Airport Master Plan

Bradley International Airport

FINAL REPORT

March 2019

Prepared for:

CAA™
CONNECTICUT AIRPORT AUTHORITY

BRADLEY
INTERNATIONAL

Prepared by:

CHA
design/construction solutions

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1 INTRODUCTION

The Connecticut Airport Authority ('CAA') has retained Clough Harbor & Associates, LLP. ('CHA') and a team of sub-consultants to prepare a Master Plan and Airport Layout Plan Update for the Bradley International Airport ('BDL' or 'the Airport'). The sub-consultant team includes Advanced Reprographics; Aerotech International Corp.; Campbell-Hill Aviation Group, LLC; Desman Associates; DKMG Consulting, LLC; Fitzgerald & Halliday, Inc.; Gensler Associates; Jones Lang LaSalle, Inc.; and Quantum Spatial, Inc.

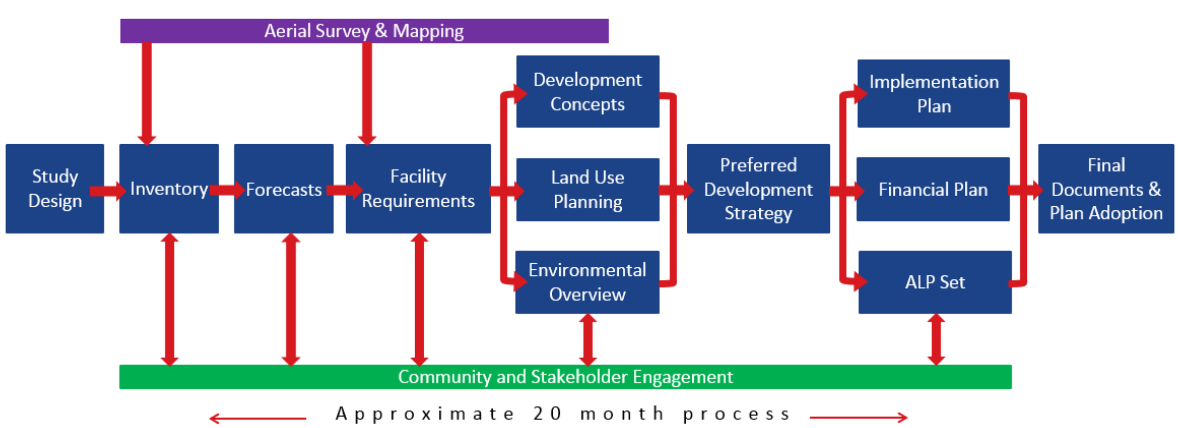
This introductory chapter provides a description of the project and a background overview of the Airport. Additional information about the Airport can be found on its website at www.bradleyairport.com. The site has destination and flight information, Airport maps, driving directions, and ground transportation and parking information. News and materials related to the Master Plan Update will be made available to the public on the at www.bradley-planning.com.

Contents of the full report include:

1.1 PROJECT DESCRIPTION

Airport master planning is a systematic process that evaluates existing facility and market conditions, identifies anticipated stakeholder needs, and formulates both near- and long-term development strategies. The results of the Master Plan Update will provide the guidance necessary for CAA to address the need for, and improvements of airport facilities and land development considerations for the next 20 years and beyond. This technical document, along with the associated Airport Layout Plan (ALP) set, will serve as a strategic development tool for the ongoing improvement of airport facilities. The process, methods and ultimate products are guided by Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B, *Airport Master Plans*. Consistent with this guidance, the process followed for preparing the BDL Master Plan Update is outlined in **Figure 1-1**.

