conditions. Note that the required number of lanes calculated to achieve LOS D may not be geometrically feasible for construction or may contain constraints that should be considered. Chapter 5, *Alternatives Definition and Evaluation*, may yield operational changes and improvements that alter the necessity of widening.

Exhibits 4.5-4 through **4.5-7** depict the volume demands and LOS conditions under each PMAD scenario for the nonterminal roadway segments entering and exiting the Airport's terminals. **Exhibit 4.5-8** represents the daily demands and LOS at the nonterminal Perimeter Road segments and the internal roadways surrounding the Airport.

Table 4.5-5 provides the V/C ratios, LOS, and LOS D facility requirements for the nonterminal roadway segments entering and exiting the Airport's terminals. **Table 4.5-6** depicts the daily LOS at Perimeter Road and the internal roadways at the Airport.

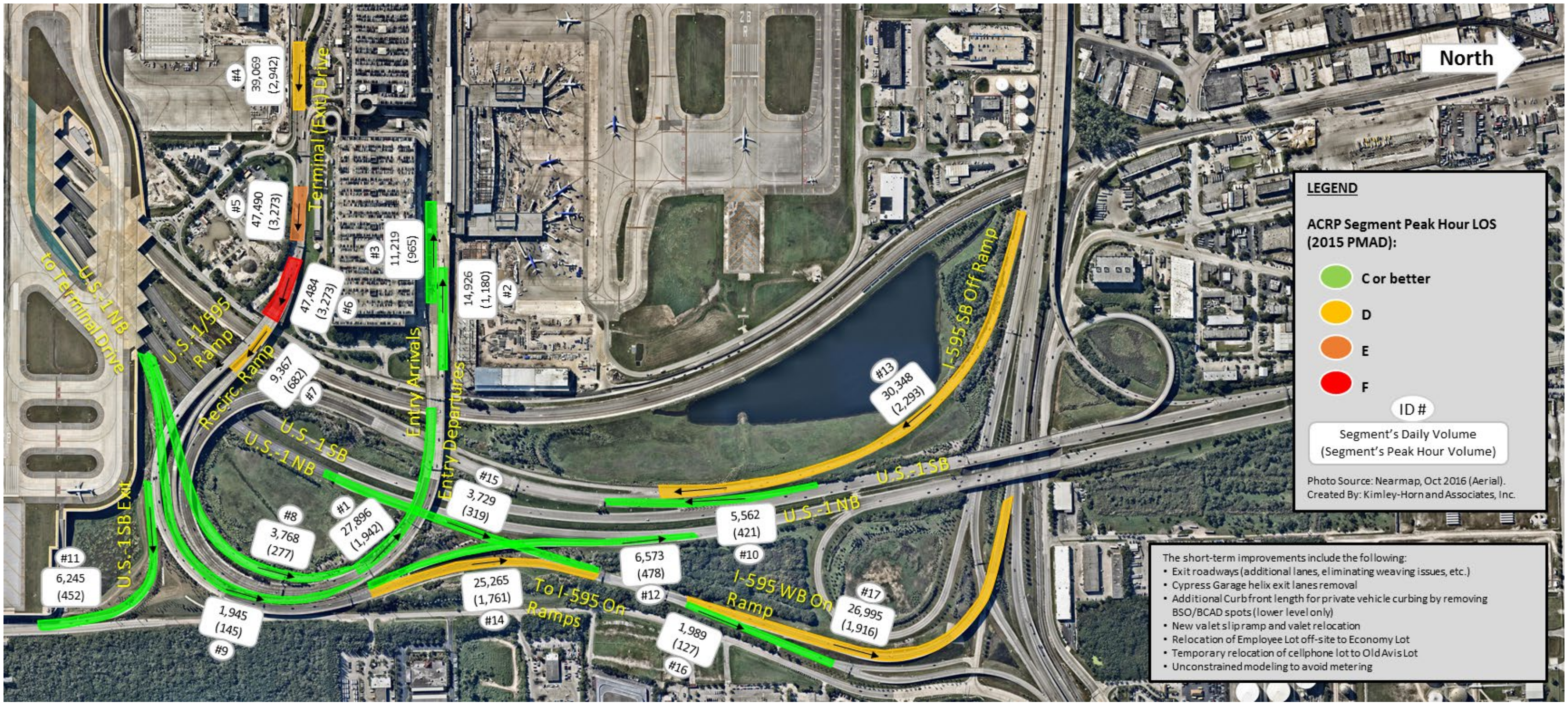
4.5.5 SUMMARY

The LOS results for the nonterminal roadways, with the short-term improvements applied, still show some areas of poor LOS that need to be addressed. The following results will be used to focus the development and implementation of long-term improvements on the identified congestion points. Nonterminal roadways are forecast to be over capacity in the following segments:

- The short-term improvements (2020) show a significant improvement on the exit roadways, but their respective capacities will continue to deteriorate in the future, particularly due to weaving demands.
- The exit segment from FLL towards the I-595 on-ramps shows LOS E in 2025 and on, despite the short-term improvements.
- The I-595 Southbound off-ramp shows LOS E in 2025 and on.

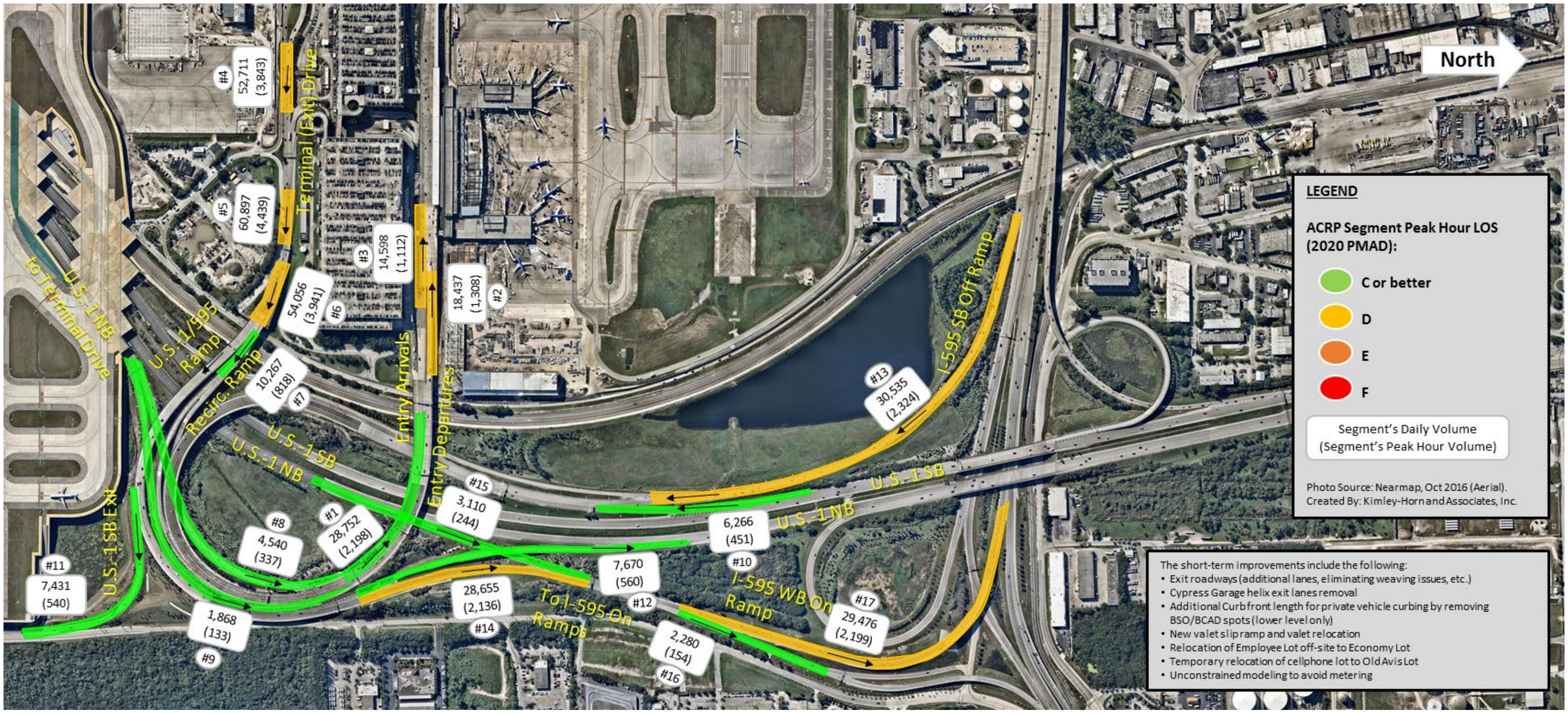
Nonterminal roadway congestion may be improved by removing rental cars, given that they comprise about 25 percent of the traffic that utilizes the nonterminal roadways. A major reconfiguration of ramps to reduce weaving movements could also contribute to mitigating congestion on the nonterminal roadways.

Exhibit 4.5-4: Peak Month Average Day 2015 Conditions – Nonterminal Roadways



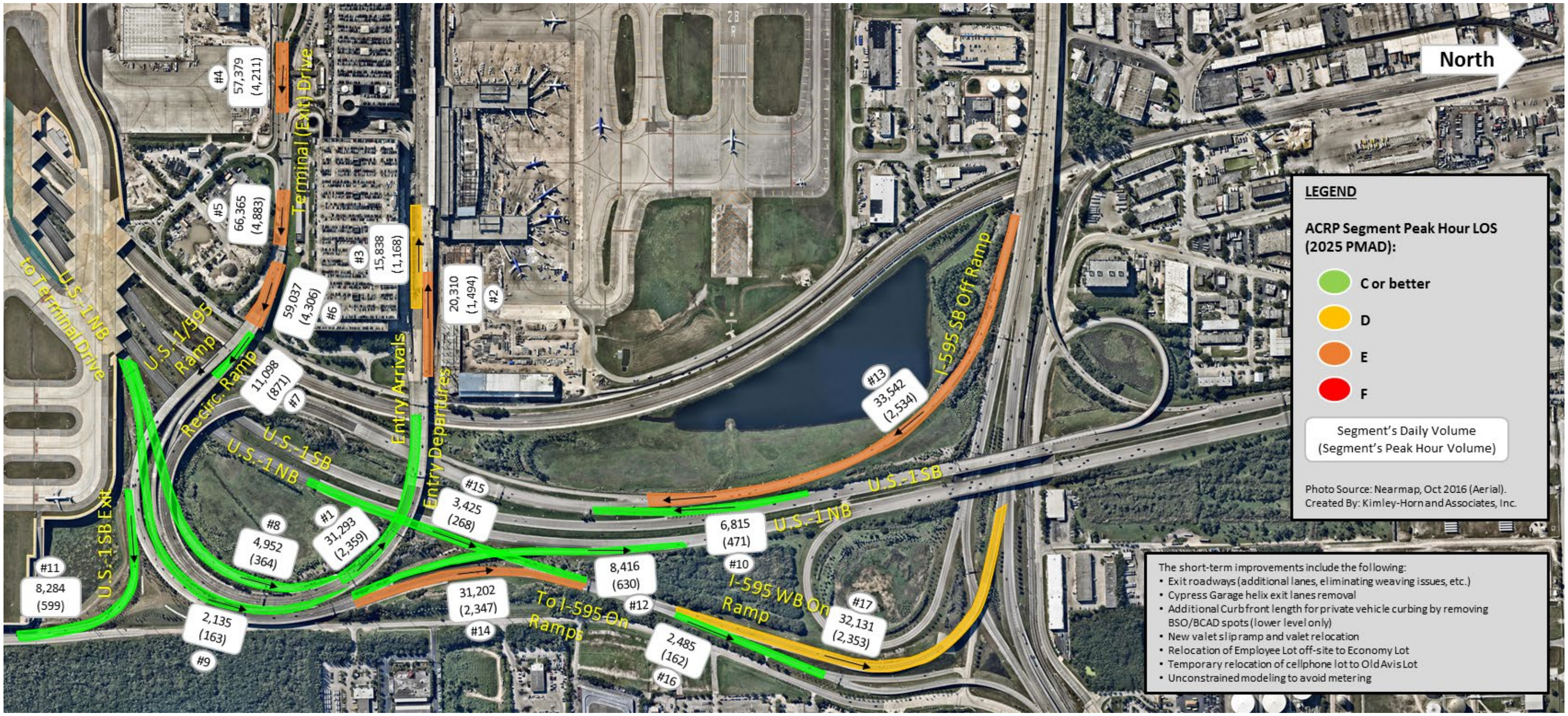
SOURCES: Ricondo & Associates, Inc., 2016 (FLL Master Plan Update Accelerated Baseline Forecast – 2015 Design Day Flight Schedule); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.5-5: Peak Month Average Day 2020 Conditions – Nonterminal Roadways



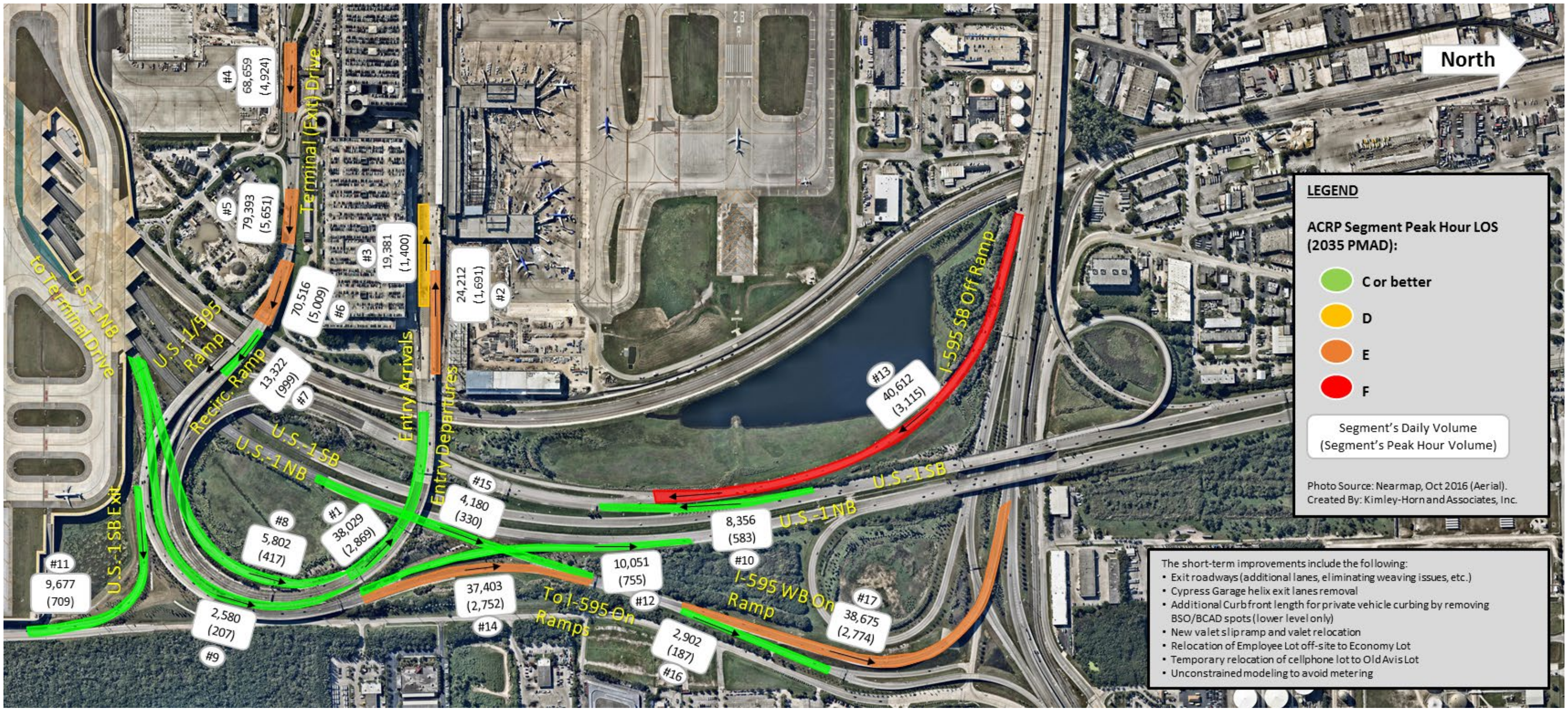
SOURCES: Ricondo & Associates, Inc., 2016 (FLL Master Plan Update Accelerated Baseline Forecast – 2020 Design Day Flight Schedule); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.5-6: Peak Month Average Day 2025 Conditions – Nonterminal Roadways



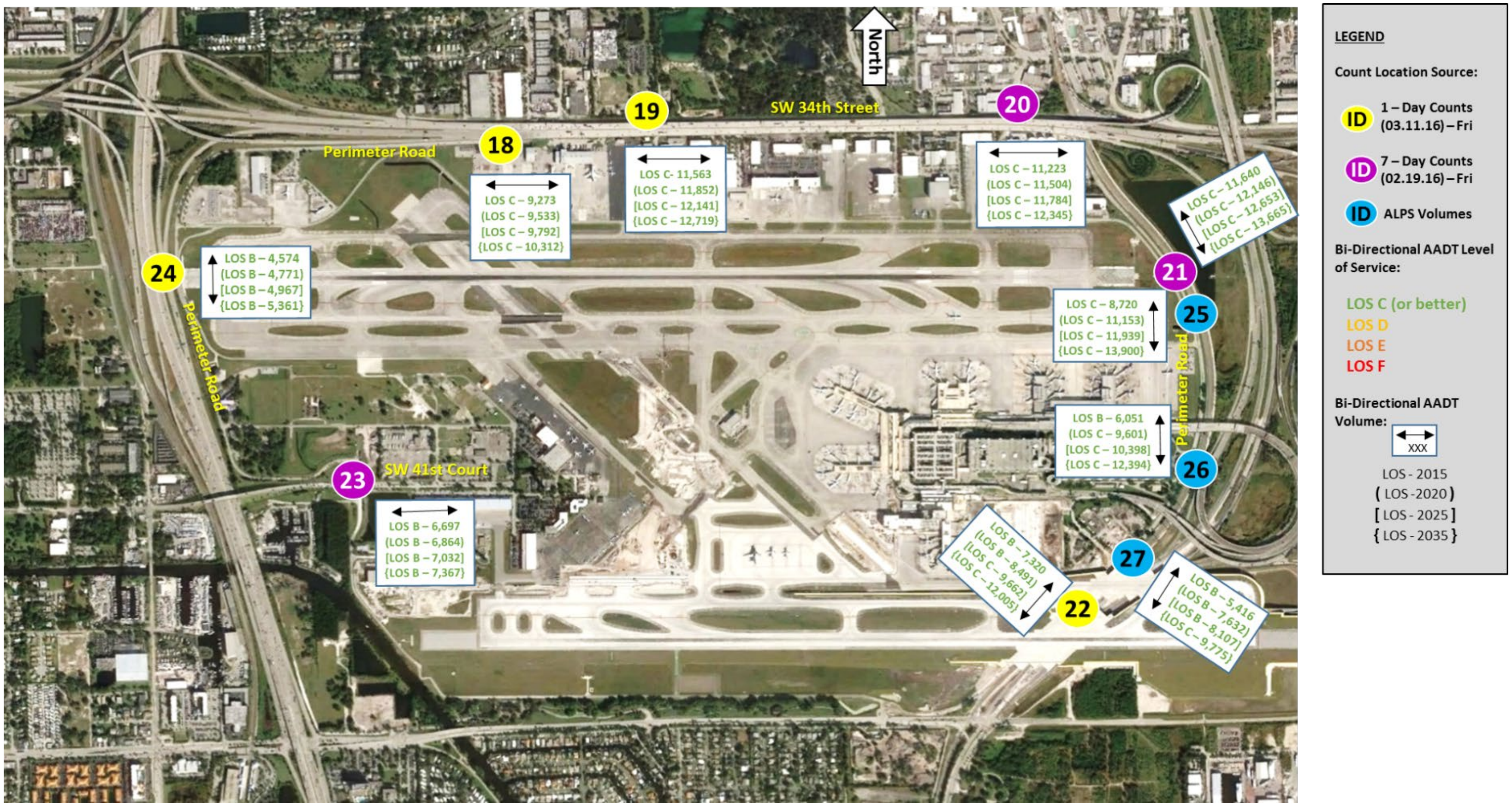
SOURCES: Ricondo & Associates, Inc., 2016 (FLL Master Plan Update Accelerated Baseline Forecast – 2025 Design Day Flight Schedule); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.5-7: Peak Month Average Day 2035 Conditions – Nonterminal Roadways



SOURCES: Ricondo & Associates, Inc., 2016 (FLL Master Plan Update Accelerated Baseline Forecast – 2035 Design Day Flight Schedule); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.5-8: Perimeter Road Conditions – Demands and Level of Service



NOTES:

ALPS = Advanced Land Transportation Performance Simulation

AADT = Historical Annual Average Daily Traffic

LOS = Level of Service

SOURCE: R.J. Behar & Company, Inc., Traffic Counts, February 19, 2016, March 11, 2016.

PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

BROWARD COUNTY FLORIDA | FORT LAUDERDALE-HOLLYWOOD INTERNATIONAL AIRPORT BROWARD COUNTY, FLORIDA

Table 4.5-5: Nonterminal Roadways – Level of Service and Facility Requirements Summary

				2015				2020			2025			2035			
ID	SEGMENT	FREE-FLOW SPEED (MPH)	EXISTING NUMBER OF LANES	PK. HR. VOL.	V/C	LOS	PROPOSED NUMBER OF LANES 1/	PK. HR. VOL.	V/C	LOS	PK. HR. VOL.	V/C	LOS	PK. HR. VOL.	V/C	LOS	REQUIRED NUMBER OF LANES FOR LOS D IN 2035
1	Entry Loop Ramp to FLL (before LL and Cypress division)	35	4	1,942	0.38	B	4	2,198	0.43	C	2,359	0.46	C	2,869	0.56	C	2/
2	Entrance to UL Roadways (before T1)	25	2	1,180	0.58	C	2	1,308	0.72	D	1,494	0.82	E	1,691	0.93	E	3
3	Entrance to LL Roadways (before T1)	25	2	965	0.48	C	2	1,112	0.61	D	1,168	0.64	D	1,400	0.77	D	2/
4	Terminal Exit Roadways (Merging Area, LL and UL)	25	4	2,942	0.73	D	5	3,843	0.76	D	4,211	0.83	E	4,924	0.98	E	7
5	Terminal Exit Roadways (Merging Area with Helix)	25	4	3,273	0.81	E	6	4,439	0.73	D	4,883	0.81	E	5,651	0.93	E	8
6	Terminal Exit Roadways (Ramp Entrance)	25	3	3,273	1.08	F	5	3,941	0.78	D	4,306	0.85	E	5,009	0.99	E	7
7	Entrance to Recirculation Ramp	25	1	682	0.68	D	2	818	0.40	C	871	0.43	C	999	0.49	C	2/
8	U.S. 1 NB Entry Loop Ramp to LL	40	1	277	0.20	A	1	337	0.24	A	364	0.26	A	417	0.30	B	2/
9	U.S. 1 NB Entry Loop Ramp to UL	40	1	145	0.10	A	1	133	0.09	A	163	0.12	A	207	0.15	A	2/
10	U.S. 1 SB Entry Ramp to FLL	45	2	421	0.14	A	2	451	0.15	A	471	0.15	A	583	0.19	A	2/
11	U.S. 1 SB Exit Ramp from FLL (New Ramp G)	40	1	452	0.32	B	1	540	0.38	B	599	0.42	C	709	0.50	C	2/
12	U.S. 1 NB Exit Ramp from FLL	40	1	478	0.34	B	1	560	0.40	B	630	0.45	C	755	0.54	C	2/
13	I-595 SB Off-Ramp	45	2	2,293	0.75	D	2	2,324	0.76	D	2,534	0.83	E	3,115	1.02	F	3
14	I-595 EB/WB On-Ramp from FLL	40	2	1,761	0.62	D	2	2,136	0.76	D	2,347	0.83	E	2,752	0.98	E	3
15	I-595 EB/WB On-Ramps from U.S. 1 NB	45	1	319	0.21	A	1	244	0.16	A	268	0.18	A	330	0.22	A	2/
16	I-595 EB On-Ramp	45	1	127	0.08	A	1	154	0.10	A	162	0.11	A	187	0.12	A	2/
17	I-595 WB On-Ramp	45	2	1,916	0.63	D	2	2,199	0.72	D	2,353	0.77	D	2,774	0.91	E	3

NOTES:

MPH = Miles per Hour

V/C = Volume to Capacity

LOS = Level of Service

1/ Number of lanes modeled per short-term improvements.