Figure 1-1 – Master Planning Process



1.1.1 Purpose and Objectives

The purpose of this study is to provide long-term guidance for continued airport improvements necessary to satisfy projected aviation demand in a logical and financially-feasible manner. Consistent with this purpose, the following objectives were established for the Master Plan Update:

- Provide a framework that allows the Airport to meet the long-term air transportation needs of the region in a safe, secure, and efficient manner, while complying with all FAA and Transportation Security Administration (TSA) requirements.
- Document changes in the aviation industry to prepare BDL for future challenges and maintain a competitive market advantage.
- Ensure that the airfield meets the latest FAA design standards, while mitigating the risk of incident at high-traffic intersections and FAA-designated 'hot spots'.
- Identify the facilities necessary to accommodate all airport users and stakeholders, and meet future aviation demands.
- Develop a strategic, flexible, and cost effective improvement plan that enhances passenger convenience and increases airline efficiency.
- Identify appropriate and best uses of land on Airport property for both aeronautical and non-aeronautical development.
- Ensure that development plans can be pursued in a safe, secure, and efficient manner and are in compliance with all FAA and Transportation Security Administration (TSA) requirements.
- Ensure that the recommended improvements are financially feasible and maximize eligibility of FAA and CAA funding programs.
- Actively engage the public throughout the planning process.

In addition to addressing these objectives, this Master Plan Update will also fulfill the broad master planning goals set forth by the FAA in AC 150/5070-6B *Airport Master Plans*. These goals are:

- Document issues that the proposed development will address.
- Justify the proposed development through the technical, economic and environmental investigation of concepts and alternatives.
- Provide an effective graphic presentation of the development of the Airport and anticipated land uses in the vicinity.
- Establish a realistic schedule for implementing the development proposed in the Master Plan Update, particularly the short-term capital improvement program.
- Propose an achievable financial plan to support the implementation schedule.
- Provide sufficient project definition and detail for subsequent environmental evaluations that may be required before the project is approved.
- Present a plan that adequately addresses the issues and satisfies local, state, and federal regulations.
- Document policies and future aeronautical demand to support municipal or local deliberations on spending, debt, land use controls, and other policies necessary to preserve the integrity of the Airport and its surroundings.
- Set the stage and establish the framework for a continuing planning process. Such a process should monitor key conditions and permit changes in plan recommendations as required.

1.1.2 Public Involvement Program

Public involvement is an integral part of any significant airport planning study. It encourages information sharing and collaboration among the community and the airport stakeholders that hold a collective interest in the outcome of the study. Stakeholders include the airport sponsor, airlines, tenants, users and travelers, local businesses and residents, resource agencies, elected and appointed public officials, and the general public. With such a diverse stakeholder group, it is important to use a variety of forums such as committees, public involvement meetings, and public awareness campaigns to enhance the program's effectiveness.

For this Master Plan Update, a Technical Advisory Committee (TAC) has been established, consisting of technical level representatives of CAA, airlines, FAA, TSA, local jurisdictions, Army National Guard, Connecticut Air National Guard, Customs and Border Patrol (CBP), fixed-base operators (FBOs), cargo operators, aircraft operators, and service providers. The TAC provides input and insight on technical issues, and will meet up to six times during the course of the program, as part of a coordinated series of meetings at key decision points in the study process. TAC members will also review working papers at various milestones throughout the course of the project to ensure that all relevant issues were adequately addressed.

In addition to the TAC, other forms of public involvement will include public meetings/workshops and briefings to public officials or special interest groups. The public information meetings will provide the opportunity to engage the public about the Airport and Master Plan Update. These meetings are conducted in an "open house" format with interactive information stations staffed by airport personnel and the consultant team. Other briefings are organized with key agencies, stakeholders, or public officials as needed on topics that are of special interest to that group.

Table 1-1 lists each of the key public involvement meetings carried out, and planned, during the process, to date.