2/ LOS D or better in PMAD 2035 scenario = no additional lanes required.

SOURCES: Ricondo & Associates, Inc., 2016 (FLL Master Plan Update Accelerated Baseline Forecast – 2015 Design Day Flight Schedule); Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Table 4.5-6: Perimeter Road – Level of Service and Facility Requirements Summary

ID	SEGMENT	FREE-FLOW SPEED (MPH)	EXISTING NUMBER OF LANES 1/	2015		2020		2025		2035		REQUIRED NUMBER OF LANES
				DAILY VOLUME	LOS	DAILY VOLUME	LOS	DAILY VOLUME	LOS	DAILY VOLUME	LOS	
18	W Perimeter Rd - Northwest of FLL (west of SW 12th Avenue)	35	2	9,273	C	9,533	C	9,792	C	10,312	C	
19	SW 34th Street - North of FLL (west of SW 9th Avenue)	35	2	11,563	C	11,852	C	12,141	C	12,719	C	2/
20	SW 34th Street - Northeast of FLL (west of SW 4th Avenue)	35	2	11,223	C	11,504	C	11,784	C	12,345	C	2/
21	Perimeter Road - East of FLL (north of Entry Bridge)	35	2	11,640	C	12,146	C	12,653	C	13,665	C	2/
22	Perimeter Road - Southeast of FLL (under S. Runway Bridge)	35	2	7,320	B	8,491	B	9,662	C	12,005	C	2/
23	SW 41st Street - West of FLL (west of SW 16th Avenue)	35	2	6,697	B	6,864	B	7,032	B	7,367	B	2/
24	Perimeter Road - West of FLL (west of the N. Runway)	35	2	4,574	B	4,771	B	4,967	B	5,361	B	2/
25	Perimeter Road - East of FLL (north of Entry Bridge) 3/	35	2	8,720 3/	C	11,153 3/	C	11,939 3/	C	13,900 3/	C	2/
26	Perimeter Road - East of FLL (between the Bridges) 3/	35	2	6,051 3/	B	9,601 3/	C	10,398 3/	C	12,394 3/	C	2/
27	Perimeter Road - East of FLL (south of Exit Bridge) 3/	35	2	5,416 3/	B	7,632 3/	B	8,107 3/	B	9,775 3/	C	2/

NOTES:

MPH = Miles per Hour

LOS = Level of Service

1/ LOS D or better in 2035 scenarios = no additional lanes required.

2/ 2 lanes (one in each direction)

3/ These demands and LOS were predicted in ALPS as they have direct access/egress from/to the Airport's terminals.

SOURCES: FSUTMS, Southeast Florida Regional Planning Model (SERPM), Version 7, 2016; Florida Department of Transportation, Highway and Traffic Data, 2015; Kimley-Horn and Associates, Inc., 2016 (ALPS Modeling Software).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

4.6 Regional (Off-Airport) Roadways

The Airport is surrounded by a regional (off-Airport) transportation system that includes freeways, highways, and arterial roadways. The regional (off-Airport) area is bounded by SR 7/U.S. 441 to the west, U.S. 1 to the east, Stirling Road (SR 848) to the south, and Davie Boulevard (SR 736) to the north. The following off-Airport regional roadways were analyzed:

- North/South Roadways: U.S. 1, I-95, and SR 7
- East/West Roadways: Davie Boulevard, Marina Boulevard, I-595, Griffin Road, and Stirling Road

Although these roadways provide access for Airport-related traffic, they are primarily used for non-Airport trips. The historical Annual Average Daily Traffic (AADT) for two locations on each roadway was obtained from the 2015 FDOT Traffic and Highway Data.[4], except for the Davie Boulevard West Section which was obtained from the SR 9/I-95 at Broward Boulevard PD&E per FDOT direction. The demands and LOS calculated for these roadways are at the specific locations where the counts were obtained, as previously presented in Section 2.

4.6.1 METHODOLOGY AND ASSUMPTIONS

To obtain the forecast demands for the established planning year horizons, a background traffic growth was calculated utilizing information from multiple sources, including the Southeast Florida Regional Planning Model (SERPM) Version 7 and other studies performed in the surrounding areas of the Airport. Details on the SERPM Methodology are provided in **Appendix G**.

4.6.2 EXISTING AND FORECAST DEMANDS

Table 4.6-1 summarizes the vehicular demands for the four PMAD levels on the off-Airport highways, freeways, and roadways that provide access for Airport-related traffic, but are primarily used for non-Airport trips. **Exhibit 4.6-1** shows the locations of these roadway segments.

4.6.3 LEVEL OF SERVICE

The following section describes the LOS methodologies, definitions, and resources used to obtain the off-Airport LOS estimates. Tables found in the FDOT's 2012 *Quality/Level of Service Handbook* are used to obtain the LOS for the off-Airport roadways.

Capacity for the off-Airport roadways, classified as arterials, freeways, and highways, is defined as the maximum sustainable flow rate at which vehicles reasonably can be expected to traverse a point or a uniform section of roadway during a given time period under prevailing conditions.

---

[4] Florida Department of Transportation, *Florida Transportation Information - 2015 FDOT Traffic and Highway Data*, 2015.

Table 4.6-1: Annual Average Daily Traffic – Off-Airport Roadway Forecast Volumes

ID	SEGMENT DESCRIPTION	AVERAGE ANNUAL GROWTH RATE	AADT TRAFFIC 2015	2020	2025	2035
1	SR 7 North Section	0.6%	47,000	48,387	49,773	52,546
2	SR 7 South Section	0.5%	49,000	50,225	51,450	53,900
3	I-95 North Section	0.5%	259,000	265,864	272,727	286,454
4	I-95 South Section	0.5%	325,000	333,450	341,900	358,800
5	U.S. 1 North Section	2.4%	57,000	63,897	70,794	84,588
6	U.S. 1 South Section	1.3%	35,000	37,188	39,375	43,750
7	Davie Boulevard East Section	0.6%	27,000	27,837	28,674	30,348
8	Davie Boulevard West Section	0.5%	32,200	33,005	33,810	35,420
9	Marina Boulevard East Section	0.9%	44,000	46,024	48,048	52,096
10	Marina Boulevard West Section	0.9%	34,500	35,966	37,433	40,365
11	Griffin Road East Section	2.1%	30,000	33,090	36,180	42,360
12	Griffin Road West Section	1.1%	31,500	33,296	35,091	38,682
13	Stirling Road East Section	1.3%	37,500	39,900	42,300	47,100
14	Stirling Road West Section	0.8%	35,500	36,938	38,376	41,251
15	I-595 East Section	0.5%	103,500	106,088	108,675	113,850
16	I-595 West Section	0.9%	202,000	211,494	220,988	239,976

NOTES:

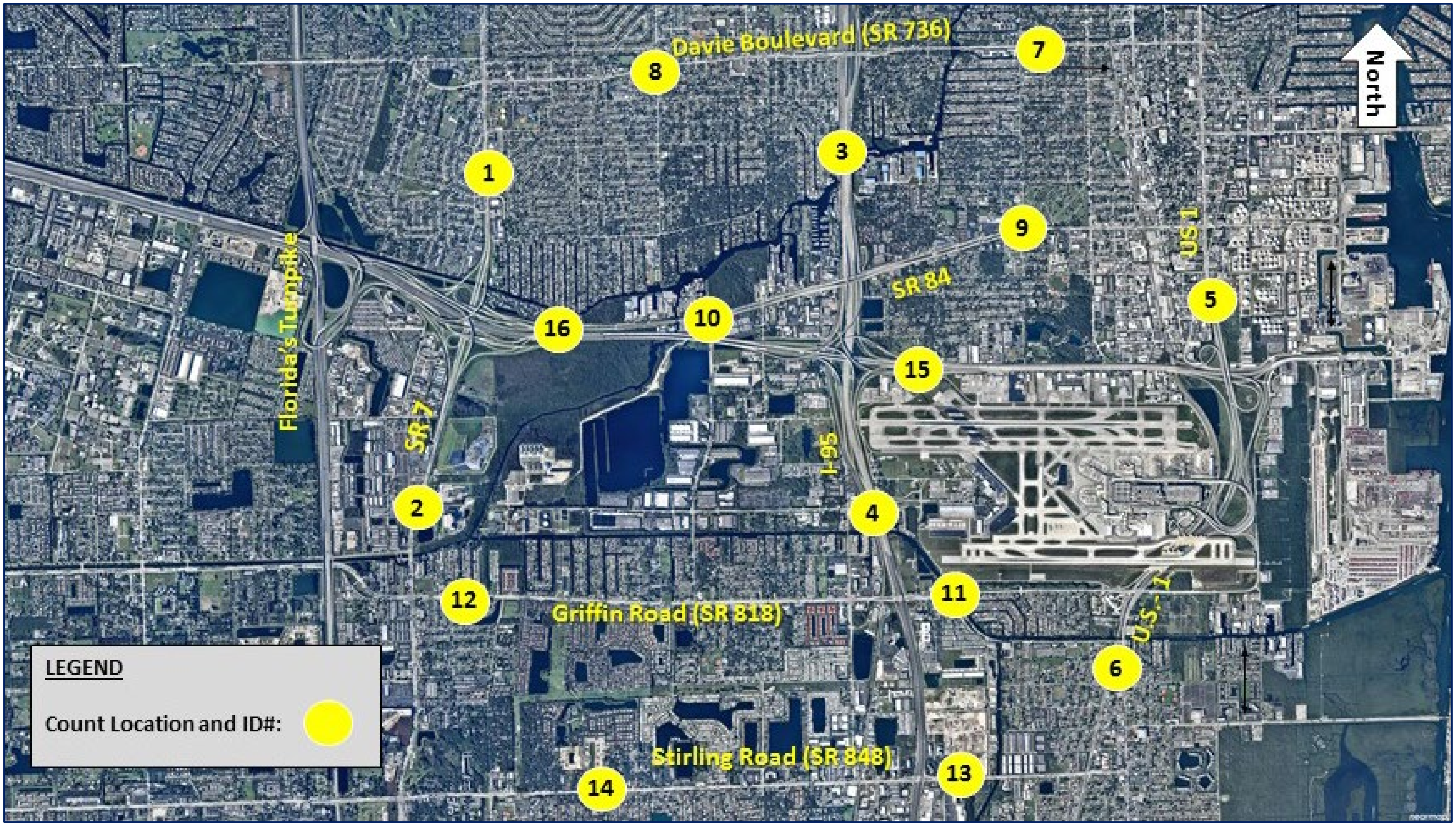
AADT = Annual Average Daily Traffic

A minimum average annual growth rate of 0.5 percent was applied to all segments.

SOURCES: FSUTMS, Southeast Florida Regional Planning Model (SERPM), Version 7, 2016 Florida Department of Transportation, Highway and Traffic Data, 2015; and SR 9/I-95 at Broward Boulevard PD&E.

PREPARED BY: Kimley-Horn and Associates, Inc., March 2018.

Exhibit 4.6-1: Off-Airport Roadways Study Area



SOURCE: Florida Department of Transportation, Historical Traffic Data Locations, 2016 (AADT).
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

To determine the LOS for the studied arterial roadways and freeways, the existing and forecast demands and AADTs, obtained from historical FDOT data, were converted into LOS using the guidelines highlighted in **Exhibit 4.6-2** (yellow box).

4.6.4 RESULTS AND REQUIREMENTS

Exhibit 4.6-3 represents the volumes and LOS expected under each scenario at the specific locations that serve as connectors to the Airport. **Table 4.6-2** summarizes the expected LOS results under each PMAD scenario for the off-Airport roadways. It is important to note that the regional off-Airport roadways are not the responsibility of the Airport owner (BCAD). However, intersections such as U.S. 1 and Griffin Road should be observed through the years, given their impact on the Airport.

4.6.5 SUMMARY

The off-Airport LOS results identified in this section, with the short-term improvements applied, still show some areas of poor LOS that need to be addressed. The following results will be used to focus the development and implementation of long-term improvements on the identified congestion points. Regional off-Airport roadways are not the responsibility of the Airport owner (BCAD). However, intersections such as U.S. 1 and Griffin Road should be taken into consideration and observed through the years, given the current and forecasted LOS F on U.S. 1 south of the airport and the potential impacts to the Airport.

4.7 Automobile Parking Facilities

The requirements for automobile parking facilities are presented in this section. On-Airport parking facilities include public parking facilities, the employee parking lot, the cell phone lot, and the commercial ground transportation holding lot. Off-Airport automobile parking capacities and occupancies were not available or collected at the time of inventory; as a result, off-Airport automobile parking demand could not be estimated as part of this Master Plan Update.

4.7.1 PUBLIC PARKING

4.7.1.1 Public Parking Space Demand

Daily Peak Parking Demand

For purposes of understanding the demand for public parking, calculations of future parking demand were based on a baseline condition from July 1, 2015, to June 30, 2016. Calendar year 2015 data were not used due to a lack of data availability and system issues and changes. Furthermore, use of this more recent data provides a better reflection of current trends and parking characteristics. Peak occupancies by day for each parking product were determined based on hour-by-hour entry and exit data from the Standard Parking (SP+) parking access and revenue control system (PARCS), as well as based on manual midnight counts of each facility.

Exhibit 4.6-2: Florida Department of Transportation – Level of Service Guidelines

TABLE 1

Generalized Annual Average Daily Volumes for Florida's Urbanized Areas

12/18/12

INTERRUPTED FLOW FACILITIES

STATE SIGNALIZED ARTERIALS

Class I (40 mph or higher posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	16,800	17,700	**
4	Divided	*	37,900	39,800	**
6	Divided	*	58,400	59,900	**
8	Divided	*	78,800	80,100	**

Class II (35 mph or slower posted speed limit)

Lanes	Median	B	C	D	E
2	Undivided	*	7,300	14,800	15,600
4	Divided	*	14,500	32,400	33,800
6	Divided	*	23,300	50,000	50,900
8	Divided	*	32,000	67,300	68,100

Non-State Signalized Roadway Adjustments

(Alter corresponding state volumes by the indicated percent.)

Non-State Signalized Roadways - 10%

Median & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 5%

One-Way Facility Adjustment

Multiply the corresponding two-directional volumes in this table by 0.6

BICYCLE MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder/Bicycle Lane Coverage	B	C	D	E
0-49%	*	2,900	7,600	19,700
50-84%	2,100	6,700	19,700	>19,700
85-100%	9,300	19,700	>19,700	**

PEDESTRIAN MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	B	C	D	E
0-49%	*	*	2,800	9,500
50-84%	*	1,600	8,700	15,800
85-100%	3,800	10,700	17,400	>19,700

BUS MODE (Scheduled Fixed Route)[3]

(Buses in peak hour in peak direction)

Sidewalk Coverage	B	C	D	E
0-84%	> 5	≥ 4	≥ 3	≥ 2
85-100%	> 4	≥ 3	≥ 2	≥ 1

UNINTERRUPTED FLOW FACILITIES

FREEWAYS

Core Urbanized

Lanes	B	C	D	E
4	47,400	64,000	77,900	84,600
6	69,900	95,200	116,600	130,600
8	92,500	126,400	154,300	176,600
10	115,100	159,700	194,500	222,700
12	162,400	216,700	256,600	268,900

Urbanized

Lanes	B	C	D	E
4	45,800	61,500	74,400	79,900
6	68,100	93,000	111,800	123,300
8	91,500	123,500	148,700	166,800
10	114,800	156,000	187,100	210,300

Freeway Adjustments

Auxiliary Lanes Present in Both Directions	Ramp Metering
+ 20,000	+ 5%

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Median	B	C	D	E
2	Undivided	8,600	17,000	24,200	33,300
4	Divided	36,700	51,800	65,600	72,600
6	Divided	55,000	77,700	98,300	108,800

Uninterrupted Flow Highway Adjustments

Lanes	Median	Exclusive left lanes	Adjustment factors
2	Divided	Yes	+5%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

[1]Values shown are presented as two-way annual average daily volumes for levels of service and are for the automobile/truck modes unless specifically stated. This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Calculations are based on planning applications of the Highway Capacity Manual and the Transit Capacity and Quality of Service Manual.

[2] Level of service for the bicycle and pedestrian modes in this table is based on number of motorized vehicles, not number of bicyclists or pedestrians using the facility.

[3] Buses per hour shown are only for the peak hour in the single direction of the higher traffic flow.

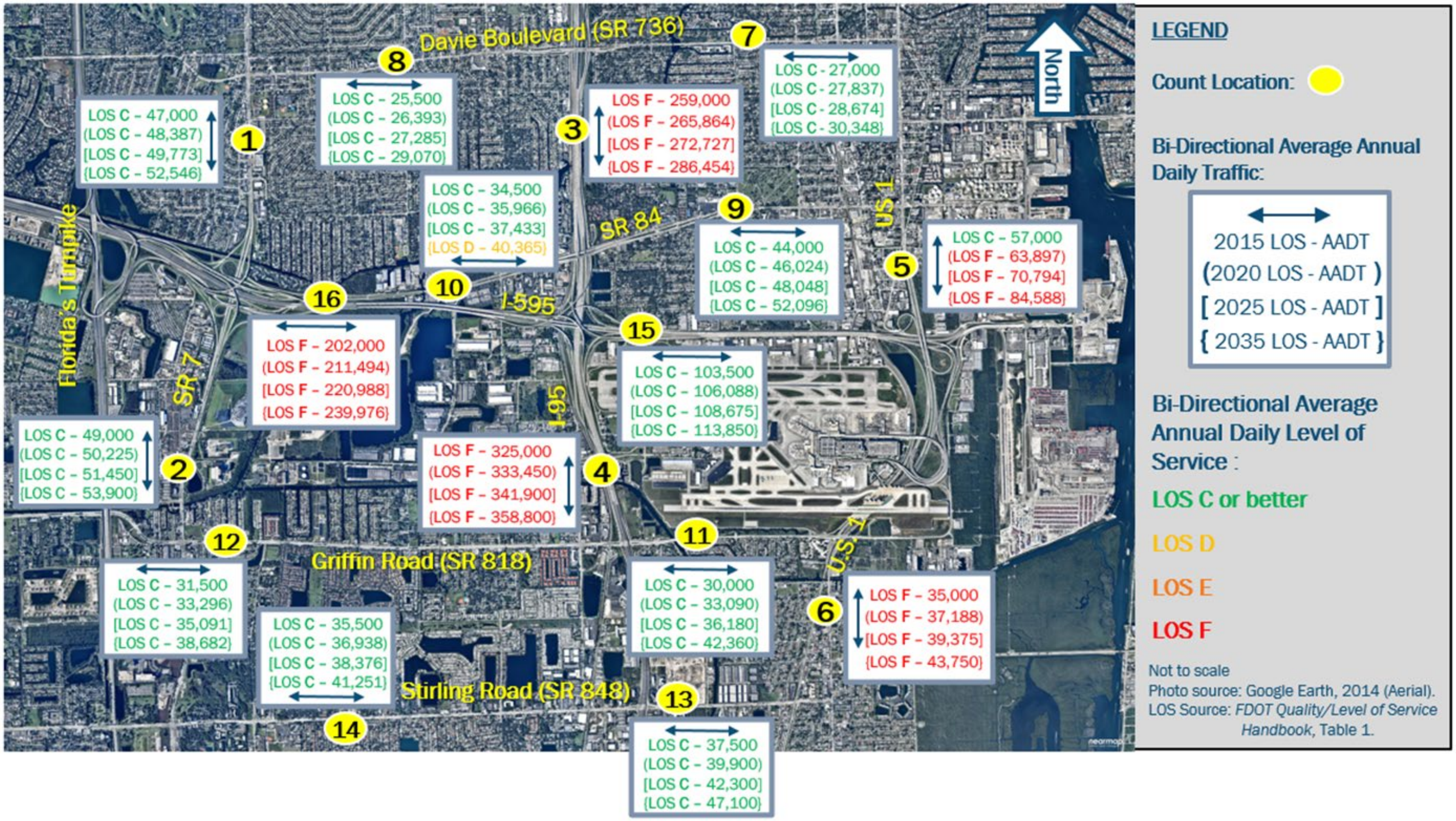
* Cannot be achieved using table input value defaults.

** Not applicable for that level of service letter grade. For the automobile mode, volumes greater than level of service D become F because intersection capacities have been reached. For the bicycle mode, the level of service letter grade (including F) is not achievable because there is no maximum vehicle volume threshold using table input value defaults.

Source:
Florida Department of Transportation
Systems Planning Office
www.dot.state.fl.us/planning/systems/sm/los/default.shtm

SOURCE: Florida Department of Transportation, *Quality/Level of Service Handbook*, Table 1, December 2012.
PREPARED BY: Kimley-Horn and Associates, Inc., February 2017.

Exhibit 4.6-3: Off-Airport Roadway Peak Month Average Day Level of Service



SOURCES: Florida Department of Transportation, Historical Traffic Data Locations, 2016 (AADT); and SR 9/I-95 at Broward Boulevard PD&E.

PREPARED BY: Kimley-Horn and Associates, Inc., March 2018.

Table 4.6-2: Off-Airport Roadways Level of Service Summary

ID	SEGMENT DESCRIPTION	ANNUAL GROWTH RATE	DAILY (AADT) LOS 2015	DAILY (AADT) LOS 2020	DAILY (AADT) LOS 2025	DAILY (AADT) LOS 2035
1	SR 7 North Section	0.6%	C	C	C	C
2	SR 7 South Section	0.5%	C	C	C	C
3	I-95 North Section	0.5%	F	F	F	F
4	I-95 South Section	0.5%	F	F	F	F
5	U.S. 1 North Section	2.4%	C	F	F	F
6	U.S. 1 South Section	1.3%	F	F	F	F
7	Davie Boulevard East Section	0.6%	C	C	C	C
8	Davie Boulevard West Section	0.5%	C	C	C	C
9	Marina Boulevard East Section	0.9%	C	C	C	C
10	Marina Boulevard West Section	0.9%	C	C	C	D
11	Griffin Road East Section	2.1%	C	C	C	C
12	Griffin Road West Section	1.1%	C	C	C	C
13	Stirling Road East Section	1.3%	C	C	C	C
14	Stirling Road West Section	0.8%	C	C	C	C
15	I-595 East Section	0.5%	C	C	C	C
16	I-595 West Section	0.9%	F	F	F	F

NOTES:

AADT = Annual Average Daily Traffic

LOS = Level of Service

SOURCES: FSUTMS, Southeast Florida Regional Planning Model (SERPM), Version 7, 2016; Florida Department of Transportation, Highway and Traffic Data, 2015; and SR 9/I-95 at Broward Boulevard PD&E.

PREPARED BY: Kimley-Horn and Associates, Inc., March 2018.

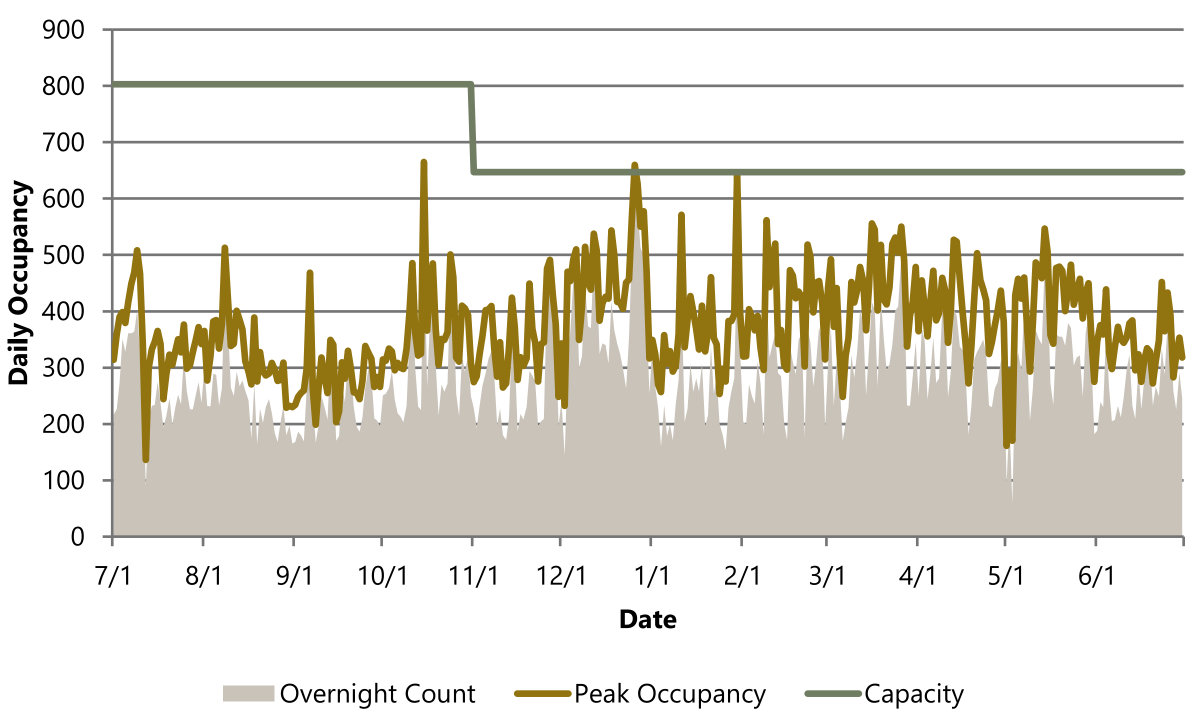
In the hour-by-hour entry and exit data, entries appeared to be systemically undercounted compared to exits. The exit data was trusted over the entry data for multiple reasons. First, the exit data matched across multiple sources, while entries did not; second, since revenue is collected upon exit, exits are much more closely tracked and reported. Therefore, the entry data was scaled up on an hour-by-hour basis so that the total entries matched the exits over the entire year. In addition, because the Hourly and Daily products exit through the same parking control plaza, the exit counts were not separated into Hourly and Daily product categories. Therefore, the total exits were split into Hourly and Daily by the corresponding Hourly and Daily entry percentage in that hour. The running total of entries and exits throughout each day was then recalibrated to the overnight count.

The peak demands for each day in the data collection year for each parking product, adjusted according to the aforementioned methodology, can be found in the following exhibits. The peak demands are compared to the product's capacity at that time. Exit data were not available for the Valet product due to system separation and the unique characteristics of the valet transaction. Therefore, it was assumed that the duration of stay characteristics in the Valet product would be similar to the Daily product. The percentage increase of the peak occupancy over the overnight occupancy was calculated for each day in the Daily product, and the same percentage was applied to the Valet overnight counts to forecast a daily peak profile for the Valet product.

On November 1, 2015, capacity was adjusted in the Hourly, Daily, and Valet products through the reorganization of products within the existing Palm, Hibiscus, and Cypress Garage facilities. The Hourly capacity decreased from 803 to 647 spaces; the Daily capacity decreased from 6,232 to 5,765 spaces; and the Valet capacity increased from 1,098 to 1,385 spaces. There was a slight increase in spaces in the Economy Lot, from 3,965 spaces to 4,010 spaces, which went into effect on this date. In addition, there are 347 spaces reserved for BCAD in the Palm and Hibiscus Garages.

Daily parking demand for the Hourly product between July 2015 and June 2016 can be found on **Exhibit 4.7-1**. Typically, the Hourly product does not reach capacity. The difference between the overnight and peak occupancy on any given day is the highest on a percentage basis in the Hourly product compared to the other products, and the peaking characteristics often vary throughout a given week. Both phenomena are due to the short-term nature of the parking customers utilizing this product.

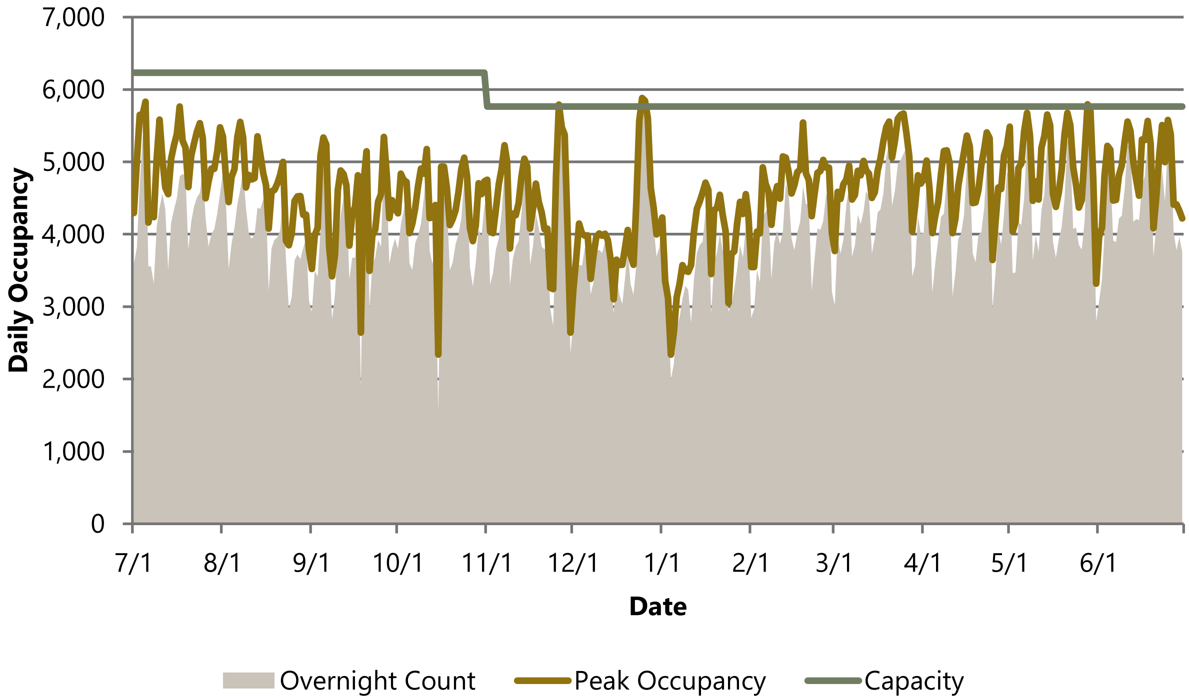
Exhibit 4.7-1: Daily Public Parking Demand – Hourly Product (July 2015 through June 2016)



SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

Daily parking demand for the Daily product between July 2015 and June 2016 can be found on **Exhibit 4.7-2**. This product routinely approached capacity in the most recent four months of data, in part due to the decrease in capacity. In a typical week, demand reaches a high point towards the end of the week on Thursday, Friday, or Saturday.

Exhibit 4.7-2: Daily Public Parking Demand – Daily Product (July 2015 through June 2016)

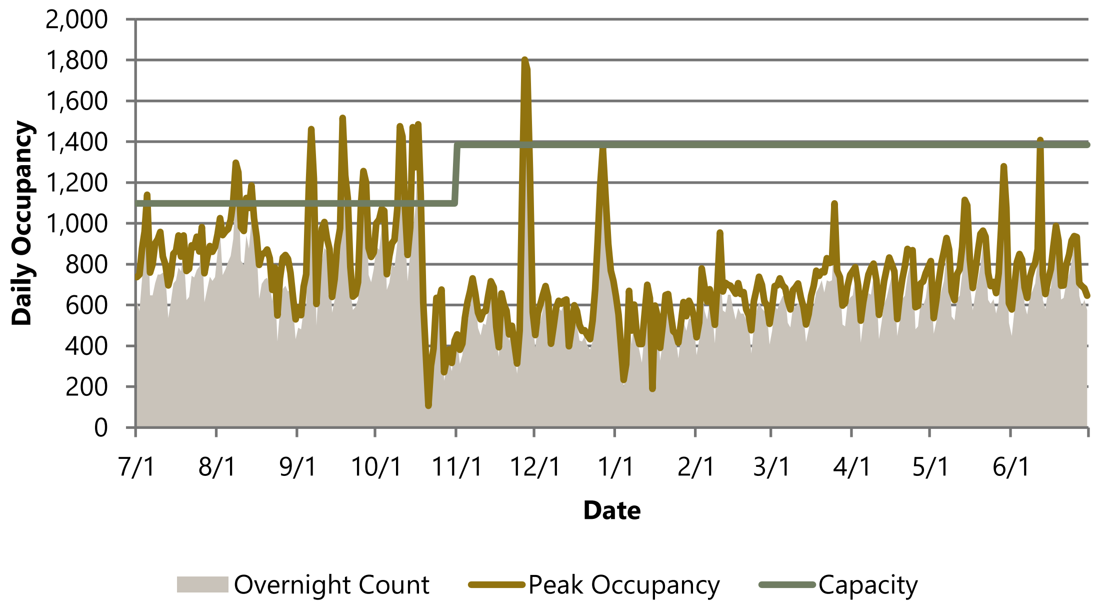


SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

Daily parking demand for the Valet product between July 2015 and June 2016 can be found on **Exhibit 4.7-3**. In addition to the capacity increase enacted on November 1, 2015, a rate increase from $21 to $25 per day also took effect at that time. It appears to have caused an initial drop-off in the usage of the Valet product, with the exception of the Thanksgiving and Christmas holiday periods.

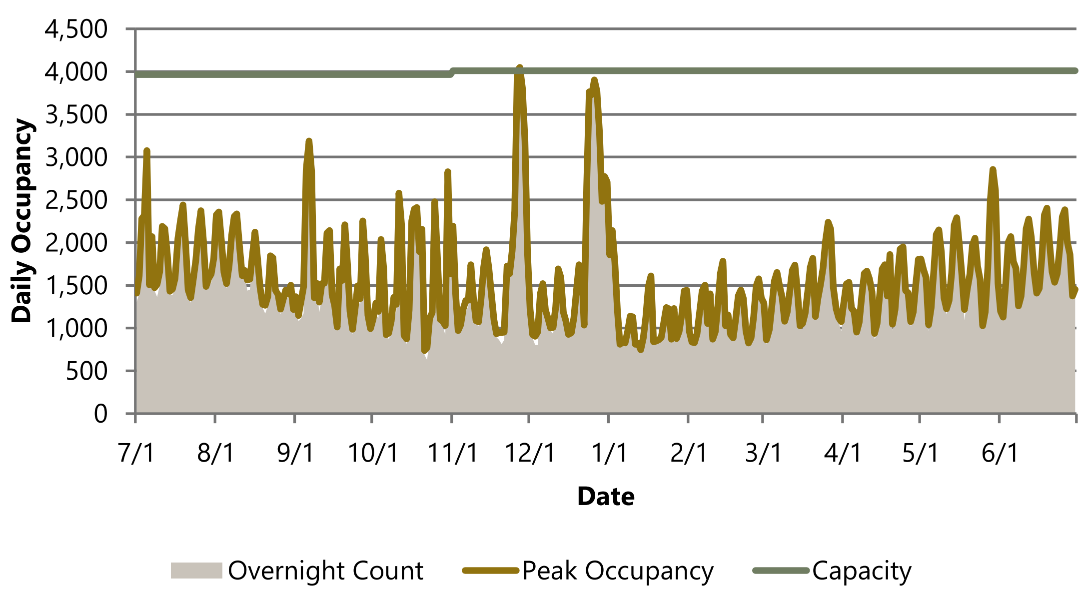
Daily parking demand for the Economy product between July 2015 and June 2016 can be found on **Exhibit 4.7-4**. On a typical day, the product only reaches approximately 40 percent of its capacity, but it experiences very large surges during the Thanksgiving and Christmas holiday periods.

Exhibit 4.7-3: Daily Public Parking Demand – Valet Product (July 2015 through June 2016)



SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

Exhibit 4.7-4: Daily Public Parking Demand – Economy Product (July 2015 through June 2016)



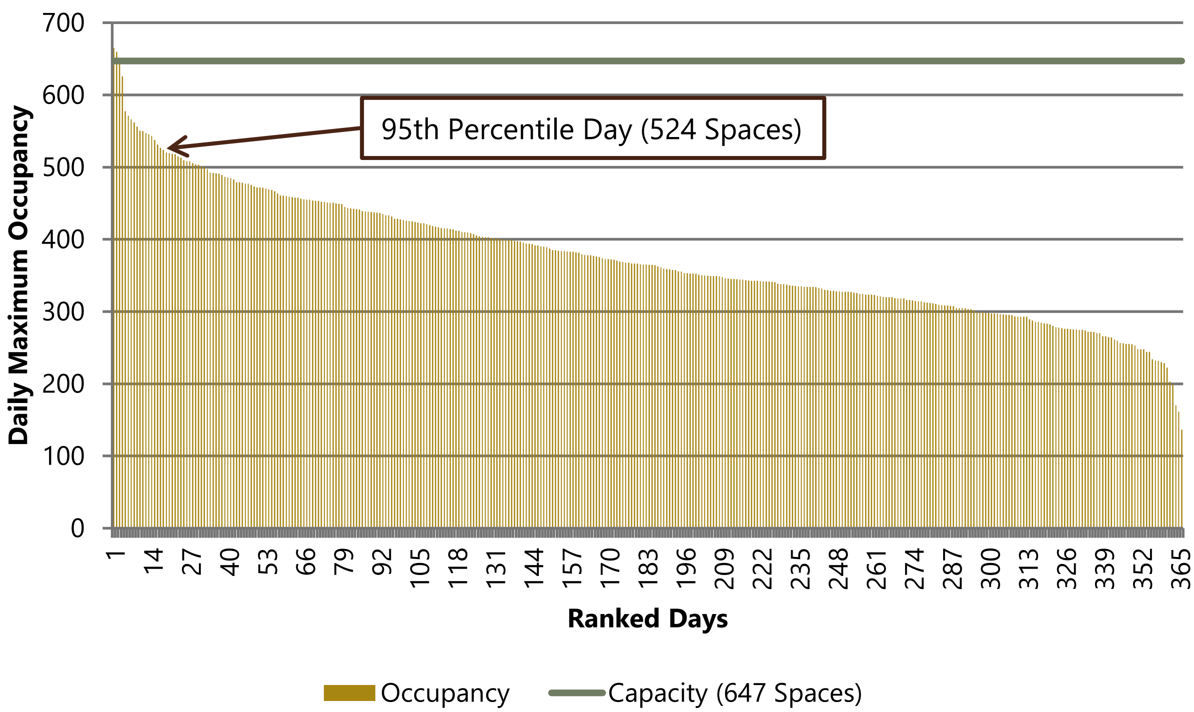
SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

Design Day Parking Demand

The daily peak occupancy counts were then ranked from highest to lowest daily occupancies to provide an annual profile for each lot. The "design day" represents the level of demand for which parking garages and surface lots should be designed to accommodate anticipated demand for parking on a typical busy day. The design day was selected based on the goal of accommodating approximately 95 percent of the demand on peak parking days throughout the year, which represents the 18th busiest day of the year. The design day excludes the extreme peaks on major holidays and other isolated peak parking events, which are typically accommodated through peak-day management or through the use of surface parking or overflow parking areas. Adequate "overflow" facilities should be provided to accommodate the absolute peak-day demand occurring during major holidays.

A profile of daily maximum parking occupancies sorted in decreasing order for the Hourly product is depicted on **Exhibit 4.7-5**. As shown on the exhibit, the parking facility accommodated a peak-day occupancy of 665 vehicles and a design-day occupancy of 524 vehicles. The 647-space facility was approximately 81 percent occupied on the design day.

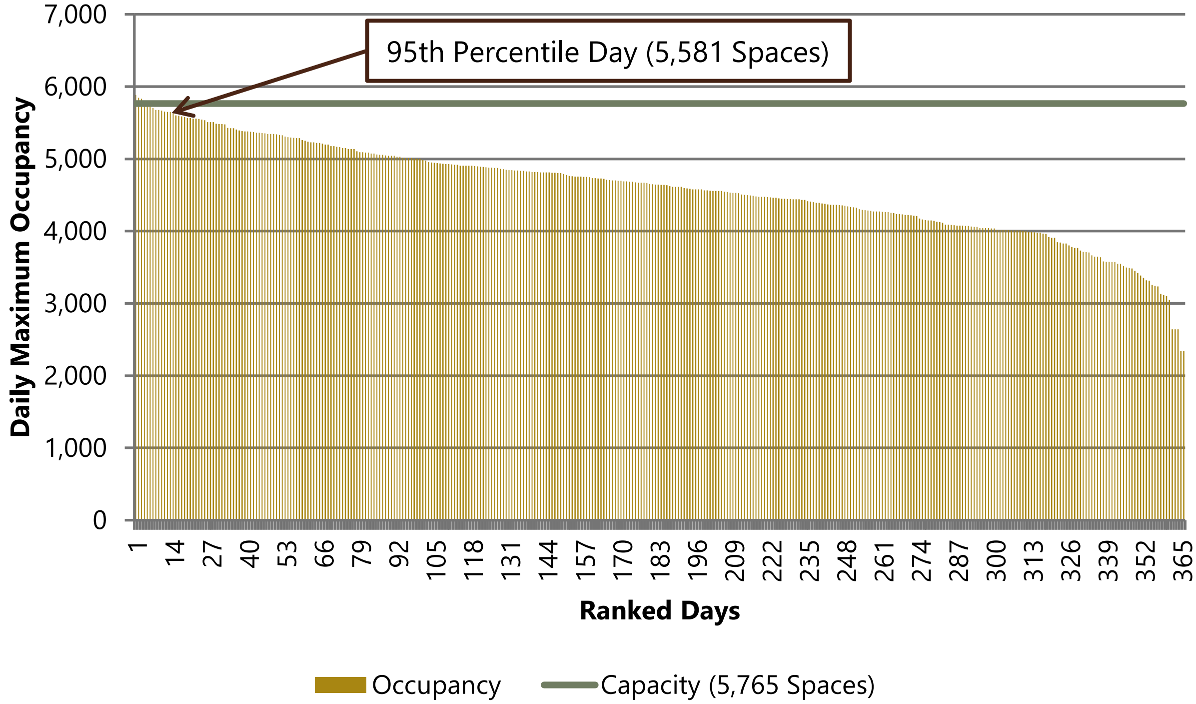
Exhibit 4.7-5: Public Parking Demand – Hourly Product (July 2015 through June 2016)



SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

A profile of daily maximum parking occupancies sorted in decreasing order for the Daily product is depicted on **Exhibit 4.7-6.** As shown on the exhibit, the parking facility accommodated a peak-day occupancy of 5,883 vehicles and a design-day occupancy of 5,581 vehicles. The 5,765-space facility was approximately 97 percent occupied on the design day.

Exhibit 4.7-6: Public Parking Demand – Daily Product (July 2015 through June 2016)

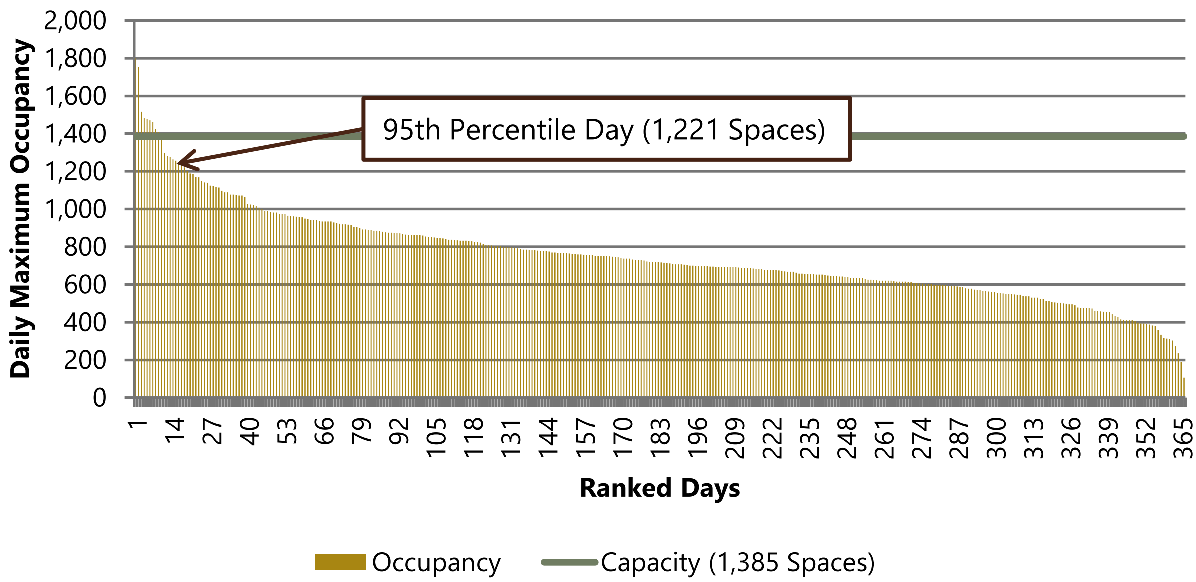


SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

A profile of daily maximum parking occupancies sorted in decreasing order for the Valet product is depicted on **Exhibit 4.7-7.** As shown on the exhibit, the parking facility accommodated a peak-day occupancy of 1,802 vehicles and a design-day occupancy of 1,221 vehicles. The 1,385-space facility was approximately 88 percent occupied on the design day.

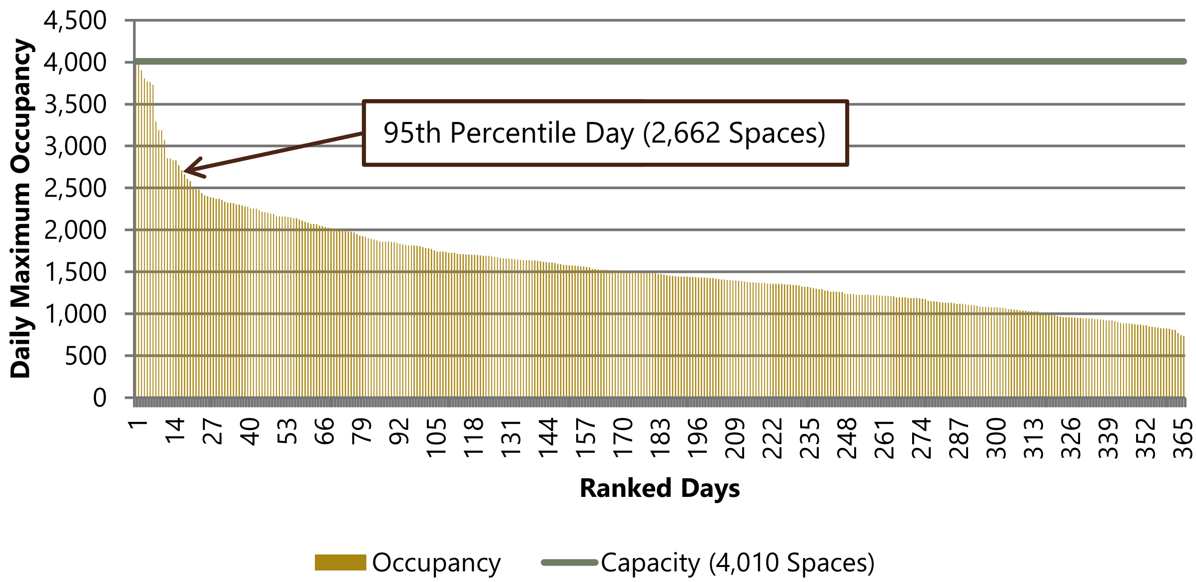
A profile of daily maximum parking occupancies sorted in decreasing order for the Economy product is depicted on **Exhibit 4.7-8.** As shown on the exhibit, the parking facility accommodated a peak-day occupancy of 4,049 vehicles and a design-day occupancy of 2,662 vehicles. The 4,010-space facility was approximately 66 percent occupied on the design day.

Exhibit 4.7-7: Public Parking Demand – Valet Product (July 2015 through June 2016)



SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

Exhibit 4.7-8: Public Parking Demand – Economy Product (July 2015 through June 2016)



SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

4.7.1.2 Public Parking Requirements

For purposes of estimating parking requirements, a service factor was added to the design day demand to provide a "buffer" of additional parking spaces, such that a customer's time spent circulating through a facility searching for an unoccupied space can be kept to an acceptable LOS. A service factor of 10 percent is typically used for short-term, higher-cost parking products, such as close-in parking garages that experience a higher space turnover during peak periods. A service factor of 5 percent is typically used for longer-term economy parking products that experience a lower turnover rate during peak periods. Given the parking guidance systems installed in the Palm and Hibiscus Garages, a service factor of 5 percent is sufficient in the higher turnover products as well. The application of these service factors yields the current year design day space requirement for each parking product. Future year space requirements were then calculated based on the assumption that current year space requirements would increase in proportion to the forecast growth in annual originating passengers.

The demand of the Daily product results in a small deficit for the required spaces at 2015–2016 levels. The Hourly and Valet products have enough capacity for current requirements, but they reach deficit levels by 2020. The Economy product has available capacity through 2030 for the design day. The findings for all of the public parking facilities can be found in **Table 4.7-1**. In May 2017, BCAD closed the Economy parking product and relocated Employee parking from the Cypress Garage to the Economy lot due to capacity constraints in Employee parking as discussed in the next section. The vacated 3,143 spaces in the Cypress Garage were converted to Daily parking spaces.