Table 1-1 – Public Involvement Meetings

Meeting	Date
Project Kickoff Meeting	8-17-2016
TAC Meeting #1 (Introduction and Inventory)	10-14-2016
TAC Meeting #2 (Forecasts)	4-26-2017
TAC Meeting #3	8-23-2017
Public Information Meeting #1	9-12-2017
TAC Meeting #4	12-5-2017
TAC Meeting #5	3-28-2018
Public Information Meeting #2	3-28-2018

1.2 AIRPORT BACKGROUND

Understanding the background of an airport and the region it serves is essential in making informed decisions pertaining to airport-related improvements. This section discusses Bradley International Airport in the context of its location, service area, history, and role in the overall aviation system.

1.2.1 Location and Service Area

Bradley International Airport comprises approximately 2,000 acres of property in north central Connecticut. While primarily located in the Town of Windsor Locks (Hartford County), portions of the Airport extend into the Towns of East Granby, Windsor, and Suffield. The Airport is within 20 nautical miles (nm) of both Hartford and Springfield, 40 nm of New Haven, and 60 nm of Bridgeport, and is directly accessible via Interstate 91, providing access south to Hartford and north to Springfield. BDL is roughly 100 nm southwest of Boston Logan International Airport, 100 nm southeast of Albany International Airport and 110 nm northeast of JFK and LaGuardia Airports in New York City.

Bradley International Airport is located in the Hartford-West/Hartford-East/Hartford, CT metropolitan statistical area (MSA). The Hartford MSA has a population of approximately 1.2 million people and is comprised of Hartford County, Tolland County, and Middlesex County, Connecticut. It includes the cities of Hartford, New Britain, Bristol, Manchester, Middletown, and Meridian. A 2015 drive-time/market analysis reveals that approximately 2.7 million people live within a 60-minute drive of the Airport, and approximately 4.4 million people live within the full service area, which was determined by drive times and the proximity to other commercial service airports. As the second busiest airport in New England (after Boston-Logan), the service area extends beyond the Hartford MSA, into Springfield and western Massachusetts and much of the remaining State of Connecticut.

The general location and vicinity of the Airport are depicted in **Figure 1-2** and **Figure 1-3**.

Figure 1-2
Location Map

BRADLEY INTERNATIONAL

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Figure 1-3
Vicinity Map

1.2.2 History

BDL Timeline of Key Events

1940 – Land acquired by state

1941 – Airport operations begin

1947 – Commercial airline service begins

1961 – Airport officially named Bradley International Airport

1971 – Murphy Terminal Expansion (Terminal B), International Arrivals Wing open

1986 – Terminal A and Bradley Sheraton Hotel open

2002 – New International Arrivals Building opens, Terminal A expanded

2011 – The CAA is established

2013 – Murphy Terminal is demolished

2016 – International European service commences

In 1940, the State of Connecticut acquired 2,000 acres of land primarily in the Town of Windsor Locks, which ultimately would become Bradley International Airport. The following year, the land was transferred to the United States Army and the airfield was used for training pilots during World War 2. The airfield was named for Lieutenant Eugene M. Bradley who was killed during a training exercise in 1941. Following the war, scheduled passenger service was relocated to BDL from the downtown-located Hartford-Brainard Airport. The State reclaimed the Airport from the federal government the following year, as operations began to expand.

The first terminal facility (later named the Murphy Terminal) went into service in 1952 to support the Airport's growing demand. The following two decades ushered in a period of rapid growth and modernization for the Airport. In 1977, the Airport's Instrument Landing System went into operation on two runways. The current passenger terminal (Terminal A) and the Bradley Sheraton Hotel opened together in 1986. Following a 1993 Master Plan Study, Terminal A was expanded and modernized by 2002, along with the addition of the current International Arrivals Building. Following the 2005 Master Plan Update, the original Murphy Terminal was demolished with operations being centralized in Terminal A. Today, BDL is home to a variety of activities including domestic and international passenger service, air cargo operations, military units, aircraft maintenance providers, and other general aviation activities.

The former Murphy Terminal (Terminal B)

1.2.3 Airport Role

In addition to connecting Connecticut and the Southern New England region to the global transportation network, the Airport plays a significant role in the nation's air travel system. The National Plan of Integrated Airports System (NPIAS) is a program maintained by the FAA to assist the agency in programming federal funds to support required aviation development at airports included in the NPIAS. The current 2017-2021 NPIAS contains 3,340 public airports. Airports included in the NPIAS are considered significant to national air transportation and, therefore, are eligible to receive grants under the FAA's Airport Improvement Program (AIP). The NPIAS further categorizes the nation's airports based on types of service provided and quantity of passengers enplaned. Of the airports included in the NPIAS, 509 are considered a primary or non-primary commercial service airport.

BDL is classified as a medium-hub primary commercial service airport in the 2017-2021 NPIAS. Medium hubs are defined as airports that enplane 0.25 to 1.0 percent of total U.S. passenger enplanements. The 33 medium hub airports account for 17 percent of all U.S. enplanements. Medium hub airports usually have sufficient capacity to accommodate air carrier operations and a substantial amount of general aviation activity. **Table 1-2** outlines the specifics of each NPIAS category and provides examples of each type in the region.

Table 1-2 – Airport Classifications

<table>
<tr><th colspan="2">Airport Classifications</th><th>Hub Type:
% of Annual Passenger Boardings</th><th>Example Airport</th></tr>
<tr><td rowspan="5">Commercial Service:

Publicly owned airports that have <u>at least 2,500</u> passenger boardings each calendar year and receive scheduled passenger service</td><td rowspan="4">Primary:

Have <u>more than 10,000</u> passenger boardings each year</td><td>Large Hub:
1% or more</td><td>Boston-Logan, New York-JFK</td></tr>
<tr><td>Medium Hub:
At least .25%, but less than 1%</td><td>Bradley International</td></tr>
<tr><td>Small Hub:
At least .05%, but less than .25%</td><td>Albany International</td></tr>
<tr><td>Non-hub Primary:
More than 10,000, but less than .05%</td><td>Tweed-New Haven</td></tr>
<tr><td>Non-primary</td><td>Non-primary Commercial Service:
At least 2,500, and no more than 10,000</td><td>New Bedford Regional</td></tr>
<tr><td colspan="2" rowspan="2">Non-primary (Except Commercial Service)</td><td>Reliever</td><td>Hartford-Brainard</td></tr>
<tr><td>General Aviation</td><td>Waterbury-Oxford</td></tr>
</table>

Source: FAA 2017-2021 NPIAS Report.

1.3 AIRPORT GOVERNANCE

The Connecticut Airport Authority is a quasi-public agency established in 2011 to develop, operate and improve Bradley International Airport and the five state-owned general aviation airports (Danielson, Groton-New London, Hartford-Brainard, Waterbury-Oxford, and Windham). The agency is governed by an appointed Executive Director and an eleven-member board of directors who possess a broad spectrum of experience in aviation and government related industries, including transportation, aviation, business, law, politics, economic development, and other areas of industry. The board of directors consists of representatives from various surrounding municipalities, the State Government and the Connecticut Department of Transportation (ConnDOT).

1.4 MAJOR AIRPORT TENANTS

The Airport hosts a variety of tenants that provide services to the traveling public and aviation community. The major tenants include the passenger airlines, air cargo providers, fixed-base operators, corporate aviation tenants, and military units.

1.4.1 Passenger Airlines

Eight airlines currently provide scheduled passenger service to approximately 30 destinations, both domestic and international. Domestic service is primarily to key markets and hubs in the Northeast and Midwest, and to leisure markets in Florida. The majority of international service is within North America (Canada and Mexico), however a new nonstop route offered to Dublin, Ireland, with connections throughout Europe.