4.7.1.3 Public Parking Sensitivity Analysis – Potential Impacts to Requirements Due to Ground Transportation Trends

Recent changes in ground transportation (GT) modes of access to airports, primarily led by the emergence of TNCs, have impacted demand for parking and other forms of transportation. TNCs have likely taken market share from both Airport parking as well as other modes since entering the airport GT market. These shifting trends in GT modes may stabilize in the near- to mid-term as TNCs reach a natural saturation point, but public parking analyses that do not consider these market forces may overestimate requirements.

Four parking requirements scenarios were developed in addition to the parking requirements methodology discussed in the previous section. These additional scenarios reflect the impact of the changing GT market on parking demand:

Scenario 1: Parking's share of the ground transportation (GT) market declines in the near-term:

- Assumes TNCs continue to take market share, and that the GT market reaches a new equilibrium around 2020 as TNCs saturate the market.
- Results:
  - Parking demand resumes growth in proportion to originating passenger growth after the GT market stabilizes.
  - 2035 parking demand is about 37 percent higher than existing parking capacity.

Table 4.7-1: Public Parking Requirements (in Number of Spaces)

	JULY 2015–JUNE 2016			FUTURE REQUIREMENTS 1/				SURPLUS / (DEFICIT)			
				2020	2025	2030	2035	2020	2025	2030	2035
				MILLION ORIGINATING PASSENGERS							
	EXISTING CAPACITY	EXISTING DEMAND	EXISTING REQUIREMENT 2/	15.1	17.0	19.0	20.8	15.1	17.0	19.0	20.8
DESIGN DAY (95TH PERCENTILE) 3/											
Hourly	647	524	550	680	760	850	930	(33)	(113)	(203)	(283)
Daily	5,765	5,581	5,860	7,180	8,090	9,020	9,910	(1,415)	(2,325)	(3,255)	(4,145)
Valet	1,385	1,221	1,290	1,580	1,790	1,990	2,180	(195)	(405)	(605)	(795)
Economy 4/	4,010	2,662	2,800	3,430	3,870	4,310	4,740	580	140	(300)	(730)
Airport Total	11,807	9,988	10,500	12,870	14,510	16,170	17,760	(1,063)	(2,703)	(4,363)	(5,953)
PEAK DAY 5/											
Airport Total	11,807	-	12,399	15,200	17,120	19,110	20,970	(3,393)	(5,313)	(7,303)	(9,163)

NOTES:

1/ Rounded to the nearest 10 spaces.

2/ Service factors of 5 percent were applied to all products to calculate design day requirements.

3/ The 95th percentile design day for each parking product does not necessarily occur on the same calendar day.

4/ The May 2017 BCAD Employee Parking relocation resulted in added daily public parking capacity and the loss of the Economy Parking product.

5/ Represents the absolute peak day for parking at the Airport.

SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

Scenario 2: Until approximately 2020, parking's share of the GT market declines at the same rate as under Scenario 1, but in contrast to Scenario 1, market share continues to decline at a lower rate after 2020 due to:

- Continued TNC growth as well as an Increase in passenger rail mode share
- Trends towards "sharing economy" preferences by Millennials.
- Results:
  - Originating passenger growth at the Airport slightly outpaces the decline in parking demand per originating passenger.
  - 2035 parking demand is about 8 percent higher than existing parking capacity.

Scenario 3: The three general trends identified in Scenario 2 progress at a faster rate:

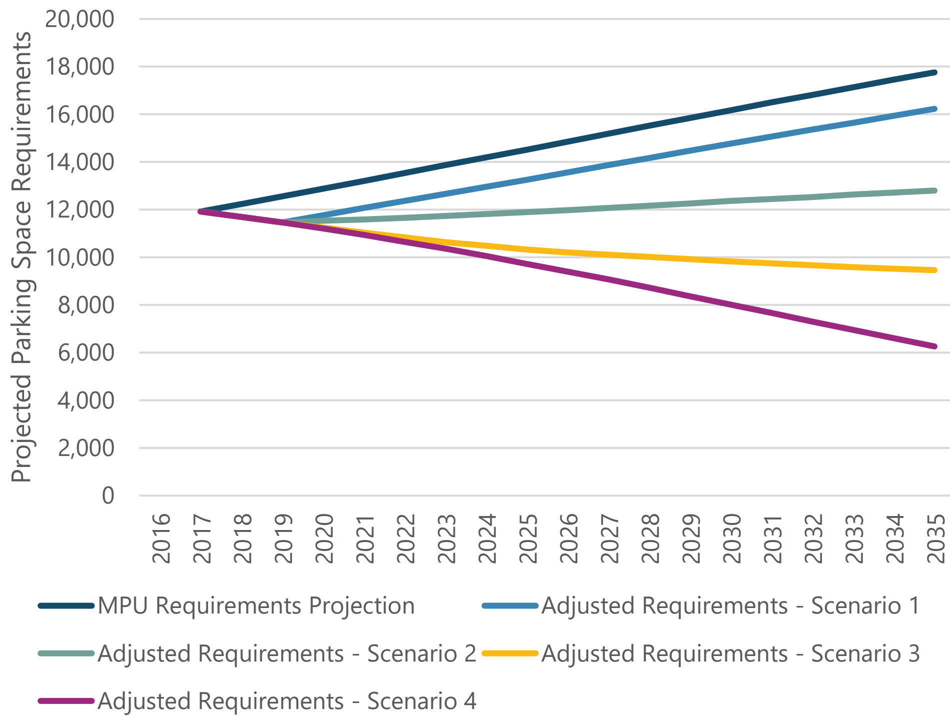
- Assumes transportation-as-a-service (TaaS) providers begin earlier transition to autonomous operations, which decreases per-mile costs and accelerates a transition away from personally-owned, human-operated vehicles, reducing parking demand.
- Results:
  - Parking demand declines despite originating passenger growth.
  - 2035 parking demand is about 20 percent lower than existing parking capacity.

Scenario 4: After 2020, declines in parking demand accelerate due to:

- High rate of adoption of autonomous vehicles, whose lesser per-mile costs accelerate a transition away from personally-owned, human-operated vehicles.
- Accelerated shifts away from vehicle ownership and towards TaaS consumption by all generations (Baby Boomers, Gen X, Millennials)
- Results:
  - Parking demand declines significantly despite originating passenger growth.
  - 2035 parking demand is about 47 percent lower than existing parking capacity.

The four Scenarios, along with a comparison to the unadjusted parking analysis, are shown on **Exhibit 4.7-9**. The GT market and its effect on Airport parking demand should be monitored going forward and tracked against these projected scenarios to determine whether, and to what extent, capital projects related to parking expansion can be delayed. The Alternatives protect land for future parking development but are flexible in the build-out conditions of those parcels dependent upon the direction of parking demand going forward. **Table 4.7-2**, **Table 4.7-3**, **Table 4.7-4**, and **Table 4.7-5** show the parking requirements by facility under Scenarios 1 through 4, respectively.

Exhibit 4.7-9: Estimated Public Parking Requirements Scenarios



SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., January 2018.

Table 4.7-2: Public Parking Requirements (in Number of Spaces) – Scenario 1

	JULY 2015–JUNE 2016			FUTURE REQUIREMENTS [1/]				SURPLUS / (DEFICIT)			
				2020	2025	2030	2035	2020	2025	2030	2035
				MILLION ORIGINATING PASSENGERS							
	EXISTING CAPACITY	EXISTING DEMAND	EXISTING REQUIREMENT [2/]	15.1	17.0	19.0	20.8	15.1	17.0	19.0	20.8
DESIGN DAY (95TH PERCENTILE) [3/]											
Hourly/Daily	6,412	6,105	6,410	7,170	8,080	9,010	9,900	(758)	(1,668)	(2,598)	(3,488)
Valet	1,385	1,221	1,290	1,450	1,630	1,820	2,000	(65)	(245)	(435)	(615)
Economy [4/]	4,010	2,662	2,800	3,140	3,540	3,940	4,330	870	470	70	(320)
Airport Total [5/]	11,807	9,988	10,500	11,760	13,250	14,770	16,230	47	(1,443)	(2,963)	(4,423)

NOTES:

1/ Rounded to the nearest 10 spaces.

2/ Service factors of 5 percent were applied to all products to calculate design day requirements.

3/ The 95th percentile design day for each parking product does not necessarily occur on the same calendar day.

4/ The May 2017 BCAD Employee Parking relocation resulted in added daily public parking capacity and the loss of the Economy Parking product.

5/ The impacts of TNCs and other potential future trends in ground transportation on airport parking can vary based on a wide variety of factors. Airport parking, taxi/limo, rental car, and private vehicle pick-up may be impacted to different degrees, depending on an airport's location, market, passenger catchment area, and parking rates, among other factors. Originating passenger growth or decline also influences parking transactions and may vary across airports. The Scenarios are loosely based on observations at other airports and observations of general ground transportation trends. They are a generalization considering these factors, and are not necessarily representative of what the impacts may be at FLL. FLL-specific data has not been incorporated into the preliminary projections.

SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., January 2018.

BROWARD COUNTY FLORIDA | FORT LAUDERDALE-HOLLYWOOD INTERNATIONAL AIRPORT BROWARD COUNTY, FLORIDA

Table 4.7-3: Public Parking Requirements (in Number of Spaces) – Scenario 2

	JULY 2015–JUNE 2016			FUTURE REQUIREMENTS 1/				SURPLUS / (DEFICIT)			
				2020	2025	2030	2035	2020	2025	2030	2035
				MILLION ORIGINATING PASSENGERS							
	EXISTING CAPACITY	EXISTING DEMAND	EXISTING REQUIREMENT 2/	15.1	17.0	19.0	20.8	15.1	17.0	19.0	20.8
DESIGN DAY (95TH PERCENTILE) 3/											
Hourly/Daily	6,412	6,105	6,410	7,030	7,250	7,540	7,810	(618)	(838)	(1,128)	(1,398)
Valet	1,385	1,221	1,290	1,420	1,470	1,520	1,580	(35)	(85)	(135)	(195)
Economy 4/	4,010	2,662	2,800	3,080	3,170	3,300	3,410	930	840	710	600
Airport Total 5/	11,807	9,988	10,500	11,530	11,890	12,360	12,800	277	(83)	(553)	(993)

NOTES:

1/ Rounded to the nearest 10 spaces.

2/ Service factors of 5 percent were applied to all products to calculate design day requirements.

3/ The 95th percentile design day for each parking product does not necessarily occur on the same calendar day.

4/ The May 2017 BCAD Employee Parking relocation resulted in added daily public parking capacity and the loss of the Economy Parking product.

5/ The impacts of TNCs and other potential future trends in ground transportation on airport parking can vary based on a wide variety of factors. Airport parking, taxi/limo, rental car, and private vehicle pick-up may be impacted to different degrees, depending on an airport's location, market, passenger catchment area, and parking rates, among other factors. Originating passenger growth or decline also influences parking transactions and may vary across airports. The Scenarios are loosely based on observations at other airports and observations of general ground transportation trends. They are a generalization considering these factors, and are not necessarily representative of what the impacts may be at FLL. FLL-specific data has not been incorporated into the preliminary projections.

SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.

PREPARED BY: Ricondo & Associates, Inc., January 2018.

Table 4.7-4: Public Parking Requirements (in Number of Spaces) – Scenario 3

	JULY 2015–JUNE 2016			FUTURE REQUIREMENTS 1/				SURPLUS / (DEFICIT)			
				2020	2025	2030	2035	2020	2025	2030	2035
				MILLION ORIGINATING PASSENGERS							
	EXISTING CAPACITY	EXISTING DEMAND	EXISTING REQUIREMENT 2/	15.1	17.0	19.0	20.8	15.1	17.0	19.0	20.8
DESIGN DAY (95TH PERCENTILE) 3/											
Hourly/Daily	6,412	6,105	6,410	6,860	6,300	6,000	5,770	(448)	112	412	642
Valet	1,385	1,221	1,290	1,390	1,270	1,210	1,170	(5)	115	175	215
Economy 4/	4,010	2,662	2,800	3,000	2,760	2,620	2,520	1,010	1,250	1,390	1,490
Airport Total 5/	11,807	9,988	10,500	11,250	10,330	9,830	9,460	557	1,477	1,977	2,347

NOTES:

1/ Rounded to the nearest 10 spaces.

2/ Service factors of 5 percent were applied to all products to calculate design day requirements.

3/ The 95th percentile design day for each parking product does not necessarily occur on the same calendar day.

4/ The May 2017 BCAD Employee Parking relocation resulted in added daily public parking capacity and the loss of the Economy Parking product.

5/ The impacts of TNCs and other potential future trends in ground transportation on airport parking can vary based on a wide variety of factors. Airport parking, taxi/limo, rental car, and private vehicle pick-up may be impacted to different degrees, depending on an airport's location, market, passenger catchment area, and parking rates, among other factors. Originating passenger growth or decline also influences parking transactions and may vary across airports. The Scenarios are loosely based on observations at other airports and observations of general ground transportation trends. They are a generalization considering these factors, and are not necessarily representative of what the impacts may be at FLL. FLL-specific data has not been incorporated into the preliminary projections.

SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., January 2018.

Table 4.7-5: Public Parking Requirements (in Number of Spaces) – Scenario 4

	JULY 2015–JUNE 2016			FUTURE REQUIREMENTS 1/				SURPLUS / (DEFICIT)			
				2020	2025	2030	2035	2020	2025	2030	2035
				MILLION ORIGINATING PASSENGERS							
	EXISTING CAPACITY	EXISTING DEMAND	EXISTING REQUIREMENT 2/	15.1	17.0	19.0	20.8	15.1	17.0	19.0	20.8
DESIGN DAY (95TH PERCENTILE) 3/											
Hourly/Daily	6,412	6,105	6,410	6,840	5,930	4,890	3,820	(428)	482	1,522	2,592
Valet	1,385	1,221	1,290	1,380	1,200	990	770	5	185	395	615
Economy 4/	4,010	2,662	2,800	2,990	2,590	2,140	1,670	1,020	1,420	1,870	2,340
Airport Total 5/	11,807	9,988	10,500	11,210	9,720	8,020	6,260	597	2,087	3,787	5,547

NOTES:

1/ Rounded to the nearest 10 spaces.

2/ Service factors of 5 percent were applied to all products to calculate design day requirements.

3/ The 95th percentile design day for each parking product does not necessarily occur on the same calendar day.

4/ The May 2017 BCAD Employee Parking relocation resulted in added daily public parking capacity and the loss of the Economy Parking product.

5/ The impacts of TNCs and other potential future trends in ground transportation on airport parking can vary based on a wide variety of factors. Airport parking, taxi/limo, rental car, and private vehicle pick-up may be impacted to different degrees, depending on an airport's location, market, passenger catchment area, and parking rates, among other factors. Originating passenger growth or decline also influences parking transactions and may vary across airports. The Scenarios are loosely based on observations at other airports and observations of general ground transportation trends. They are a generalization considering these factors, and are not necessarily representative of what the impacts may be at FLL. FLL-specific data has not been incorporated into the preliminary projections.

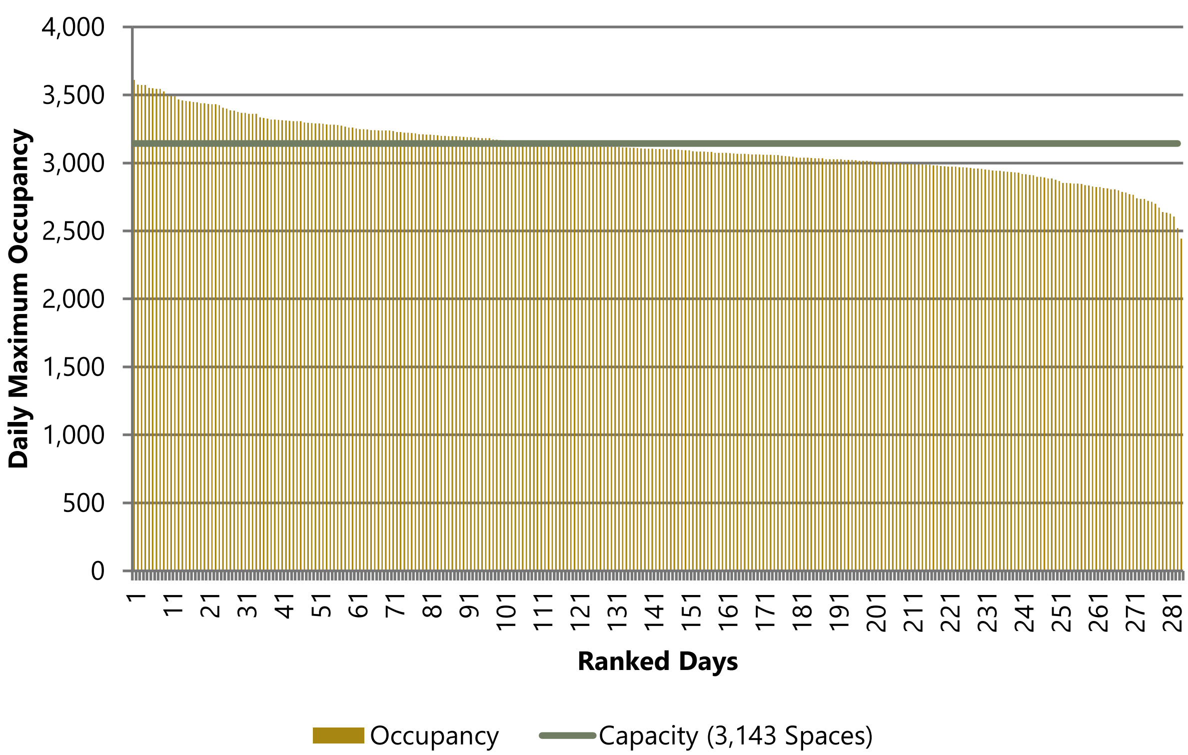
SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., January 2018.

4.7.2 EMPLOYEE PARKING

4.7.2.1 Employee Parking Space Demand

The employee parking demand and requirements are based on overnight and entry/exit counts collected for calendar year 2015. There were a number of days with incomplete entry/exit data, and those were excluded from the analysis. The peak-day demand was calculated to be 3,611 spaces, which is over the capacity of 3,143 spaces available in the Cypress Garage at that time. This calculation corresponds with anecdotal reports of employees routinely having to park in aisles or in striped-out areas of the employee parking facility, only to return and move their vehicles into spaces later in their shifts. A profile of daily maximum parking occupancies sorted in decreasing order for the employee parking facility is depicted on **Exhibit 4.7-10**. As shown on the exhibit, the parking facility accommodated a design-day occupancy of 3,611 vehicles. The 3,143-space facility was approximately 115 percent occupied on the design day.

Exhibit 4.7-10: CY 2015 Employee Parking Demand



NOTE:

Not all 365 days of the year are ranked in the chart due to incomplete data on some days.

SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

4.7.2.2 Employee Parking Requirements

Future employee parking requirements are assumed to grow in proportion to the average increase of enplaned passengers and aircraft operations. The future growth rates for employee parking are presented in **Table 4.7-6**. **Table 4.7-7** shows the future employee parking demand based on these values for 2020, 2025, 2030, and 2035. Based on these assumptions, a peak-day parking deficit of 1,777 spaces is expected in 2020, growing to a peak-day deficit of 3,537 spaces in 2035.

Table 4.7-6: Future Employee Parking Growth Rates

FISCAL YEAR	ENPLANED PASSENGERS	PERCENT INCREASE COMPARED TO 2015	AIRCRAFT OPERATIONS	PERCENT INCREASE COMPARED TO 2015	BLENDED PERCENT INCREASE COMPARED TO 2015
2015	13,214,469	-	215,192	-	-
2020	18,372,000	39%	287,400	34%	36%
2025	20,955,000	59%	318,100	48%	53%
2030	23,624,000	79%	348,700	62%	70%
2035	26,198,000	98%	369,500	72%	85%

SOURCES: Ricondo & Associates, Inc., *Airport Master Plan Update, Aviation Activity Forecasts, Baseline Scenarios*, June 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

Table 4.7-7: Employee Parking Requirements

	2015 EXISTING CONDITIONS			FUTURE REQUIREMENTS 1/				SURPLUS / (DEFICIT)			
	EXISTING CAPACITY	EXISTING DEMAND	EXISTING REQUIREMENT	2020	2025	2030	2035	2020	2025	2030	2035
Employee	3,143	3,611	3,611	4,920	5,530	6,150	6,680	(1,777)	(2,387)	(3,007)	(3,537)

NOTE:

1/ Rounded to the nearest 10 spaces.

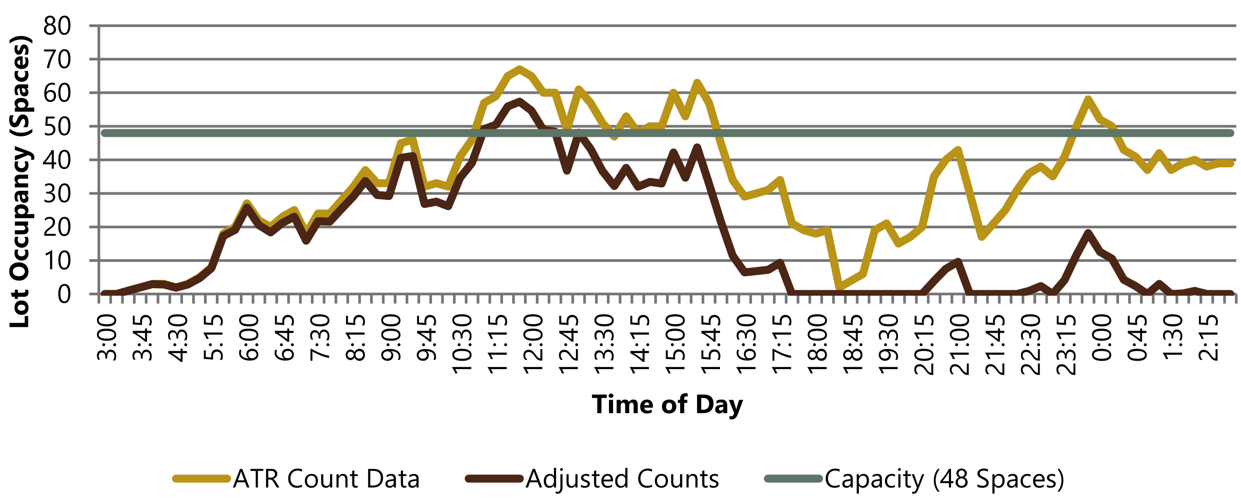
SOURCES: Broward County Aviation Department, July 2016; Standard Parking (SP+), July 2016.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

4.7.3 CELL PHONE LOT

The cell phone lot space requirement was developed by calculating an estimated 24-hour vehicle accumulation count within the lot using entry and exit counts collected via automatic traffic recorders (ATR) summarized in 15-minute increments obtained during the period of November 17-20, 2015. Based on a preliminary review of the data, it was determined that the data obtained on Wednesday, November 18, provided the most representative profile for an average typical day during the data collection period. Using this approach, it was assumed that the lot would be empty during the period when aircraft arrivals are not occurring (assumed to be 3:00 a.m. for this analysis) and that the accumulation would build and decrease throughout the day by adding and subtracting the ATR entry and exit volumes in 15-minute increments. At the end of the 24-hour period, the calculation indicated a positive bias in the traffic accumulation such that the lot was not empty at the trailing 3:00 a.m. period (39 vehicles were resulting). A bias in count data is not uncommon when using ATR counters; therefore, the bias was adjusted downward proportionally throughout the 24-hour period such that the ending 3:00 a.m. period resulted in a zero lot occupancy.

While the adjustment decreases the late evening peak, the purpose of this analysis is to define a single peak hour requirement that can be used for planning purposes and not to provide a definitive profile. The adjusted mid-day peak is the same order of magnitude as the uncorrected late evening counts, such that the calculated peak demand is representative of the requirement for that typical day. The resulting analysis depicted on **Exhibit 4.7-11**, indicated that the lot would reach full capacity during the day and slightly exceed capacity at times, which was anecdotally confirmed by BCAD staff. The data collection period (Baseline) demand was determined to be 57 vehicles during the data collection period.

Exhibit 4.7-11: Cell Phone Lot Occupancy for November 18, 2015



NOTE:

1/ Automatic traffic recorders (ATR) data collected by Kimley-Horn and Associates, Inc. from November 17-20, 2015.

SOURCES: Broward County Aviation Department, 2015; Kimley-Horn and Associates, Inc., November 2015.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

As shown in **Table 4.7-8**, the Baseline peak demand was factored up to the 2015 PMAD, based on a 7.3 percent increase in terminating passengers to determine the 2015 existing conditions demand. Similar to the public parking service factors described in Section 4.7.1.2, a 10 percent service factor was applied to the existing demand to provide a requirement that assumes that a cell phone lot user would be able to find an available space in the lot. The application of this service factor yields the 2015 existing space requirement for the cell phone lot. Future year space requirements were then calculated based on the assumption that current year space requirements would increase in proportion to the forecast growth in annual originating passengers. From this analysis, it was determined that in 2035 the lot would have a deficit of 71 spaces. This requirement is based on the cell phone lot remaining at its current location or at another location that would provide similar demand characteristics. It is possible that these requirements could increase if the lot were moved to a location that is more convenient or desirable or, alternatively, decrease if the lot were moved to a less desirable location.

Table 4.7-8: Cell Phone Lot Requirements

	2015 EXISTING CONDITIONS				FUTURE REQUIREMENTS				SURPLUS / (DEFICIT)			
	EXISTING CAPACITY	BASELINE DEMAND	EXISTING DEMAND (PMAD) 1/	EXISTING REQUIREMENT 2/	2020	2025	2030	2035	2020	2025	2030	2035
Cell Phone	48	57	62	68	86	97	108	119	(38)	(49)	(60)	(71)

NOTES:

1/ Peak Month Average Day (PMAD) demands were calculated assuming that Baseline volumes would increase by 7.3 percent in proportion to the change in daily terminating passengers during the PMAD (38,100 passengers) as compared with the data collection day (35,500 passengers).

2/ A service factor of 10 percent was applied to the existing demand to calculate design day requirements.

SOURCES: Broward County Aviation Department, 2015; Kimley-Horn and Associates, Inc., November 2015.
PREPARED BY: Ricondo & Associates, Inc., March 2017.

4.8 Rental Car Facilities

Rental car demand was analyzed and presented in *Rental Car Center Operations and Capacity Study*.[5] The report forecast rental car growth using the FAA's Terminal Area Forecast (TAF) Summary for FY 2013–2040, and it assumed the percentage of connecting passengers remained constant over that period. The development of rental car requirements was not part of the scope of services for the MPU. However, the forecast originating passengers in the Accelerated Baseline Forecast outpace the TAF used in the report. **Table 4.8-1** compares the forecast originating passengers in the 2013 TAF with the 2015 Accelerated Baseline Forecast schedule. Therefore, estimated planning figures were developed for use in landside facility alternatives planning to account for the forecast increase in originating passengers. **Table 4.8-2** shows the planning estimates that were developed by adjusting the requirements in the report proportionally to the increase in originating passengers from the Accelerated Baseline Forecast schedule.

Table 4.8-1: Comparison of 2013 TAF to 2015 Accelerated Baseline Schedule

	ORIGINATING PASSENGERS (MAP)		FORECAST ORIGINATING PASSENGERS (MAP)			
	2013	2015	2020	2025	2030	2035
2013 TAF 1/	10.7	-	12.1	13.5	15.0	16.7
Master Plan Update Accelerated Baseline Forecast	-	11.8	15.1	17.0	19.0	20.8

NOTES:

MAP = Million Annual Passengers

1/ The LeighFisher report assumes a constant connecting passenger percentage throughout the forecast years. The Accelerated Baseline Forecasts do not have that assumption.

SOURCES: LeighFisher, *Rental Car Center Operations and Capacity Study*, January 2015; *Airport Master Plan Update, Aviation Activity Forecasts, Baseline Scenarios*, Ricondo & Associates, Inc., June 2016.

5 LeighFisher, *Rental Car Center Operations and Capacity Study*, January 2015.

Table 4.8-2: Rental Car Planning Estimates

		PLANNING ESTIMATES 1/					SURPLUS / (DEFICIT)				
	EXISTING CAPACITY	2015	2020	2025	2030	2035	2015	2020	2025	2030	2035
Customer Service	75,600	48,300	55,200	59,100	63,200	67,100	27,300	20,400	16,500	12,400	8,500
Ready/Return	814,100	839,600	1,086,100	1,200,200	1,350,800	1,475,200	(25,500)	(272,000)	(386,100)	(536,700)	(661,100)
QTA	327,000	268,800	348,100	383,900	432,900	472,300	58,200	(21,100)	(56,900)	(105,900)	(145,300)
Storage/Staging 2/	280,200	65,500	453,600	514,900	577,500	633,200	214,700	(173,400)	(234,700)	(297,300)	(353,000)

NOTES:

QTA = Quick Turn-Around

1/ All planning estimates are in square feet.

2/ A limited amount of storage is available for lease in the Cypress Garage, and according to the LeighFisher report, it is not fully utilized. The report's analysis therefore assumed a traditional staging function. Many companies also store vehicles off-site.

SOURCES: LeighFisher, *Rental Car Center Operations and Capacity Study*, January 2015; Ricondo & Associates, Inc., September 2016.
Prepared By: Ricondo & Associates, Inc., March 2017.

4.9 Fixed-Base Operator and Other General Aviation Facilities

This section presents the requirements for FBOs and other general aviation (GA) facilities at FLL, including privately leased aircraft storage facilities, U.S. CBP, and aircraft maintenance facilities.

4.9.1 FIXED-BASE OPERATORS

Currently, GA activity at FLL is served by four FBOs: Sheltair (North and West), Jetscape Services, Signature Flight Support, and National Jets. This section assesses the requirements for these facilities, as well as H Aviation, the sole corporate business operator at FLL.

4.9.1.1 Aircraft Storage and Parking

The focus of this evaluation is to determine the GA aircraft storage and parking needs at FLL over the 20-year planning horizon, as well as to identify any facility deficits to meet current and forecast activity levels. The following sections describe the analysis methodology, the existing GA facilities, and the results of the analysis.

Methodology

The analysis was performed following guidance provided in FAA AC 150/5300-13A, *Airport Design*, Change 1, and ACRP Report 96, *Apron Planning and Design Guidebook*. The process included the following steps:

- Calculating existing apron and hangar floor areas that are available for GA use, taking into consideration the need to retain the ability to taxi into and out of aircraft parking and storage areas.
- Identifying the aircraft fleet mix for both based and transient GA aircraft (including air taxi operations) using the FAA-approved MPU forecasts presented in Section 3 (GA aircraft operations were assumed to be the same for both the Baseline and Accelerated Baseline Forecasts; as such, this section only refers to the Baseline Forecast), information from the FBOs, and data from the FAA ANOMS for the period April 2014 through March 2015.
- Developing average per aircraft parking space requirements for each aircraft type (i.e., length by width plus buffer) that is applicable for both hangar and apron areas, exclusive of taxilane and maneuvering areas.
- Identifying transient GA activity peaking characteristics based on 5 years of historical operations data.
- Calculating hangar and apron parking space demand for the 2035 forecast period, with transient and air taxi parking requirements based on PMAD activity levels.
- Developing an alternative activity forecast and conducting a separate "sensitivity analysis" to account for a possible upward fluctuation in GA activity beyond that associated with the Baseline Forecast, as well as taking into consideration anticipated or planned FBO developments.

Planning Considerations

- **Existing General Aviation Facilities:** Of the four existing FBOs at FLL, Sheltair maintains complexes on both the north and west sides of the airfield. Jetscape is currently located on the north side of the airfield, but it is in the process of relocating to expanded facilities on the west side. Sheltair and National Jets also have facilities on the north side of the airfield. As presented in **Table 4.9-1**, and including the private corporate hangar currently leased by H Aviation (Building N-37), there is approximately 1.07 million square feet of based and transient aircraft storage space within these facilities.

The following assumptions were made to more accurately reflect the current aircraft storage hangar and apron area square footages availability at the Airport:

- The calculations account for aircraft parking spaces only inside hangars and on the apron; hangar office and maintenance areas, as well as apron taxilane and maneuvering areas, are not included.
- Jetscape North remains available for GA use after FBO facilities are relocated to the west side of the airfield.
- The three unoccupied hangars and associated apron (Buildings N-8, N-9, and N-10) immediately east of National Jets are not included (currently vacant).
- Within the H Aviation complex, Building N-38 is used for office and maintenance operations only; it is not included as available aircraft storage space.

- **Fleet Mix and Peaking Characteristics:** To further the accuracy in evaluating the GA space requirements, a detailed aircraft fleet mix was determined based on interviews with the FBOs and data from the FLL ANOMS. The ANOMS data were used to identify specific aircraft types for each takeoff and landing at the Airport, based on radar flight-track information. ANOMS data provided a listing of each aircraft arriving and departing the Airport and was used to define a fleet mix by specific aircraft type. This information was then compared to dimensional criteria for each aircraft identified. From the ANOMS data, a based and representative transient aircraft fleet mix at FLL was determined by classifying the identified aircraft into categories consisting of single-engine piston, twin-engine, small jet, medium jet, large jet, and Boeing Business Jet (BBJ) aircraft. An air taxi category was also identified for large charter aircraft (e.g., sports teams) based on FBO experience. Specific aircraft models within each classification, as identified by the ANOMS data, were then categorized by wingspan and length.

  To ensure that adequate storage space would be available to accommodate transient aircraft during peak traffic periods at the Airport, PMAD activity levels were derived using averages from 5 years of historic GA and air taxi operational data. This data identified March as being the peak month, since it accounted for approximately 10.7 percent of annual GA and air taxi operations. This value was applied to the baseline forecast of GA and air taxi aircraft operations to determine the number of peak month operations, and the PMAD was derived by dividing that number by the number of days in the peak month.

- **Aircraft Storage Space Requirements:** As noted, dimensions of aircraft within the fleet mix groupings, combined with wingtip clearance buffers for safety planning purposes, were used to generate the per aircraft parking space requirements, which are presented in **Table 4.9-2**. The values were vetted with the FBOs to ensure their accuracy. These space requirements were applied to the based and transient aircraft fleet mixes to determine total aircraft storage space required and, ultimately, the mix of hangar and apron area required to serve the aircraft storage demand over the forecast period.

Table 4.9-1: Based and Transient Aircraft Storage – Existing Facilities

	HANGARS				AIRCRAFT PARKING APRON AREA			
FACILITY/COMPLEX	QUANTITY	GROSS AREA 1/ (SQUARE FEET)	USED FOR AIRCRAFT STORAGE 2/ (SQUARE FEET)	PARKING POSITIONS	PARKING POSITIONS	TIE-DOWN POSITIONS	GROSS AREA 3/ (SQUARE FEET)	USED FOR AIRCRAFT PARKING (SQUARE FEET)
Sheltair North	4	99,000	50,200	16	15	10	311,500	75,000
Sheltair West	17 4/	375,100	269,000	75	30	10	844,500	132,450
Signature Flight Support	1	5,000	0	4	20–25	4	201,100	137,500
National Jets	2	50,200	12,600	10	16	2	330,700	89,000
Jetscape North	3	54,600	30,000	6 5/	28 6/	0	159,000	37,000
Jetscape West	1	78,456	78,456	4	15	0	638,900	78,998
H Aviation	1	94,400	30,000	2–3	1	0	279,900	10,000
Total	**29**	**756,756**	**470,256**	**117–118**	**125–130**	**26**	**2,765,000**	**559,948**

NOTES:

1/ The gross area of hangars includes aircraft storage space, office space, and maintenance areas. It matches values provided in Chapter 2, Existing Conditions Inventory.

2/ Hangar size used for aircraft storage based on tenant interviews.

3/ The gross area of aircraft parking aprons includes taxilanes and maneuvering areas.

4/ Includes eight hangars that are currently under construction.

5/ Six ramp parking positions consist of four jet parking spaces and two piston aircraft parking spaces.

6/ The 28 ramp parking positions consist of 16 mid-size jet parking spaces, 10 twin-engine aircraft parking spaces, and 2 single-engine aircraft parking spaces.

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016; Basulto Management Consultants, Inc., FBO Tenant Interviews, January 23–24, 2017;
PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

Table 4.9-2: General Aviation Aircraft Parking Space Requirements by Aircraft Type

AIRCRAFT TYPE	AIRPLANE DESIGN GROUP (ADG)	SPACE REQUIREMENT (SQUARE FEET)
Rotor	N/A	1,250
Single-Engine	I	2,000
Twin-Engine	I	2,500
Small and Medium Jet	I/II	5,000
Large jet	III	10,050
BBJ (737-700)	III	17,920
BBJ (757-200)	IV	32,175

SOURCES: Federal Aviation Administration, Advisory Circular 150/5300-13A, *Airport Design*, Change 1, February 26, 2014; Aircraft Manufacturer Specifications.
PREPARED BY: Kimley Horn & Associates, Inc., March 2017.

- **Transient Air Taxi Apron Space Requirement:** According to the Baseline Forecast, air taxi operations at FLL will decrease from 16,723 in 2015 to 15,900 in 2035. With the exception of air taxi operators that are based at FLL, air taxi operations are typically transient in nature and are accommodated on the apron areas. Based on the operational characteristics of the air taxi operators, it was assumed that approximately 70 percent of the PMAD air taxi aircraft are on the ground at any one time. Based on the PMAD calculations, a total of 27 daily air taxi aircraft arrivals are forecast for 2035, with an estimated 19 of those being at the Airport at any one time and requiring apron parking space. Accordingly, the air taxi fleet mix and apron parking space requirements (exclusive of taxilane and maneuvering area) are presented in **Table 4.9-3**.

Table 4.9-3: Transient Air Taxi Apron Requirements – Baseline Forecast (2035)

AIRCRAFT TYPE	SQUARE FOOTAGE REQUIREMENT	TOTAL PMAD	PERCENT OF AIRCRAFT ON GROUND	PARKING DEMAND	TRANSIENT AIR TAXI SQUARE FOOTAGE REQUIREMENT
Helicopter	1,250	0	70	0	0
Single-Engine	2,000	0	70	0	0
Twin-Engine	2,500	5	70	3	7,500
Small and Medium Jet	5,000	14	70	10	50,000
Large Jet	10,050	6	70	4	40,200
BBJ (737-7)	17,920	1	70	1	17,920
BBJ 757 size (sports team charters)	32,175	1	70	1	32,175
Totals		**27**		**19**	**147,800** 1/

NOTES:
PMAD = Peak Month Average Day
1/ Numbers rounded to nearest 100.
SOURCE: Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts, Fort Lauderdale-Hollywood International Airport*, June 2016.
PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

Analysis Based on Forecasts

The Baseline Forecast and the FAA TAF both projected a constant number of based aircraft at FLL throughout the planning horizon (94 aircraft). This represents no growth in based aircraft between 2015 and 2035. The Baseline Forecast did, however, forecast a 0.5 percent annual average increase in GA operations, with activity increasing from 37,704 annual operations in 2015 to 41,300 annual operations by 2035. This is exclusive of air taxi operations, which are forecast to decline over the same timeframe.

As noted, the based and transient aircraft fleet mixes were defined from actual aircraft types delineated in the ANOMS data. Using these fleet mixes, the next step in the process was to determine the split between operators who would prefer and choose to store their aircraft outside on one of the aprons and those who would seek to store their aircraft inside a hangar. Separate ratios were determined for both based and transient operators, as informed by the experience and knowledge of FBO staff. The following assumptions regarding based and transient aircraft storage were employed in the definition of hangar versus apron needs:

- All based rotorcraft and jet aircraft are stored in hangars.
- 50 percent of the based single- and twin-engine aircraft would be in hangars, with the rest stored on the apron.
- 75 percent of PMAD transient aircraft will remain overnight or longer.
- 60 percent of GA transient aircraft are to be accommodated within hangars, with the rest parked on the apron.

Table 4.9-4 summarizes the aircraft parking space requirements for the Baseline Forecast. With 1.07 million square feet of available storage space, the existing facilities could accommodate total projected demand. However, with only 509,500 square feet of existing hangar space, there is a deficit of 63,600 square feet in 2035 to accommodate the estimated demand for enclosed aircraft storage. **Table 4.9-5** details fleet mix and aircraft storage space requirements for the Baseline Forecast.

Table 4.9-4: Aircraft Parking Space Requirements – Baseline Forecast (in Square Feet)

	2015		2020		2025		2030		2035	
	HANGAR	APRON	HANGAR	APRON	HANGAR	APRON	HANGAR	APRON	HANGAR	APRON
Based Aircraft	372,600	39,500	372,600	39,500	372,600	39,500	372,600	39,500	372,600	39,500
Transient Aircraft	177,900	70,800	182,900	75,800	185,400	75,800	195,500	75,800	200,500	75,900
Air Taxi	0	157,800	0	142,800	0	137,800	0	142,800	0	147,800
Subtotals	550,500	268,100	555,500	258,100	558,000	253,100	568,100	258,100	573,100	263,200
Total Required		818,600		813,600		811,100		826,200		836,300
Existing	509,500	560,000	509,500	560,000	509,500	560,000	509,500	560,000	509,500	560,000
Surplus/Deficit	(41,000)	291,900	(46,000)	301,900	(48,500)	306,900	(58,600)	301,900	(63,600)	296,800
		250,900		255,900		258,400		243,300		233,200

NOTE: Numbers rounded to the nearest 100.

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts, Fort Lauderdale-Hollywood International Airport*, June 2016.

PREPARED BY: Kimley Horn & Associates, Inc., March 2017.

Table 4.9-5: Aircraft Parking Space Requirements by Fleet Mix – Baseline Forecast (2035)

			JET				
	SINGLE-ENGINE	MULTI-ENGINE	SMALL	MEDIUM	LARGE	HELICOPTER	TOTAL
BASED AIRCRAFT:							
Fleet Mix	12	22	13	30	11	6	94
Hangar Space (sq ft)	12,000	27,500	65,000	150,000	110,600	7,500	372,600
Apron Space (sq ft)	12,000	27,500	0	0	0	0	39,500
Total Space Required (sq ft)	**24,000**	**55,000**	**65,000**	**150,000**	**110,600**	**7,500**	**412,100**
TRANSIENT GENERAL AVIATION AIRCRAFT:							
Fleet Mix	6	7	9	20	10	1	53
Hangar Space (sq ft)	0	5,000	25,000	80,000	90,500	0	**200,500**
Apron Space (sq ft)	12,000	12,500	20,000	20,000	10,100	1,300	75,900
Total Space Required (sq ft)	**12,000**	**17,500**	**45,000**	**100,000**	**100,600**	**1,300**	**276,400**
TRANSIENT AIR TAXI AIRCRAFT:							
Apron Space (sq ft)							**147,800**
						Total Hangar Space	573,100
						Total Apron Space	263,200
						Total Aircraft Parking Space Required	**836,300**

NOTE: Numbers rounded to the nearest 100.

SOURCES: Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts, Fort Lauderdale-Hollywood International Airport*, June 2016.
PREPARED BY: Kimley Horn & Associates, Inc., March 2017.

Sensitivity Analysis

Neither the Baseline Forecast nor the FAA TAF projected an increase in the number of based aircraft over the 20-year planning period. Recognizing that the current FBOs at FLL are either undergoing facility improvements or having new facilities developed, it was deemed prudent to develop an alternative demand scenario recognizing the potential for additional GA aircraft to be based at FLL. The sensitivity analysis scenario was based on growth rates by segment of the GA fleet (i.e., single-engine, twin-engine, turbo-prop, jet, and rotor) contained in the FAA Aerospace Forecast 2016–2036. Applying the projected national fleet change percentages from the FAA's Aerospace Forecast to the current based fleet at FLL generated a projected level of future based aircraft demand at FLL: 135 aircraft by 2035. This value provided the basis for the sensitivity analysis, recognizing that if there were going to be 41 additional based aircraft, the number of GA aircraft operations at FLL would also likely increase from that shown in the Baseline Forecast. To account for this growth, an operations-per-based-aircraft value was calculated using current actual data, which was then multiplied by the projected future number of based aircraft. For the sensitivity analysis, this resulted in a forecast 54,135 total GA operations for 2035, versus the 41,300 operations in the Baseline Forecast. Applying the same peaking factors as the previous analysis, the resulting PMAD transient aircraft demand was estimated to be 70 aircraft, versus the 53 estimated from the Baseline Forecast. For the sensitivity analysis, air taxi activity is assumed to remain the same as in the Baseline Forecast. **Table 4.9-6** compares the starting data used in the Baseline Forecast analysis versus the sensitivity analysis.

Table 4.9-6: Baseline Forecast Versus Sensitivity Analysis Starting Data

	2035	
	BASELINE FORECAST	SENSITIVITY ANALYSIS
Based Aircraft	94	135
Forecast General Aviation Aircraft Operations	41,300	54,100
PMAD Transient Aircraft Demand	53	70
Transient Air Taxi Operations	15,900	15,900
PMAD Air Taxi Demand	19	19
Total Transient Aircraft Demand	72	89

NOTE:

PMAD = Peak Month Average Day

SOURCES: Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts, Fort Lauderdale-Hollywood International Airport*, April 2016; Federal Aviation Administration, Aerospace Forecast 2016-2036, January 2016.

PREPARED BY: Kimley-Horn and Associates, Inc., March 2017.

To define the aircraft storage requirements under the sensitivity analysis demand levels, the same assumptions that were used in the analysis for the MPU forecast were applied. **Table 4.9-7** summarizes the aircraft parking space requirements for the sensitivity analysis. As with the MPU forecast scenario, there appears to be sufficient apron space to accommodate the increased demand of this alternative scenario. The hangar storage deficit, however, increases to over 290,400 square feet, or 57 percent above existing supply. **Table 4.9-8** presents aircraft storage space requirements by fleet mix for the sensitivity analysis.

Table 4.9-7: Aircraft Parking Space Requirements – Sensitivity Analysis (in Square Feet)

	2015		2020		2025		2030		2035	
	HANGAR	APRON	HANGAR	APRON	HANGAR	APRON	HANGAR	APRON	HANGAR	APRON
Based Aircraft	372,600	39,500	406,400	44,000	456,000	46,500	494,800	51,000	548,100	53,500
Transient Aircraft	177,900	70,800	195,500	80,800	209,200	90,900	229,300	100,400	251,800	115,400
Air Taxi	0	157,800	0	142,800	0	137,800	0	142,800	0	147,800
Subtotals	550,500	268,100	601,900	267,600	665,200	275,200	724,100	294,200	799,900	316,700
Total Required		818,600		869,500		940,400		1,018,300		1,116,600
Existing	509,500	560,000	509,500	560,000	509,500	560,000	509,500	560,000	509,500	560,000
Surplus/Deficit	(41,000)	291,900	(92,400)	292,400	(155,700)	284,800	(214,600)	265,800	(290,400)	243,300
		250,900		200,000		129,100		51,200		(47,100)

NOTE: Numbers rounded to the nearest 100.

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts, Fort Lauderdale-Hollywood International Airport*, June 2016.

PREPARED BY: Kimley Horn & Associates, Inc., March 2017.

Table 4.9-8: Aircraft Parking Space Requirements by Fleet Mix– Sensitivity Analysis (2035)

	SINGLE-ENGINE	MULTI-ENGINE	JET SMALL	JET MEDIUM	JET LARGE	HELICOPTER	TOTAL
BASED AIRCRAFT:							
Fleet Mix	16	31	17	45	17	9	135
Hangar Space (sq ft)	16,000	37,500	85,000	225,000	170,850	11,250	548,100
Apron Space (sq ft)	16,000	37,500	0	0	0	0	53,500
Total Space Required (sq ft)	**32,000**	**77,500**	**85,000**	**225,000**	**170,900**	**11,300**	**601,600**
TRANSIENT AIRCRAFT:							
Fleet Mix	7	10	12	25	14	2	70
Hangar Space (sq ft)	0	10,000	40,000	90,000	110,550	1,250	251,800
Apron Space (sq ft)	14,000	15,000	20,000	35,000	30,150	1,250	115,400
Total Space Required (sq ft)	**14,000**	**25,000**	**60,000**	**125,000**	**140,800**	**2,600**	**367,200**
TRANSIENT AIR TAXI AIRCRAFT:							
Apron Space (sq ft)							**147,800**
						Total Hangar Space	**799,900**
						Total Apron Space	316,700
						Total Aircraft Parking Space Required	**1,116,600**

NOTE: Numbers rounded to the nearest 100.

SOURCE: Ricondo & Associates, Inc. Airport Master Plan Update Aviation Activity Forecasts, Fort Lauderdale-Hollywood International Airport, June 2016.

PREPARED BY: Kimley Horn & Associates, Inc., March 2017.

Summary of Results

Based on these analyses and the information gathered from Airport personnel and FBO management, there is a deficiency in GA hangar supply for both the Baseline Forecast and the sensitivity analysis. This will likely result in a decreased level of customer service, as some of those patrons desiring hangar parking would have to be accommodated on the apron, or they would have to store their aircraft at another airport. FBO staff has also indicated that the majority of larger transient aircraft tend to stay longer than a day and generally seek to hangar their aircraft. A longer duration of transient aircraft storage would exacerbate this situation.

At the master plan level, the analysis of facility demand versus capacity tends to focus on Airport-wide needs; it is important to recognize that the inventory of available apron and hangar space varies considerably, and it can result in some tenants being more space-constrained than others. Further, sheer numbers do not always present an adequate measure—it is possible to have sufficient square footage, but still be deficient operationally. Indeed, facility configuration can challenge the adequacy of the space that is provided. This is evident at FLL, where the current configuration has become more problematic as the mix and size of GA aircraft, and particularly the GA jet fleet, have increased significantly.

When many of the current FBO facilities were originally constructed, aircraft such as the Gulfstream G550/G650 and the Bombardier Global Express series, with wingspans near 100 feet, did not exist. The increasing presence of these aircraft in the fleet at FLL presents operational challenges to current FBO facility configurations, which will need to be addressed. These factors are undoubtedly part of the motivation for the current and planned FBO expansions. For purposes of this analysis, facility expansion projects that were well into the design phase or under construction, including the eight Sheltair West hangars and the relocation of Jetscape Services, were included. A summary of the aircraft storage requirements, for both demand scenarios, is presented in **Table 4.9-9**.

Table 4.9-9: Aircraft Storage Requirements Summary (in Square Feet)

	BASELINE FORECAST			SENSITIVITY ANALYSIS		
	HANGAR	APRON	TOTAL	HANGAR	APRON	TOTAL
Existing Supply	509,500	560,000	1,069,500	509,500	560,000	1,069,500
2020 Demand	555,500	258,100	813,600	601,900	267,600	869,500
2025 Demand	558,000	253,100	811,100	665,200	275,200	940,400
2030 Demand	568,100	258,100	826,200	724,100	294,200	1,018,300
2035 Demand	573,100	263,200	836,300	799,900	316,700	1,116,600
Existing vs. 2035 Surplus / (Deficit)	(63,600)	296,800	233,200	(290,400)	243,300	(47,100)

NOTE: Numbers rounded to the nearest 100.

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.9.1.2 Terminal Area

FBO terminal facilities range in function, but they typically include passenger lobbies, office areas, conference rooms, pilot lounges, cafeterias or vending areas, gym areas and/or shower rooms, and flight planning rooms. **Table 4.9-10** presents the approximate size of the terminal facilities for each of the FBOs at the Airport, based on conversations with FBO personnel.

Table 4.9-10: Fixed-Base Operator Terminal Areas

FIXED-BASE OPERATOR	TERMINAL (SQUARE FEET)
Sheltair North	31,700
Sheltair West	100,200
Signature Flight Support	5,000
National Jets	1,800
Jetscape Services North	14,100
Jetscape Services West	32,500
H Aviation	8,300
Total	**193,600**

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016; Basulto Management Consulting, FBO Tenant Interviews, January 23–24, 2017.
PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

FBO personnel have indicated that the existing terminals are adequate to meet current and anticipated demand through the 2035 planning horizon. Should significant changes in user or operator demand occur, a re-evaluation of terminal capacity and function may be warranted. **Table 4.9-11** summarizes FBO terminal area requirements through the planning horizon.

Table 4.9-11: Fixed-Base Operator Terminal Space Requirements (in Square Feet)

	REQUIREMENTS			
EXISTING	2020	2025	2030	2035
193,600	193,600	193,600	193,600	193,600

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016.
PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.9.1.3 Automobile Parking

FBO automobile parking consists of both public and employee parking areas. **Table 4.9-12** identifies the total available parking area (including circulation) for each of the FBOs, as well as the additional space FBO personnel reported they desired.

Table 4.9-12: Fixed-Base Operator Automobile Parking Areas

FIXED-BASE OPERATOR	AUTOMOBILE PARKING AVAILABLE (SQUARE FEET)	ADDITIONAL PARKING DESIRED (SQUARE FEET)
Sheltair North	80,000	0
Sheltair West	255,500	110,000 3/
Signature	37,600	0
National Jets	60,400	15,000 4/
Jetscape Services North	37,400	0
Jetscape Services West	103,000 1/	0
H Aviation	21,600 2/	0
Total	**595,500**	**125,000**

NOTES:

1/ Based on Jetscape Westside Development Site Plan, Cartaya & Associates, P.A., May 25, 2016.

2/ Includes parking area adjacent to main hangar (Building N-37) but not adjacent to office/maintenance buildings (Building N-38).

3/ Based on 400 square feet per space, inclusive of circulation. Sheltair West requested an additional 275 parking spaces.

3/ Based on 400 square feet per space, inclusive of circulation. National Jets requested an estimated additional 38 parking spaces (50 percent increase from existing).

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016; Basulto Management Consulting, FBO Tenant Interviews, January 23–24, 2017; Cartaya & Associates, P.A., Jetscape Westside Development Site Plan, May 25, 2016.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

Both Sheltair West and National Jets noted specific concerns about the inadequacy of their current parking areas, with limited expansion options at both facilities. Assumptions to calculate automobile parking requirements are outlined below:

- National Jets has the potential to utilize additional area beneath I-595. Assuming a 50-percent increase in parking area would be sufficient for National Jets, an approximate 15,000 square feet of additional space would be needed in addition to existing parking areas (i.e., 38 spaces at 400 square feet per space, including circulation) to accommodate its needs through 2025.
- Sheltair West indicated a need to increase its available parking by 275 spaces, which may require a vertical structure, or approximately 110,000 square feet (2.5 acres) of additional surface parking to accommodate its needs through 2025.
- Jetscape Services is in the final stages of design on its new facility on the west side of the Airport, and it has incorporated adequate parking into the site development plan through the planning horizon (2035).
- Starting in 2025, the average annual GA operations growth rate of 0.46 percent was applied to the total parking area of 720,500 square feet for the remaining 10 years of the planning horizon (except for Jetscape West).

Thus, there is a potential demand for 154,000 square feet of automobile parking by 2035 (an additional 385 spaces). **Table 4.9-13** summarizes FBO automobile parking requirements through the planning horizon.

Table 4.9-13: Fixed-Base Operator Automobile Parking Requirements (in Square Feet)

		REQUIREMENTS 1/			
TENANT	EXISTING AREA	2020	2025	2030	2035
Sheltair North	80,000	80,000	80,000	81,900	83,800
Sheltair West	255,500	365,500	365,500	374,000	382,700
Signature	37,600	37,600	37,600	38,500	39,400
National Jet	60,400	75,400	75,400	77,200	78,900
Jetscape Services North	37,400	37,400	37,400	38,300	39,200
Jetscape Services West	103,000	103,000	103,000	103,000	103,000
H Aviation	21,600	21,600	21,600	22,100	22,600
Total	**595,500**	**720,500**	**720,500**	**735,000**	**749,500**
Additional Number of Parking Spaces (from Existing) 1/		**+300**	**+300**	**+350**	**+400**

NOTE:

1/ Future automobile parking requirements assumes an average of 400 square feet per parking stall. Numbers have been rounded to the nearest 50.

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016; Basulto Management Consulting, FBO Tenant Interviews, January 23–24, 2017; Cartaya & Associates, P.A., Jetscape Westside Development Site Plan, May 25, 2016.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.9.1.4 General Aviation Fuel Storage Facilities

GA fueling services are provided by several FBOs at FLL:

- Sheltair maintains and operates 10 fuel tanks at its Sheltair West complex: six 25,000-gallon JetA tanks, three 15,000-gallon JetA tanks, and one 15,000-gallon AvGas tank.
- Signature Flight Support does not maintain any fuel tanks; instead, JetA and AvGas fuel trucks are utilized to store fuel and to service aircraft operating at the FBO.
- National Jets has an in-ground fuel tank farm with a total capacity of 80,000 gallons: 75,000 gallons of JetA and 5,000 gallons of AvGas.
- Jetscape North does not currently have on-site fuel storage, other than in its tender trucks: one 10,000-gallon JetA truck and one 5,000-gallon AvGas truck.
- The Jetscape West conceptual site plan includes the development of a fuel farm with sufficient space for three 20,000-gallon JetA storage tanks and one approximately 12,000-gallon AvGas tank.

As of 2016, cumulative GA fuel storage capacity equaled 270,000 gallons of Jet A and 20,000 gallons of AvGas. With the addition of Jetscape West, total fuel capacity would be 330,000 gallons of JetA and 32,000 gallons of AvGas. FBO personnel have indicated that no additional GA fuel capacity beyond this is needed or anticipated at this time. With consideration of no additional based aircraft under the Baseline Forecast scenario, and a decrease in the number of air taxi operations, the current and planned fuel capacity appears adequate to meet the GA demand through the planning horizon. Under the sensitivity analysis scenario, however, based aircraft and transient aircraft operations would increase. Acknowledging that the FBOs could increase the frequency of fuel shipments to compensate for at least some of this increase, additional on-site storage could be desired. It is estimated that under the sensitivity analysis scenario, GA fuel demand for both JetA and AvGas could increase by 25 percent over 2015 levels by 2030 and by 35 percent by 2035. While the planned AvGas capacity would be sufficient to accommodate the 2035 demand, JetA demand could increase by 30,000 to 40,000 gallons. **Table 4.9-14** summarizes existing and required fuel storage facilities through the planning horizon for both the Baseline Forecast and the sensitivity analysis.

Table 4.9-14: Fixed-Base Operator Fuel Storage Requirements (in Gallons)

	BASELINE FORECAST				SENSITIVITY ANALYSIS			
	JET A		AVGAS		JET A		AVGAS	
	STORAGE	(DEFICIT)	STORAGE	(DEFICIT)	STORAGE	(DEFICIT)	STORAGE	(DEFICIT)
2015	270,000	0	20,000	0	270,000	0	20,000	0
2020 *	330,000	0	32,000	0	330,00	0	32,000	0
2025 *	330,000	0	32,000	0	330,000	0	32,000	0
2030 *	330,000	0	32,000	0	337,500	(7,500)	32,000	0
2035 *	330,000	0	32,000	0	364,500	(34,500)	32,000	0

NOTE:

* Capacity includes planned Jetscape West fuel farm.

SOURCES: Basulto Management Consulting, FBO Tenant Interviews, January 23–24, 2017; Cartaya & Associates, P.A., Jetscape Westside Development Site Plan, May 25, 2016.
PREPARED BY: Kimley-Horn & Associates, Inc., April 2017.

4.9.1.5 Summary of FBO Requirements

Table 4.9-15 and **Table 4.9-16** summarize the gross areas required for each FBO function through the planning horizon for the Baseline Forecast and the sensitivity analysis, respectively. As shown for the sensitivity analysis, approximately 4 acres are required to accommodate the anticipated FBO growth.

4.9.2 U.S. CUSTOMS AND BORDER PROTECTION

The U.S. CBP facility that serves GA activity at FLL processed 53,754 persons (passengers and crew members) and 13,000 aircraft in 2015. Applying the GA peaking characteristics, it is estimated that approximately 185 persons and 45 aircraft would have been processed during the PMAD. Applying the forecast 0.5 percent average annual growth of GA operations to the 2015 activity levels would increase the CBP processing demand to approximately 200 persons and 49 aircraft during the PMAD in 2035. These figures could, however, vary significantly from day to day, depending on the size and type of aircraft being processed (i.e., charter versus corporate).

Table 4.9-15: Fixed-Base Operator Overall Facility Requirements (Baseline Forecast)

		REQUIREMENTS			
	EXISTING AREA	2020	2025	2030	2035
Hangar	509,500	555,500	558,000	568,100	573,100
Apron	560,000	258,100	253,100	258,100	263,100
Terminal	193,600	193,600	193,600	193,600	193,600
Auto parking	595,500	720,500	720,500	735,000	749,500
Total	**1,858,600**	**1,727,700**	**1,725,200**	**1,754,800**	**1,779,300**
Total (acres)	**43**	**40**	**40**	**40**	**41**

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016; Basulto Management Consulting, FBO Tenant Interviews, January 23–24, 2017; Cartaya & Associates, P.A., Jetscape Westside Development Site Plan, May 25, 2016.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

Table 4.9-16: Fixed-Base Operator Overall Facility Requirements (Sensitivity Analysis)

		REQUIREMENTS			
	EXISTING AREA	2020	2025	2030	2035
Hangar	509,500	601,900	665,200	724,100	799,900
Apron	560,000	267,600	275,200	294,200	316,700
Terminal	193,600	193,600	193,600	193,600	193,600
Auto parking	595,500	720,500	720,500	735,000	749,500
Total	**1,858,600**	**1,783,600**	**1,854,500**	**1,946,500**	**2,059,700**
Total (acres)	**43**	**41**	**43**	**45**	**47**

NOTE: Except as noted otherwise, all values are expressed in square feet. Numbers have been rounded to the nearest 100.

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016; Basulto Management Consulting, FBO Tenant Interviews, January 23–24, 2017; Cartaya & Associates, P.A., Jetscape Westside Development Site Plan, May 25, 2016.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.9.2.1 Building

The 10,000-square-foot CBP administration/passenger processing building was refurbished in 2016. Updates included renovations and improvements of the interior layout, improvements of apron access, expansion of processing areas, and updates to security systems. Discussions with Airport personnel have indicated that the recently renovated CBP building will be adequate throughout the 20-year planning horizon.

4.9.2.2 Apron

The approximate 49,300 square feet of existing CBP apron area is undersized and poorly configured for the current level of international GA activity at FLL. With consideration of maneuvering area and the adjacent apron used by Sheltair West, the remaining area can effectively accommodate one Boeing 737–sized aircraft and possibly one or two smaller corporate-type aircraft simultaneously. During peak periods, the CBP apron has difficulty accommodating all aircraft and becomes overcrowded, with some aircraft having to utilize the adjacent Sheltair West apron. While this situation may be acceptable on a case-by-case basis, it is estimated that the CBP apron should be able to accommodate three to four aircraft at any given time, without operational or access restrictions. Conceptual apron configurations capable of accommodating four Gulfstream G550 corporate-type aircraft with dedicated taxilane access and appropriate wingtip clearance would require approximately 75,000 square feet of pavement area. This represents an increase of approximately 60 percent of the existing apron area. This apron area could also accommodate multiple Boeing 737–sized aircraft with a combination of smaller aircraft at any given time.

To maximize functionality of the apron, a relocated or reconfigured standalone CBP facility and apron could be considered. Providing a standalone facility with a 10,000-square-foot processing building, 75,000-square-foot apron, automobile parking, and support space would require a 3 to 4 acre site. Developing a standalone facility in a new location would also provide additional apron and automobile parking for the Sheltair West facility.

Table 4.9-17 summarizes the CBP space requirements through the planning horizon.

Table 4.9-17: Customs and Border Protection Space Requirements

		REQUIREMENTS (SQUARE FEET)			
	EXISTING	2020	2025	2030	2035
Apron [1/]	49,300	75,000	75,000	75,000	75,000
Building	10,000	10,000	10,000	10,000	10,000

NOTE:

1/ Does not include aircraft circulation space.

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011.
PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.9.3 SUMMARY OF FIXED-BASE OPERATOR/GENERAL AVIATION REQUIREMENTS

Over the course of the 20-year planning horizon, additional space is anticipated to be required for the following:

- GA hangar space – 63,600 square feet for the Baseline Forecast scenario and up to 290,400 square feet for the Accelerated Baseline Forecast.
- FBO automobile parking – approximately 154,000 square feet or 400 spaces.
- CBP apron – approximately 25,700 square feet.

4.10 Air Cargo Facilities

Currently, air cargo at FLL is handled by a combination of cargo integrators (FedEx and UPS), passenger airline belly cargo, and a smaller on-demand all-cargo airline (GB Airlink). They operate from multiple facilities on the north side of the airfield, as either primary or sublease tenants. The following evaluates the ability of these existing facilities to accommodate current and future air cargo volumes as projected under the Baseline Forecast. Facilities evaluated include warehouse processing space, apron space, and ground service equipment (GSE) storage space.

4.10.1 METHODOLOGY

The demand capacity analysis for air cargo facilities at FLL followed a methodology outlined in ACRP Report 143, *Guidebook for Air Cargo Facility Planning and Development*, 2015. This methodology is founded on typical processing rates of cargo volume per square foot of facility (i.e., warehouse space, apron, GSE storage). The process included the following steps:

- Inventorying existing cargo facilities (by carrier and leasehold) from BCAD data, on-site observations, and carrier/tenant interviews.
- Evaluating 2010–2015 cargo activity and processing rates by carrier and facility.
- Comparing historic processing rates at FLL to the metrics prescribed in ACRP Report 143 and selecting appropriate target processing rates for evaluating future capacity.
- Applying target processing rates to projected cargo volumes to identify any facility surpluses or deficits.
- Cargo aircraft operations projected in the MPU FAA-approved forecast presented in Section 3 were assumed to be the same for both the Baseline and Accelerated Baseline Forecasts; as such, this section only refers to the Baseline Forecast.

4.10.2 EXISTING AIR CARGO FACILITIES

As of 2016, existing air cargo facilities at FLL are distributed in four primary facilities: the FedEx complex; the LYNXS Cargoport, of which UPS is a tenant; the Aero Lauderdale complex, which includes multiple buildings and both all-cargo and belly cargo tenants; and the dedicated Belly Haul Air Cargo Building, with multiple passenger airline and cargo service provider tenants. The facilities, current tenants, and available cargo processing areas are summarized in **Table 4.10-1**.

Assumptions included in this inventory are the following:

- UPS processes its cargo off-site but leases office, storage, and aircraft maintenance support space at the LYNXS Cargoport.
- Warehouse processing space reflects a percentage of the total building footprint based on cursory observation and leasing information, as provided by BCAD. For the belly cargo operators, this ranges from 80 to 90 percent. For the integrator and all-cargo operators, the percentages range from 57 percent for UPS to 82 percent for FedEx.

Table 4.10-1: Existing Air Cargo Facilities (in Square Feet)

CARRIER/TENANT	TYPE	BUILDING FOOTPRINT	BUILDING WAREHOUSE SPACE ONLY	APRON FOOTPRINT	APRON AIRCRAFT PARKING ONLY	GROUND SUPPORT EQUIPMENT AREA AVAILABLE	GROUND SUPPORT EQUIPMENT AREA USED
FedEx/Mountain Air	Integrator	62,100	50,900	641,000	401,400	102,300	102,300
LYNXS Cargoport 1/		56,100	45,700	154,000	130,900	43,000	9,200
UPS	Integrator	1,200	700	54,100	46,000	9,200	9,200
Vacant/Other Uses	N/A	54,900	45,000	99,900	84,900	33,800	0
Aero Lauderdale Complex		38,700	27,100	86,200	20,300	12,500	12,500
GB Airlink (Bldg. N-19E)	All-Cargo	7,000	4,500	22,500	20,300	500	500
Azul/JetBlue Airlines (Bldg. N-15)	Belly Cargo	9,000	7,200	0	0	0	0
Spirit Airlines (Bldg. N-19W) 2/	Belly Cargo	19,200	15,400	63,700	n/a	9,000	9,000
United Airlines (Bldg. N-14) 3/	Belly Cargo	3,500	0	0	0	3,000	3,000
Belly Haul Cargo Building (Bldg. N-29)		35,000	28,800	0	0	43,200	40,100
Delta Air Lines	Belly Cargo	15,000	12,000	0	0	18,500	18,500
United Airlines	Belly Cargo	2,500	2,000	0	0	3,100	3,100
Southwest Airlines	Belly Cargo	10,000	8,000	0	0	12,300	12,300
Consolidated Airline Services	Belly Cargo	5,000	4,500	0	0	6,200	6,200
Vacant	N/A	2,500	2,300	0	0	3,100	0
Subtotal Belly Cargo		66,700	51,400	63,700	0	55,200	52,100
Subtotal Integrator and All-Cargo		125,200	101,100	817,500	552,600	145,800	112,000
Total Cargo Space		191,900	152,500	881,200	552,600	201,000	164,100

NOTES: Numbers have been rounded to the nearest 100.

1/ GSE maintenance operators occupy portions of the LYNXS Cargoport building.

2/ Apron area associated with the Spirit Airlines lease in Building N-19W is not included in space used for processing belly cargo processing; it is assumed to be used for overnight staging and other activities.

3/ United Airlines' lease within Building N-14 is used for GSE and miscellaneous storage and equipment repair. No apron space is provided.

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department, Tenant Leasehold Drawings, December 2016; Kimley-Horn & Associates, Inc., 2016 (On-site Observations).

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

- Continental Airlines and United Airlines both utilized the Belly Haul Air Cargo Building prior to their merger. Post-merger, cargo tonnage processed in the Belly Haul Cargo Building as reported by United Airlines for 2014–2015 includes merged airline volumes.
- Belly cargo from American Airlines and US Airways, both pre- and post-merger, was processed in the Belly Haul Air Cargo Building by a third-party handler.
- Both Azul and JetBlue Airlines process belly cargo in a single building within the Aero Lauderdale complex.
- While Spirit Airlines leases space within the Aero Lauderdale complex, it has reported no cargo tonnage through 2015 (and 2016).
- Apron space available for cargo processing does not include the BCAD ARFF training apron east of the LYNXS Cargoport, the apron space leased by Spirit Airlines in the Aero Lauderdale complex, and the apron space leased by United Airlines and Azul/JetBlue Airlines near the Belly Haul Air Cargo Building for GSE storage.
- Apron space available for cargo processing was calculated exclusive of taxilane, maneuvering, and other storage areas.
- Available GSE storage space at the Belly Haul Air Cargo Building is based on a pro-rata share of the building lease area.

4.10.3 HISTORICAL AND PROJECTED AIR CARGO VOLUMES

Historical freight volume data by airline indicates that 81,322 tons of air freight and belly cargo were processed at the Airport in calendar year 2015. Of this, 79.1 percent was carried by integrators and all-cargo carriers, while 20.9 percent was belly cargo (Delta Air Lines, United Airlines, Southwest Airlines, Azul/JetBlue Airlines, and others). The percentage of air cargo processed by each carrier in 2015 is presented in **Table 4.10-2**.

Table 4.10-2: Air Cargo Carrier Share – Total Cargo (CY 2015)

INTEGRATED AND ALL-CARGO CARRIERS			BELLY CARGO		
CARRIER	TONS	PERCENT	CARRIER	TONS	PERCENT
FedEx/Mountain Air	55,736	86.7	Delta Air Lines	1,953	11.5
UPS	7,779	12.1	United Airlines	1,331	7.8
GB Airlink	771	1.2	Southwest Airlines	5,293	31.1
Total	**64,286**	**100.0**	Azul/JetBlue Airlines	4,909	28.8
			Spirit Airlines	Not Reported	Not Reported
			All Others	3,550	20.8
			Total	**17,036**	**100.0**

Total Air Cargo Processed in 2015: 64,286 + 17,036 = 81,322 tons

NOTES:
1/ U.S. (short) ton = 2,000 pounds.
2/ BCAD records do not include cargo volumes for Spirit Airlines.

SOURCE: Broward County Aviation Department, Air Cargo Records 2010-2015, July 2016.
PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

According to Table 3.1-10 in Chapter 3, Aviation Activity Forecast, annual tonnage has decreased -7.1 percent between 2005 and 2015, and -3.0 percent between 2009 and 2015. Based on the FAA's 2015 Aerospace Forecasts, an average annual growth rate of 0.62 percent for air cargo tonnage was utilized through the planning horizon.

As shown in **Table 4.10-3**, applying this growth rate to the reported 2015 volumes results in a projection of approximately 92,000 tons of air cargo being processed at FLL by 2035.

Table 4.10-3: Air Cargo Projected Growth

	TONS (U.S.) OF AIR-CARGO		
YEAR	INTEGRATED AND ALL-CARGO CARRIERS	BELLY CARGO	TOTAL
2015 (Actual)	64,286	17,036	81,322
2020	68,000	18,000	86,000
2025	70,400	18,600	89,000
2030	71,900	19,100	91,000
2035	72,700	19,300	92,000
Average Annual Growth		0.62%	
20-Year Growth		13.1%	

SOURCES: Broward County Aviation Department, Air Cargo Records 2010-2015, July 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts, Fort Lauderdale-Hollywood International Airport,* June 2016; Kimley-Horn and Associates, Inc., June 2016.
PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.10.4 INTEGRATED AND ALL-CARGO WAREHOUSE PROCESSING SPACE

The integrated and all-cargo carrier facilities at FLL include:

- the FedEx complex,
- the LYNXS Cargoport, which houses UPS in a portion of its building; and
- GB Airlink, which leases a portion of Building N-19E in the Aero Lauderdale complex.

Combined, these include approximately 101,100 square feet of available integrated/all-cargo warehouse processing space, or approximately 77 percent of the total cargo building space (acknowledging the balance is used for office, storage, and other functions). Based on 2010–2015 reported cargo volumes, FedEx processed between 1.12 and 1.42 tons per square foot and GB Airlink processed approximately 0.17 tons per square foot. It should be noted that GB Airlink accommodates mostly smaller packages and documents.

ACRP Report 143 identifies typical processing ratios between 0.19 and 1.84 tons of cargo, based on the type of airport and the type of operator (i.e., domestic or international, integrator or all-cargo). For this analysis, the target processing rate of 0.74 was selected to represent the approximate midrange of both domestic integrated and international all-cargo carriers, acknowledging most air cargo at FLL is currently by domestic integrated carriers (FedEx and UPS). **Table 4.10-4** summarizes cargo warehouse processing space requirements through the planning horizon (civil years). Based on the results, there are sufficient facilities to accommodate the projected cargo volumes at FLL in accordance with the Baseline Activity Forecast. Discussions with FedEx personnel have indicated those facilities are anticipated to be satisfactory over the planning horizon and there are no current plans for expansion. Similarly, GSE maintenance operators are currently using the remainder of the space in the LYNXS Cargoport, but they could be relocated to other on-Airport facilities should UPS elect to process its cargo on-site.

Table 4.10-4: Integrated and All-Cargo Carrier – Warehouse/Processing Space Requirements

YEAR	FORECAST INTEGRATED AND ALL-CARGO (TONS)	WAREHOUSE SPACE DEMAND (SQUARE FEET) 1/	TOTAL AVAILABLE WAREHOUSE SPACE (SQUARE FEET)	SURPLUS (SQUARE FEET)
2015	64,286	86,900	101,100	14,200
2020	68,000	91,900	101,100	9,200
2025	70,400	95,100	101,100	6,000
2030	71,100	97,200	101,100	3,900
2035	72,700	98,200	101,100	2,900
Average Annual Growth Rate: 0.62%				

NOTES: Numbers have been rounded to the nearest 100.

1/ Integrator and all-cargo warehouse processing space demand calculated on 0.74 tons of annual enplaned cargo per square foot.

SOURCES: Broward County Aviation Department, Air Cargo Records 2010-2015, July 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts*, *Fort Lauderdale-Hollywood International Airport,* June 2016; Airport Cooperative Research Program Report 143, *Guidebook for Air Cargo Facility Planning and Development*, 2015.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.10.5 BELLY CARGO WAREHOUSE PROCESSING SPACE

The belly cargo facilities at FLL include the Belly Haul Air Cargo Building and two buildings within the Aero Lauderdale complex. As of 2016, Delta Air Lines, United Airlines, Southwest Airlines, and Consolidated Airline Services are tenants in the Belly Haul Air Cargo Building; there is also one vacant space in the building. Azul/JetBlue Airlines and Spirit Airlines lease two buildings in the Aero Lauderdale complex (Spirit Airlines does not report any cargo volumes). Combined, these account for approximately 51,300 square feet of available belly cargo warehouse processing space, which represents approximately 81 percent of the total belly cargo building space (acknowledging the balance is used for office, storage, and other functions).

Based on 2010–2015 reported cargo volumes, the belly cargo operators processed between 0.20 and 0.70 tons of cargo per square foot of warehouse space. ACRP Report 143 identifies typical processing ratios between 0.32 and 1.28 tons per square foot, based on the type of airport and the type of operator (i.e., domestic or international). For this analysis, the ACRP default target processing rate of 0.64 was selected to acknowledge the historic range of operator efficiencies and the current vacant space in the Belly Haul Air Cargo Building. **Table 4.10-5** summarizes belly cargo warehouse processing space requirements through the planning horizon (civil years). Based on the results, there are sufficient facilities to accommodate the projected belly cargo volumes. At the target processing rate, the 21,100 square feet of surplus space in 2035 could accommodate up to 15,500 tons of additional cargo.

Table 4.10-5: Belly Cargo – Warehouse/Processing Space Requirements

YEAR	FORECAST BELLY CARGO (TONS)	WAREHOUSE SPACE DEMAND (SQUARE FEET) 1/	TOTAL AVAILABLE WAREHOUSE SPACE (SQUARE FEET)	SURPLUS (SQUARE FEET)
2015	17,036	26,600	51,300	24,700
2020	18,000	28,100	51,300	23,200
2025	18,600	29,100	51,300	22,200
2030	19,100	29,800	51,300	21,800
2035	19,300	30,200	51,300	21,100
Average Annual Growth Rate: 0.63%				

NOTES: Numbers have been rounded to the nearest 100.

1/ Belly cargo warehouse processing space demand calculated on 0.64 tons of annual enplaned cargo per square foot.

SOURCES: Broward County Aviation Department, Air Cargo Records 2010-2015, July 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts*, *Fort Lauderdale-Hollywood International Airport,* June 2016; Airport Cooperative Research Program Report 143, *Guidebook for Air Cargo Facility Planning and Development*, 2015.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.10.6 CARGO PROCESSING APRON SPACE

Only apron space associated with the integrated and all-cargo facilities is included in this analysis, as belly cargo is typically loaded and unloaded on the terminal apron and transported to the processing facility by other vehicles. The apron space included in this analysis consists of the FedEx facility, the LYNXS Cargoport, and the GB Airlink apron in the Aero Lauderdale complex. The total area available for cargo processing is approximately 552,600 square feet, which represents approximately 68 percent of the total apron space associated with cargo processing (recognizing the balance consists of taxilanes, maneuvering, and other storage areas). The 2010–2015 reported cargo volumes indicate these operators processed between 0.04 and 0.19 tons of cargo per square foot of apron space. The FedEx and UPS ratios were fairly consistent at 0.12 to 0.19 tons per square foot, and GB Airlink processed at a ratio of 0.04 tons per square foot. ACRP Report 143 identifies typical processing ratios between 0.20 and 1.82 tons per square foot of apron, based on the type of airport and the type of operator (i.e., domestic or international). For this analysis, a target processing rate of 0.20 tons per square foot of apron was selected to represent historic efficiencies, which corresponds with the ACRP low range for both domestic integrated and all-cargo carriers.

Table 4.10-6 summarizes cargo apron space requirements through the planning horizon (civil years). Based on the results, there is sufficient apron space to accommodate the projected cargo volumes. This is consistent with information from FedEx personnel, who noted the overall apron space is anticipated to be adequate for the foreseeable future. Additionally, FedEx is modifying its aircraft parking apron to accommodate an upgauging to larger Boeing 767-300F aircraft.

Table 4.10-6: Integrated and All-Cargo Carrier – Aircraft Parking Apron Space Requirements

YEAR	FORECAST INTEGRATED AND ALL-CARGO (TONS)	APRON SPACE DEMAND (SQUARE FEET) 1/	TOTAL AVAILABLE APRON (SQUARE FEET)	SURPLUS (SQUARE FEET)
2015	64,286	321,400	552,600	231,200
2020	68,000	340,000	552,600	212,600
2025	70,400	352,000	552,600	200,600
2030	71,900	359,500	552,600	197,100
2035	72,700	363,500	552,600	189,100
Average Annual Growth Rate: 0.62%				

NOTES: Numbers have been rounded to the nearest 100.

1/ Integrator and all-cargo apron space demand calculated on 0.2 tons of annual enplaned cargo per square foot.

SOURCES: Broward County Aviation Department, Air Cargo Records 2010-2015, July 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts*, *Fort Lauderdale-Hollywood International Airport,* June 2016; Airport Cooperative Research Program Report 143, *Guidebook for Air Cargo Facility Planning and Development*, 2015.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.10.7 GROUND SUPPORT EQUIPMENT STORAGE SPACE

Integrated, all-cargo, and belly cargo operators require space to store and maintain their cargo-related GSE. Among all the air cargo facilities, there is approximately 201,000 square feet of GSE storage, with over half of that being maintained by FedEx. It was noted that the passenger airlines tend to flex the use of their various leaseholds to accommodate both passenger and cargo functions, as operational demands warrant. In other words, they may move and store equipment and supplies between their terminal area and cargo area facilities. Based on 2010–2015 reported cargo volumes, processing rates by the various operators ranged from 0.28 tons of cargo per square foot of GSE space at the Belly Haul Air Cargo Building to 1.56 tons of cargo per square foot of GSE space for GB Airlink. The ACRP Report 143 range for GSE space ratios is equally as diverse, ranging from 0.29 to 2.22 tons of cargo per square foot of GSE space. The target processing rate of 0.57 tons of cargo per square foot of GSE space was selected for the integrated and all-cargo carriers and 0.36 tons of cargo per square foot of GSE space for the belly cargo facilities. This acknowledges historic operational trends and the fact that all the inventoried GSE space may not be used solely for cargo GSE. This also acknowledges the belief that some of the GSE space could be reconfigured or that certain functions could be accommodated elsewhere.

Table 4.10-7 summarizes cargo GSE storage space requirements through the planning horizon. Based on the results, there is sufficient cargo GSE storage space to accommodate the projected cargo volumes.

Table 4.10-7: Air Cargo Ground Support Equipment Storage Requirements

YEAR	TOTAL FORECAST AIR CARGO (TON)	GSE SPACE DEMAND (SQUARE FEET) 1/	TOTAL AVAILABLE GSE SPACE (SQUARE FEET)	SURPLUS (SQUARE FEET)
2015	81,322	160,100	201,000	40,900
2020	86,000	169,300	201,000	31,700
2025	89,000	175,200	201,000	25,800
2030	91,000	179,200	201,000	21,800
2035	92,000	181,200	201,000	19,800
Average Annual Growth Rate: 0.62%				

NOTES: Numbers have been rounded to the nearest 100.

1/ Ground support equipment (GSE) space demand calculated on 0.57 tons of annual enplaned cargo per square foot for integrated and all-cargo carriers and 0.36 tons of annual enplaned cargo per square foot for belly cargo carriers.

SOURCES: Broward County Aviation Department, Air Cargo Records 2010-2015, July 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts*, *Fort Lauderdale-Hollywood International Airport,* June 2016; Airport Cooperative Research Program Report 143, *Guidebook for Air Cargo Facility Planning and Development*, 2015.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.10.8 SUMMARY

Based on the analyses in this section, there are sufficient air cargo facilities at FLL to accommodate the projected cargo volumes. A combined summary of the calculated facility demands is presented in **Table 4.10-8**.

Table 4.10-8: Summary of Air Cargo Facility Requirements (in Square Feet)

	INTEGRATED AND ALL-CARGO WAREHOUSE SPACE		BELLY CARGO WAREHOUSE SPACE		INTEGRATED AND ALL-CARGO APRON SPACE		GROUND SUPPORT EQUIPMENT STORAGE SPACE	
YEAR	DEMAND	SURPLUS	DEMAND	SURPLUS	DEMAND	SURPLUS	DEMAND	SURPLUS
Existing Facilities	101,100		51,310		552,550		201,000	
2015	86,900	14,200	26,600	24,700	321,400	231,200	160,100	40,900
2020	91,900	9,200	28,100	23,200	340,000	212,600	169,300	31,700
2025	95,100	6,000	29,100	22,200	352,000	200,600	175,200	25,800
2030	97,200	3,900	29,800	21,800	359,500	197,100	179,200	21,800
2035	98,200	2,900	30,200	21,100	363,500	189,100	181,200	19,800

SOURCES: Broward County Aviation Department, Air Cargo Records 2010-2015, July 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts*, *Fort Lauderdale-Hollywood International,* June 2016; Airport Cooperative Research Program Report 143, *Guidebook for Air Cargo Facility Planning and Development*, 2015.

PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

This analysis acknowledges there are existing vacant facilities, which could accommodate new or expanded operations or UPS, if it was inclined to move its processing function onto Airport property. Over the planning horizon, specific operator demands may result in the need to adjust leaseholds or to reconfigure facilities. While there is an adequate amount of cargo handling facilities, FedEx has noted that it desires between 20 and 40 additional automobile parking spaces for its employees and customers.

From another perspective, when combined with office space, truck bays, automobile parking, and associated stormwater management facilities, the existing air-cargo facilities at FLL encompass approximately 48 acres of total space. Using a similar methodology of calculating tons of cargo processed per acre of facility from the 2010–2015 BCAD cargo data, the belly cargo facilities processed approximately 4,900 tons per acre, and the integrated and all-cargo facilities processed approximately 2,950 tons per acre. Applying this to the projected cargo volumes indicates the total space requirement to be 25 to 29 acres over the planning horizon.

4.11 Airline and Airport Support Facilities

Airline and Airport support facilities at FLL include the following:

- aviation fuel storage
- ARFF station
- FAA ATCT
- airline flight kitchens
- Airport maintenance and storage
- aircraft maintenance
- airline GSE storage

This section describes the existing facilities and examines their ability to perform their intended functions and meet user demand over the course of the planning horizon. Several sources helped inform these evaluations; some are technical in nature, while others are based on user/tenant/operator input.

4.11.1 AVIATION FUEL STORAGE FACILITIES

Fuel storage facilities at the Airport consist of four above-ground JetA tanks, each with a capacity of 1.15 million gallons, providing a total stored volume of 4.60 million gallons. ASIG is the operator of the fuel farm. According to the *Fuel Storage Facility Assessment and Fuel Demand Analysis*[6] (the 2016 Fuel Facility Assessment), three of the tanks are over 30 years old and the fourth was installed in 2015/2016. This assessment further indicates that much of the piping, transfer, and control systems are also 30 years old and are considered outdated. The age of the

6 Argus Consulting, *Fuel Storage Facility Assessment and Fuel Demand Analysis*, October 21, 2016.

equipment results in inaccurate tank gauging and poor fuel-flow management, as well as requires increasing maintenance and difficult-to-find replacement parts.

The 2016 Fuel Facility Assessment also identifies that the fuel facility maintenance and operations building (Building N-31) is insufficient to meet the function and space requirements for the control room, administrative offices, and laboratory. In addition, it is possible that the building itself does not meet current fire code requirements due to its age. The *Northeast Quadrant Facilities and Access Planning Study*[7] indicates that the fuel farm site has experienced previous hazardous materials contamination and is encumbered by ongoing remediation and monitoring efforts.

Table 4.11-1 details the annual fuel disbursements and peak-month disbursement at FLL from 2011 through 2015 (civil years), as provided by ASIG. The data show that fuel sales have increased an average of 4.9 percent over that 5-year period, and March is the typical peak month.

Table 4.11-1: Historical Fuel Disbursements

YEAR	TOTAL GALLONS	PEAK MONTH (MILLIONS OF GALLONS DISBURSED)
2011	206,996,600	March (21.0)
2012	210,979,900	March (21.5)
2013	213,440,300	March (22.8)
2014	226,401,600	December (24.1)
2015	250,987,800	March (25.2)
Average Annual Growth Rate	4.9%	4.7%
4-Year Growth	21.3%	20.0%

SOURCE: Aircraft Service Group International (ASIG), October 2016.
PREPARED BY: Kimley-Horn & Associates, Inc., February 2017.

The basis for determining adequate fuel storage reserves is based on the IATA, which suggests airports should maintain a 3 to 10-day fuel reserve to sustain efficient operations and to account for fluctuations in aircraft activity, maintenance, and supply interruptions.[8] A study prepared by the ACRP further indicates that for pipeline delivery to an airport, the amount of reserve time can typically be less than that for airports served only by truck delivery.[9] Both the IATA and the ACRP acknowledge the various factors affecting an individual airport's assessment of desired fuel reserves, such as equipment capabilities, inspection and settling time, average and peak demand, and fuel delivery methods.

7 Kimley-Horn and Associates, Inc., *Northeast Quadrant Facilities and Access Planning Study*, March 2016.

8 International Air Transport Association, *Guidance on Airport Fuel Storage Capacity*, 2008.

9 Airport Cooperative Research Program, Synthesis 63, *Overview of Airport Fueling System Operations*, 2015.

Table 4.11-2 presents the average daily fuel demand and the approximate usable days of reserve[10] based on monthly 2015 activity levels and total tank volume. This analysis indicates that the four existing tanks provide an average of 6.7 days of reserve over the course of the year, but only 5.7 days during the peak month. This is relatively consistent with the 2016 Fuel Facility Assessment that calculated an average usable reserve capacity of 6.4 days in 2016.

Table 4.11-2: Average Daily Fuel Demand and Reserve Supply (2015)

MONTH	TOTAL GALLONS DISTRIBUTED	AVERAGE GALLONS/DAY 1/	USABLE DAYS OF RESERVE SUPPLY 2/
January	23,802,079	767,809	6.0
February	21,395,664	764,131	6.0
March (peak month)	25,206,481	813,112	5.7
April	22,759,693	758,646	6.1
May	20,147,101	649,906	7.1
June	19,242,168	641,406	7.2
July	20,121,366	649,076	7.1
August	18,724,146	604,005	7.6
September	15,771,972	525,732	8.7
October	18,299,601	590,310	7.8
November	20,894,798	696,493	6.6
December	24,622,725	794,281	5.8
Total	**250,987,794**	**687,909**	**6.7 (average)**

NOTES:

1/ Average gallons per day is calculated on total calendar days of the month.

2/ Usable supply is based on total physical tank capacity.

SOURCE: Aircraft Service Group International (ASIG), 2016.
PREPARED BY: Kimley-Horn & Associates, Inc., February 2017.

As presented in **Table 4.11-3**, the preferred Accelerated Baseline Forecast of passenger airline and all-cargo aircraft operations projects an increase in fuel demand from approximately 220,000 gallons in 2015 to 374,800 gallons by 2035 at an average annual growth rate of 2.74 percent (growth rates for passenger and all-cargo airline operations combined). Assuming fuel demand will increase at the same rate, by 2035, FLL would experience an average daily fuel demand of 1.17 million gallons and a peak daily demand of 1.39 million gallons. With consideration of the existing 4.6 million-gallon storage capacity, the usable fuel reserve would drop to 3.9 and 3.3 days, respectively.

10 The "usable" days of reserve is based on the total volume of the storage tanks as compared to the "operational" days of reserve, which is based on the typical volume of fuel available at any given time.

Table 4.11-3: Projected Fuel Demand and Usable Days of Reserve

	FORECAST PASSENGER AIRLINE AND ALL-CARGO AIRCRAFT OPERATIONS	AVERAGE DAY		PEAK MONTH AVERAGE DAY	
		PROJECTED DAILY FUEL DEMAND (GALLONS)	USABLE DAYS OF FUEL RESERVE	PROJECTED DAILY FUEL DEMAND (GALLONS)	USABLE DAYS OF FUEL RESERVE
2015	219,896	687,638	6.7	813,112	5.7
2020	292,400	785,700	5.9	929,100	5.0
2025	323,300	897,700	5.1	1,061,600	4.3
2030	353,900	1,025,800	4.5	1,212,900	3.8
2035	374,800	1,172,000	3.9	1,385,900	3.3
Average Annual Growth Rate	2.7%	2.7%		2.7%	

SOURCE: Aircraft Service Group International (ASIG), 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts*, *Fort Lauderdale-Hollywood International,* June 2016.
PREPARED BY: Kimley-Horn and Associates, Inc., March 2017

While the IATA and the ACRP recommend maintaining between 3 and 10 days of usable reserve, a common industry planning standard is 7 days of reserve. Because of the relatively long peak activity season experienced at FLL, the reserve storage goal should be based more towards satisfying the projected peak fuel demand. With consideration of FLL's current reserve capability and the robust aviation fuel pipeline serving it, something less than 7 days may be appropriate. **Table 4.11-4** presents the total number of 1.15-million-gallon storage tanks that would be needed to provide 4, 5, 6, or 7-day usable fuel reserves for both the projected average day and the projected peak-day fuel demand. Under this metric, green cells indicate the storage goal that could be accommodated by the existing tanks; blue cells indicate demand that could be accommodated with one additional 1.15-million-gallon tank; orange cells indicate demand accommodated with a second additional tank; and red cells indicate the need for a third additional tank. This is consistent with the 2016 Fuel Facility Assessment that recommended maintaining at least a 4-day usable reserve, as well as recommended that two additional 1.15-million-gallon tanks be installed over the course of the planning horizon. It should be noted that the fuel storage analysis presented in this MPU is based on planning level methodologies, and the 2016 Fuel Facility Assessment provides a more detailed analysis that takes into consideration additional technical factors related to system mechanisms that are not reflected herein.

With consideration of this analysis and the 2016 Fuel Facility Assessment, the installation of two additional storage tanks, an expanded operations and maintenance building, and replacement/rehabilitation of much of the piping and associated fuel control systems are needed. A total of 6.9 million gallons of JetA storage (i.e. six 1.15 million-gallon tanks) will provide between four and five days of peak month average day reserve supply.

Table 4.11-4: Storage Tank Requirements Based on Various Days of Fuel Reserve

NO. OF DAYS USABLE RESERVE	AVERAGE DAILY DEMAND				PEAK MONTH AVERAGE DAY DEMAND			
	4	5	6	7	4	5	6	7
2015	2.5	3.1	3.7	4.3	2.9	3.6	4.4	5.1
2020	2.8	3.5	4.2	4.9	3.3	4.2	5.0	5.8
2025	3.2	4.0	4.8	5.6	3.8	4.8	5.7	6.7
2030	3.7	4.6	5.5	6.4	4.4	5.4	6.5	7.6
2035	4.2	5.3	6.3	7.4	5.0	6.2	7.5	8.7

NOTE: Green cells indicate the storage goal that could be accommodated by the existing storage tanks; blue cells indicate demand that could be accommodated with one additional 1.15-million-gallon tank; orange cells indicate demand accommodated with a second additional tank; and red cells indicate the need for a third additional tank.

SOURCES: Aircraft Service Group International (ASIG), 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts, Fort Lauderdale-Hollywood International Airport*, June 2016.

PREPARED BY: Kimley-Horn & Associates, Inc., April 2017.

4.11.2 AIRCRAFT RESCUE AND FIRE FIGHTING FACILITIES

The existing ARFF station is operated by the Broward Sherriff's Office Fire Rescue Service and is located midfield, east of Taxiway Q. This location is consistent with the FAA ARFF siting criteria that include: providing immediate access to the airfield, ensuring non-interference with the ATCT's line of sight, adhering to the building restriction line (BRL), and meeting requirements for emergency response time. As detailed in Title 14 Code of Federal Regulations Part 139 (14 CFR Part 139), the first ARFF response vehicle must be able to maneuver to the midpoint of any runway within 3 minutes.

4.11.2.1 Aircraft Rescue and Fire Fighting Index

The existing 10-bay ARFF station was constructed in 2004. It is approximately 20,400 square feet in size, and it is considered in good condition. The station accommodates an average of 11 to 13 employees at any given time. The station also maintains six-passenger trucks, one fire truck, a medical transport vehicle, and three crash response trucks. The facility and equipment meet the requirements of 14 CFR Part 139 for "Index D" operations. The index determination is based on the length of the longest air carrier aircraft performing five average daily departures at the Airport. Index D represents an aircraft length of 159 feet or greater but less than 200 feet.

Table 4.11-5 summarizes projected average daily departures by fleet mix, as well as corresponding aircraft types and ARFF indices for FLL. The index determination is based on the length of the longest air carrier aircraft performing five average daily departures at the Airport. Index D is the current (2015) ARFF Index at FLL, based on the A330-200, B787-800, DC10, and A300-600 aircraft average number of daily departures (green box).

Table 4.11-5: Aircraft Fleet Mix and Aircraft Rescue and Firefighting Index Projections

		REGIONAL JETS	SMALL NARROWBODY	LARGE NARROWBODY	SMALL WIDEBODY	LARGE WIDEBODY
AVERAGE DAILY DEPARTURES						
	2015	4	105	163	5	0
	2020	3	16	249	7	0
	2025	2	95	312	8	0
	2035	2	63	405	18	0
ARFF INDEX	AIRCRAFT LENGTH	REGIONAL JETS	SMALL NARROWBODY	LARGE NARROWBODY	SMALL WIDEBODY	LARGE WIDEBODY
A	< 90'	CRJ 100/200 (88')				
B	90' – < 126'	CRJ 700 (106') CRJ 900 (119')	A319 (111') A320 (123') B717 (124') B737-700 (110')			
C	126' – < 159'	CRJ 1000 (129')		A321 (146') B737-800 (130') B737-900 (138') B757-200 (155')		
D	159' – < 200'				A330-200 (192') B787-800 (186') DC10 (171') A300-600 (177')	
E	≥ 200'				B787-900 (206')	A380-800 (239') B747-800 (250')

NOTES:

ARFF = Aircraft Rescue and Firefighting

Blue text indicates cargo aircraft. The aircraft length is provided in parentheses after each aircraft type.

SOURCES: Federal Aviation Administration, Advisory Circular 150/5300-13, *Airport Design*, Change 1, February 2016; Ricondo & Associates, Inc., *Airport Master Plan Update Aviation Activity Forecasts, Fort Lauderdale-Hollywood International Airport*, June 2016.

PREPARED BY: Kimley-Horn & Associates, Inc., February 2017.

As of 2016, Norwegian Air Shuttle operates the B787-800 (Index D) into FLL, but it is in the process of upgrading to the B787-900. This aircraft has a wingspan of 206 feet and is therefore considered an Index E aircraft. Currently, this size of aircraft (Index E) does not operate five average annual daily departures at FLL. However, industry trends are seeing more of the B787-900 aircraft entering the fleet. According to Boeing, airlines are trending away from the larger widebody passenger aircraft and replacing them with smaller widebody aircraft, such as the B787, B777, and B747-8.[11] From 1995 to 2015, the percent of large widebody aircraft in the fleet has decreased from 36 percent to 11 percent, and it is forecast to decrease to 5 percent by 2035. As more of these aircraft enter the fleet, FLL may experience the need to increase its ARFF capabilities to Index E.

11 Boeing, Long-Term Market, http://www.boeing.com/commercial/market/long-term-market/traffic-and-market-outlook/ (accessed December 2016).

4.11.2.2 Equipment and Extinguishing Agents

The basic equipment and extinguishing agent requirements of an Index D ARFF facility is three crash response trucks with:

- one vehicle carrying extinguishing agents of either 500 pounds of sodium-based dry chemical, halon 1211, or cleaning agent or 450 pounds of potassium-based dry chemical and water with a commensurate quantity of aqueous film forming foam (AFFF) to total 100 gallons for simultaneous dry chemical and AFFF application;
- two vehicles carrying an amount of water and the commensurate quantity of AFFF so that the total quantity of water for foam production carried by all three vehicles is at least 4,000 gallons.

Increasing to Index E would require crash response vehicles to carry a greater amount of extinguishing agent. ARFF personnel at FLL have indicated the equipment can meet the Index E requirements; however, additional agent storage space within the facility would be needed.

4.11.2.3 Building

ARFF leadership has also indicated that the existing facility is undersized for the number of personnel working there and for equipment storage. It is estimated that an additional 6,700 square feet of building space would be adequate for future ARFF needs. This includes an increase in the number of bays from 10 to 14 to accommodate all vehicles at the facility.

It is understood that ARFF and BCAD staff have started to consider the possibility of a relocated ARFF station or the development of both a west side and east side ARFF station to maintain response times, especially if a future expansion of Terminal 3 might require the displacement of the existing ARFF station.

4.11.3 FEDERAL AVIATION ADMINISTRATION FACILITIES AND EQUIPMENT

The primary FAA ATC facilities at FLL include the ATCT, two sets of remote transmitter/receiver (RTR) antennas, and an airport surveillance radar (ASR).

4.11.3.1 Airport Traffic Control Tower

The ATCT includes a 1.74-acre site that has two administration buildings, totaling 8,700 square feet and including 60 automobile parking spaces. The ATCT is 177.4 feet in height and has a 163-foot-cab eye-sight elevation. The current tower does not provide adequate line-of-sight to the Runway 28L end. BCAD and the FAA performed a Preliminary Tower Siting Analysis in 2015, which proposed a new tower location that would increase allowable tower height and, in turn, cab eye-sight elevation. The proposed location would allow for a tower height of 231 feet and a cab eye-sight elevation of 211 feet. According to the siting study, the ATCT height would be controlled by the Runway 10L required navigation performance (RNP) missed approach surface. The proposed site is slightly further to the north and west of the existing site, at the northwest corner of the intersection of SW 41st Court and SW 12th Terrace. The proposed site at FLL has currently undeveloped space that could accommodate an expansion of the ATCT facilities compared to existing facilities. The ATCT siting study has not progressed; however, should it move forward again, any facility design would need to be in accordance with FAA Order 6480.4A, *Airport Traffic Control Tower Siting*

Process, and FAA Order 6480.7E, *Airport Traffic Control Tower and Terminal Radar Approach Control Facility Design Guidelines*, which includes standard design parameters for the ATCT, administration buildings, and office sizes.

Previous versions of FAA AC 150/5300-13, *Airport Design*, have indicated that typical ATC sites range from 1 to 4 acres depending on the level of tower activity. Based on the previous version of Order 6480.7, Version D, which was cancelled in 2009, the ATCT at FLL would be considered a "major activity" facility. General site considerations prescribed by the FAA focus on providing adequate visibility and line-of-site to the approach and movement areas of the Airport. Consideration is also given to the tower not becoming an airspace obstruction or impacting existing and future approach/departure procedures. Facility sizing and site concerns include: access and security; availability of automobile parking; the number of tower personnel to be accommodated; expansion potential and the flexibility to accommodate changing technology and new equipment; available utilities; adjacent development and land uses; cost-effective development and construction methods; and environmental compatibility.

4.11.3.2 Remote Transmitter/Receiver

The RTR antennas are sensitive to their surroundings, as nearby infrastructure has the potential to affect the radio signals, thereby compromising the RTR's utility and the level of operational safety. Any future development near the RTR facilities must take into consideration potential effects to the electronic signal. No deficiencies in the existing RTR have been noted; however, future development may require relocation of the RTR antennas.

4.11.3.3 Airport Surveillance Radar

The ASR is sensitive to its surroundings, as nearby infrastructure has the potential to affect the radar signals, thereby compromising its utility and the level of operational safety. Any future development near the ASR facilities must take into consideration potential effects to the electronic signal. No deficiencies in the ASR have been noted.

4.11.4 AIRLINE FLIGHT KITCHENS

There are currently two flight kitchens that service the airlines operating at FLL: LSG Sky Chefs and Gate Gourmet. LSG Sky Chefs maintains a total of 17,500 square feet of leased space in Buildings N-19W and N-14 of the Aero Lauderdale complex. This space is used predominately to support concession-type food and snack contracts with the airlines. For airlines requiring full meal service at FLL, LSG Sky Chefs maintains an offsite meal preparation facility located in Miami that delivers the meals to FLL via truck.

LSG Sky Chefs management has indicated that if the flight kitchen were to locate its concessions and meal preparation facilities at FLL, it would need approximately 30,000 square feet of space to accommodate current contracts and airline activity levels. Based on the passenger enplanements projected in the Accelerated Baseline Forecast, by 2035 the amount of space required by LSG Sky Chefs would increase to approximately 50,000 square feet.

Gate Gourmet is located off Airport property and is estimated to have between 14,000 and 30,000 square feet of space. The flight kitchen's exact facilities and operational needs are unconfirmed, but it is assumed that the requirements would be similar to those of LSG Sky Chefs if it were to relocate onto FLL property.

4.11.5 AIRCRAFT MAINTENANCE

Of the four FBOs currently at FLL, National Jets and Jetscape provide GA maintenance services at their facilities, while the other two may provide limited service through third-party providers. During tenant interviews, FBO personnel did not express any inclination to expand their aircraft maintenance operations. As a result, no expansion was assumed for FBO maintenance areas.

Bombardier Business Aircraft Service Center and Embraer Aircraft Holdings, Inc. both provide sales, customer support, and maintenance services for their respective lines of executive jet aircraft. Maintenance activity at the Bombardier and Embraer facilities is not tied to operational aircraft demand at the Airport. As a result, no expansion was assumed for these facilities, and it was further assumed that both facilities will remain in their current location.

While Bombardier, Embraer, and the FBOs provide various maintenance services for GA aircraft at FLL, there are currently no maintenance, repair, and overhaul (MRO) facilities for commercial aircraft on Airport property. Should future demand or opportunity arise to develop a commercial aircraft MRO facility at FLL, a benchmarking analysis of several existing MRO facilities was conducted to determine how much space might be required. The sizing analysis took into consideration hangar space, apron area, automobile parking, equipment and parts storage, truck loading, and engine run-up areas.

Table 4.11-6 lists the MRO facilities that were analyzed. These facilities include sites ranging from 5 to 31 acres depending on the LOS provided and the types of aircraft serviced. Generally, the larger the facility, the larger the aircraft. For example, the TIMCO Aviation Services facility at Cincinnati/Northern Kentucky International Airport (CVG) is approximately 5 acres in size and accommodates mostly regional jet aircraft. The 31-acre American Airlines MRO facility at Charlotte Douglas International Airport (CLT), which was previously a US Airways MRO, accommodates many of American Airlines' fleet, including narrowbody and widebody aircraft. For comparison, though, the Cessna Citation maintenance base at Wichita Mid-Continent Airport (ICT) is 24 acres in size, which is larger than the 15-acre Embraer and 9-acre Bombardier sites at FLL. Based on a review of these various facilities, it is believed that a reasonable planning level assumption for a potential MRO facility at FLL would be between 10 and 15 acres.

Table 4.11-6: Maintenance, Repair, and Overhaul Facility Benchmarking Analysis

AIRPORT	OPERATOR	FACILITY SIZE (INCLUSIVE OF RAMP AND VEHICULAR PARKING AREAS)
Cincinnati/Northern Kentucky International Airport (CVG)	TIMCO Aviation Services	5 acres
McGhee Tyson Airport (TYS)	Express Jet	6 acres
Orlando International Airport (MCO)	JetBlue	8 acres
Orlando International Airport (MCO)	United Airlines	11 acres
Lambert-St Louis International Airport (STL)	American Airlines	11 Acres
Seattle-Tacoma International Airport (SEA)	Alaska Airlines	13 acres
Phoenix Sky Harbor International Airport (PHX)	Southwest Airlines	14 acres
Phoenix Sky Harbor International Airport (PHX)	American Airlines (previously US Airways)	24 acres
Salt Lake City International Airport (SLC)	Delta Air Lines	15 acres
Tampa International Airport (TPA)	PEMCO World Air Services (formerly Delta and US Air facilities)	16 acres (north side of run-up area) 16 acres (south side of run-up area)
Piedmont Triad International Airport (GSO)	HAECO Americas	17 acres
Wichita Mid-Continent Airport (ICT)	Cessna Citation Maintenance Base	24 acres
Dallas Love Field Airport (DAL)	Southwest Airlines	26 acres
Charlotte Douglas International Airport (CLT)	American Airlines (previously US Airways)	31 acres

SOURCES: GoogleEarth, November 2016;
PREPARED BY: Kimley-Horn & Associates, Inc., March 2017.

4.11.6 AIRPORT MAINTENANCE AND EQUIPMENT STORAGE

As outlined in **Table 4.11-7**, facilities supporting the maintenance of Airport property and infrastructure include an administration building, multiple warehouse/storage buildings, machine and equipment repair shops, outdoor storage areas, and a solid waste facility. The primary maintenance facility (Building N-28), constructed in 2014 and 2015, is located adjacent to the west side of the fuel farm. The facility includes 63,900 square feet of warehouse and shop space over two floors, as well as 55,600 square feet of automobile parking on the roof of the facility and on the ground. According to BCAD staff, the building does not have sufficient space for an HVAC shop, and as such, those personnel and equipment are currently located in one of the terminal buildings, resulting in inefficient operations. Therefore, an approximate 4,000-square foot shop collocated with other maintenance activities is recommended. While the maintenance division anticipates adding staff over the planning horizon, existing administrative and office space are believed to be adequate. Employee parking, however, is already insufficient for current staffing levels, especially during shift change. With 150 existing spaces, an additional 30 to 40 spaces will be needed in the near term, with incremental increases likely being needed later in the planning horizon. It should be noted that the space below Interstate 595 and adjacent to the main maintenance building is used for storage and staging of maintenance equipment and supplies and is not available for employee parking.

Table 4.11-7: Airport Maintenance and Equipment Storage Requirements (square feet)

		REQUIREMENTS			
	EXISTING AREA	2020	2025	2030	2035
Shop Space	57,730 1/	61,730 2/	61,730	61,730	61,730
Warehouse/Storage	64,870 3/	74,870 4/	74,870	82,360	82,360
Outdoor Storage/Layout Area	67,000 5/	67,000	73,700	73,700	77,385
Employee Parking (spaces)	55,600 (150) 6/	70,400 (190)	70,400 (190)	74,100 (200)	81,500 (220)
Admin/Office Space	40,000	40,000	40,000	40,000	40,000
Waste & Recycling Facility	10,900 7/	10,900	132,000 8/	132,000	132,000
Landscape Debris Storage	87,120 9/	87,120 9/	87,120 9/	87,120 9/	87,120 9/
Total	**383,220**	**412,020**	**539,820**	**551,010**	**562,095**

NOTE:

1/ Includes estimated shop space in new maintenance facility (Building N-28).

2/ Approximately 3,800 sq. ft. of shop space and associated 200 sq. ft. of office space is needed for HVAC personnel and equipment which are currently in various locations in the terminal buildings

3/ Includes new maintenance facility (Bldg. N-28) with 6,170sq. ft.., the G&G Building (Building. E-29) with 41,800 sq. ft.., the old maintenance building/paint shop (Building. N-33) with an estimated 3,900 sq. ft.., and the airport security building (Building.N-35) with an estimated 13,000 sq. ft..

4/ Approximately 10,000 sq. ft. of additional space is needed, however Building. E-29 is also in need of major repair or replacement.

5/ Includes areas beneath I-595 (26,000 sq. ft.), by the solid waste facility (13,000), and the G&G Building (Building E-29, 28,000)

6/ Includes marked roof and ground spaces of new maintenance facility (Building. N-28), does not include any space under I-595 as that is used for material storage/layup area

7/ Includes Building N-32 and associated paved lot

8/ Development of a full mixed-waste stream material recovery facility (MRF), or "dirty MRF", would include a 45,000 sq. ft. sort facility and adjacent ±2.0 acre storage lot.

9/ Approximately 87,000 square feet (2 acres) of outside storage area is required for landscape debris. BCAD Maintenance confirmed this area would accommodate the long-term needs for landscape debris storage.

SOURCES: Broward County Aviation Department, *Fort Lauderdale-Hollywood International Airport, Airport Layout Plan*, February 2011; Broward County Aviation Department Maintenance Division staff interviews June 2017.
PREPARED BY: Kimley-Horn & Associates, Inc., June 2017.

Maintenance equipment and supplies are stored in multiple buildings, including the G&G Building (Building E-29) located in the Runway 28L Runway Protection Zone (RPZ), the old maintenance building/paint shop (Building N-33) located near the fuel farm, and the recently converted airport security building (Building N-35). The G&G Building's location inside the RPZ restricts its use to storage and the building cannot be occupied by personnel. Additionally, it does not have fire sprinklers and needs repair. Overall, BCAD personnel indicate that an additional 10,000 square feet of storage/warehouse space is needed to satisfy current and near-term needs.

Outdoor equipment and material storage areas include the space beneath Interstate 595 and adjacent to the new maintenance building, a fenced yard near the solid waste handling facility (Building N-32), and the paved area around the G&G Building. To accommodate anticipated equipment acquisitions, approximately 15 percent of additional space will likely be needed over the planning horizon.

The BCAD maintenance division maintains and operates a solid waste handling facility near the fuel farm. Prior to 2015, solid waste and recycling was handled by a third-party contractor. Staff considers the current operation somewhat inefficient and costly to operate. Staff have also indicated an interest in developing a single-stream, solid waste materials reclamation facility (MRF). This type of facility accommodates the separation of comingled waste and recyclables, and, for an airport the size of FLL, would require an approximate 45,000-square foot sorting building with an adjacent two-acre storage yard.

In addition to the outdoor equipment and storage area, BCAD Maintenance utilizes approximately 2 acres of outdoor storage for landscape debris. This utilization rate of this area fluctuates throughout the year but is fully utilized after storm events. BCAD Maintenance confirmed that protecting for 2-acres of landscape debris was appropriate and would meet their long-term needs.

4.11.7 GROUND SUPPORT EQUIPMENT STORAGE AND MAINTENANCE

In addition to the cargo GSE facilities evaluated previously, Aero Lauderdale and Airside Fort Lauderdale (leaseholder of the LYNXS Cargoport) sublease shop and storage space to other GSE service providers. Their tenants include Air General and TUG Technologies. Both organizations provide GSE maintenance for passenger and air cargo operators at FLL. Most of their GSE equipment is stored by the aircraft gates on the terminal area. TUG Technologies has indicated that the warehouse it currently occupies does not meet its operational needs, and it will likely seek to occupy a maintenance-specific warehouse or facility at the Airport in the future. As described previously, several of the airlines at FLL have leaseholds within the Aero Lauderdale complex and/or the belly cargo building. Most of these airlines flex the use of their space to perform light maintenance and store GSE equipment and other supplies, as needed.

4.11.8 AIRPORT ADMINISTRATION

BCAD is in the process of consolidating its administration offices in Terminal 4; these new offices will meet administrative space requirements through 2035.

4.11.9 AIRPORT POLICE AND SECURITY

Airport police and security functions include:

- **BCAD Airport Security**—located in the former Airport maintenance facility (Building N-35), which houses executive staff and the 24/7 Airport Security Operations staff, as well as in Terminal 3, on the departures level, which houses the Emergency Operations Center (EOC).
- **Credentialing Offices**—located in trailers south of Hibiscus Garage.
- **Broward Sheriff's Offices (BSO)** —located in Terminal 2 (ramp level) and in Terminal 3 (bag claim level).

BCAD expressed interest in consolidating these functions into one location, such as a Public Safety Building. Future building requirements were based on a BCAD study that evaluated existing building area (October 2013) and developed corresponding building requirements. A 20 percent drainage contigency was added, and each parking stall was assumed to be 350 square feet.

Table 4.11-8 summarizes existing and future (2035) area requirements. Total required area for a consolidated Public Safety Building was estimated to be 74,300 square feet (1.7 acres).

Table 4.11-8: Public Safety Building Requirements

	EXISTING (OCTOBER 2013)	FUTURE REQUIREMENTS (2035)						
	BUILDING AREA (SQ FT)	BUILDIN G AREA (SQ FT)	EMPLOYEE PARKING (STALLS)	VISITORS PARKING (STALLS)	TOTAL PARKING (STALLS)	TOTAL PARKING (SQ FT)	DRAINAGE (20%)	TOTAL AREA REQUIRED (SQ FT)
Airport Security	1,017	3,100	16	0	16	5,600	1,700	10,400
Credentialing	4,570	5,100	22	40	62	21,700	5,400	32,200
BSO	4,280	6,600	28	0	28	9,800	3,300	19,700
Shared Spaces (Airport Security and BSO)	991 1/	8,900 2/	3	-	3	1,100	2,000	12,000
Total	10,858	23,700	69	40	109	38,200	12,400	74,300

NOTES:

BSO = Broward Sheriff's Office

1/ Only includes Emergency Operations Center (EOC).

2/ Includes EOC, employee areas (sleeping quarters, kitchen, workout area, showers, library), visitors area, conference room, cleaners area, mail room, storage room, server room, car wash area, and motorcycle parking.

SOURCES: Broward County Aviation Department, Public Safety Facility (Programming Report - Final), October 2013; Broward County Aviation Department, Broward County Municode, May 2016.

PREPARED BY: Ricondo & Associates, Inc., May 2016.

4.11.9.1 Public Safety Relocation Scenarios

Several relocation scenarios were considered based on whether all public safety functions would be centralized (consolidated on a single site) or decentralized (primary and remote facilities):

- Scenario 1: BCAD Security administration, BCAD Credentialing/Badging Offices, and BSO will be consolidated in one facility.
- Scenario 2: BCAD Security administration and BCAD Credentialing/Badging Offices will be consolidated in one facility. BSO will remain at its current location or relocate to its own facility.
- Scenario 3: BCAD Security administration and BSO Offices will be consolidated in one facility. BCAD Credentialing/Badging Offices will relocate to its own facility.
- Scenario 4: BCAD Security administration and BCAD Credentialing/Badging Offices will be separated; BSO will remain at its current location or relocate to its own facility.

Table 4.11-9 summarizes the requirements specific to each scenario.

Table 4.11-9: Future Requirements per Scenario

	SCENARIO 1: (FULL CONSOLIDATION - WITH BSO	SCENARIO 2: (FULL CONSOLIDATION -WITHOUT BSO)	SCENARIO 3: (DECENTRALIZED - WITH BSO)	SCENARIO 4: (DECENTRALIZED - WITHOUT BSO)
PRIMARY FACILITY				
Airport Security	10,400	10,400	10,400	10,400
Credentialing	32,200	32,200	-	-
BSO	19,700	-	19,700	-
Shared Spaces	12,000	12,000	12,000	12,000
Total (Square Feet)	74,300	54,600	42,100	22,400
Total (Acres)	**1.70 Acres**	**1.25 Acres**	**0.95 Acres**	**0.50 Acres**
REMOTE CREDENTIALING FACILITY	-	-		
Total (Square Feet)			32,200	32,200
Total (Acres)			0.75 Acres	0.75 Acres
GRAND TOTAL	1.70 Acres	1.25 Acres	1.70 Acres	1.25 Acres

NOTE:

BSO = Broward Sheriff's Office

SOURCES: Broward County Aviation Department, Public Safety Facility (Programming Report - Final), October 2013; Broward County Aviation Department, Broward County Municode, May 2016.

PREPARED BY: Ricondo & Associates, Inc., May 2016.

The site size for a centralized facility ranges from approximately 1.25 acres to 1.70 acres. The decentralized site size ranges from 0.50 acres to 0.95 acres (BCAD Airport Security) and 0.75 acres (Credentialing Office).

Additional considerations when selecting a potential site include:

- BCAD Airport Security must provide easy access to the airfield.
- The Credentialing Office must retain public access.
- The site should avoid drainage areas, existing leasehold areas (termination clauses and expiration dates), and preclusion to AOA and RPZs.

4.11.9.2 Centralized Receiving and Distribution Facility

The TSA has requested that BCAD establish a central warehouse and distribution facility for concessions. In a centralized facility, all concessions would be directed to one facility for security screening and distribution. Based on facilities provided at other similar-sized airports, it is estimated that the Centralized Receiving and Distribution Facility would have a gross area of approximately 25,000 to 30,000 square feet. It would need to be located adjacent to the AOA perimeter with loading dock access on both the airside and landside. The overall site, including vehicular parking and truck docks, would have a gross area of 1.5 to 2.0 acres.

4.12 Summary of Facility Requirements

Airport-wide capacity or space requirements by 2035 are summarized herein:

- Airfield facilities: none
- Terminal facilities:
  - 19 additional aircraft parking gates required
  - Terminal 1: additional 179,000 sq. ft. of building space
  - Terminal 2: additional 17,000 sq. ft. of building space
  - Terminal 3: additional 144,500 sq. ft. of building space
  - Terminal 4: additional 133,800 sq. ft. of building space
- Terminal roadways: additional curbfront capacity required for:
  - Terminal 1 lower and on upper level.
  - Terminal 3 lower level.
  - Terminal 4 lower level.
- Nonterminal roadways:
  - The exit roadways capacities will continue to deteriorate in the future.
  - The exit segment from FLL towards the I-595 on-ramps shows LOS E in 2025 and on.
  - The I-595 Southbound off-ramp shows LOS E in 2025 and on.
- Regional (off-airport) roadways: LOS F on U.S. 1 south of the airport.
- Automobile parking facilities: additional 9,000 sq. ft. of space
- Rental car facilities: additional 1,159,400 sq. ft of space
- FBO and GA facilities:
  - additional 63,600 sq. ft. of hangar space
  - additional 154,000 sq. ft. of auto parking
  - additional 75,000 sq. ft. of CBP apron
- Air cargo facilities: none
- Airline and airport support facilities:
  - Fuel farm:
    - two additional storage tanks

- expanded operations and maintenance building
- replacement/rehabilitation of much of the piping and associated fuel control systems

– ARFF: additional 6,700 sq. ft. of building space

– ATCT: relocated to new site

– Flight kitchens: new/additional 30,000 or 100,000 sq. ft. of building space

– Aircraft maintenance: new site on 0 to 15 acres

– Airport maintenance: additional 179,000 sq. ft. of building space

– Ground support equipment: none

– Airport administration: none

– Airport police and security:

- Public safety facilities: new/additional facilities on 1.25 to 1.7 acres
- Centralized receiving and distribution facility: new facility on 1.5 to 2.0 acres

THIS PAGE INTENTIONALLY LEFT BLANK