As of January 2017, the commercial passenger service airlines at BDL include:

- **Aer Lingus**
- **Air Canada Express**
- **American Airlines**
- **Delta Air Lines**
- **JetBlue Airways**
- **OneJet**
- **Southwest Airlines**
- **United Airlines**

1.4.2 Air Cargo Operators

Bradley International Airport is home to several types of air cargo activities including small freight operations (belly cargo), dedicated freight operations (cargo airlines), airmail (U.S. Postal Service), and other freight forwarding services. The majority of domestic passenger airlines listed above transport cargo on scheduled passenger flights using the spare volume in the airplane's baggage hold ("belly") that is not being used for passenger luggage. This activity would also include airmail services in cooperation with the U.S. Postal Service, which has a post office and mail sorting facility at the Airport. The dedicated cargo airlines that have regular operations at BDL include:

- **United Parcel Service (UPS)**
- **Federal Express (FedEx)**
- **DHL Express**

In addition to these regular cargo services, Bradley is occasionally visited by an Antonov An-124 aircraft operated by Volga-Dnepr Airlines, Polet Airlines, and Antonov Airlines, transporting heavy cargo, such as Sikorsky helicopters or Pratt & Whitney engines internationally. UPS also operates a regional ground cargo supporting facility at BDL.

1.4.3 Fixed-Base Operators (FBO)

Two full-service FBOs provide aviation services and amenities to the airlines and general aviation public operating out of BDL.

- **Signature Flight Support**
- **TAC Air**

1.4.4 Corporate Aviation

In addition to the FBOs providing GA support services, corporate aviation companies operate facilities performing maintenance services at BDL.

- **Bombardier – Hartford Service Center –** performs maintenance that supports their regional aircraft fleet, and operate an aircraft service facility serving private GA clients in the Northeast.
- **Embraer – Executive Jet Service Center –** performs maintenance and service on corporate GA aircraft.

1.4.5 Military

Military branches remain a key tenant of Bradley International Airport. The military tenants of the Airport include the following:

- **The Connecticut Air National Guard** base is home to the 103d Airlift Wing and the 118th Airlift Squadron.
- **The Connecticut Wing Civil Air Patrol** shares a space with the Air National Guard for their operations.
- **The Connecticut Army National Guard** post is home to the ANG's 169th, 104th and 142nd Aviation Regiments, handling various Army Operations, MedEvac, and Air Assault Support.

2 INVENTORY OF FACILITIES AND EXISTING CONDITIONS

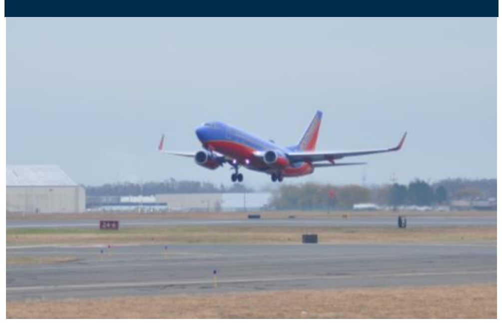
The initial step in the master planning process is to develop an inventory of the existing physical conditions and operational characteristics of the Airport and its surroundings. The information presented in this chapter is the basis for evaluating the Airport's existing and future facility requirements. The following elements are detailed in this chapter:

- Airfield
    - Runway System
    - Taxiway System
    - Apron Areas
    - Pavement and Signage
- Navigational and Lighting Aids
- Passenger Terminal Building
- Automobile Parking and Access
- Support Facilities
    - Aircraft Fueling
    - Aircraft Rescue and Fire Fighting (ARFF)
    - Snow and Ice Control
- Air Cargo Facilities
- General Aviation Facilities
- Military Facilities
- Non-Aeronautical Facilities
- Airspace Environment
- Meteorological Conditions

2.1 AIRFIELD

The airfield facilities are infrastructure elements that are most closely associated with the movement of aircraft (takeoff, landing, taxiing, parking, etc.). The airside components at BDL include runways, taxiways, aprons, pavement markings, and signage. The existing facilities are presented in **Figure 2-1** and **Figure 2-2**.

Aircraft landing on Runway 6-24



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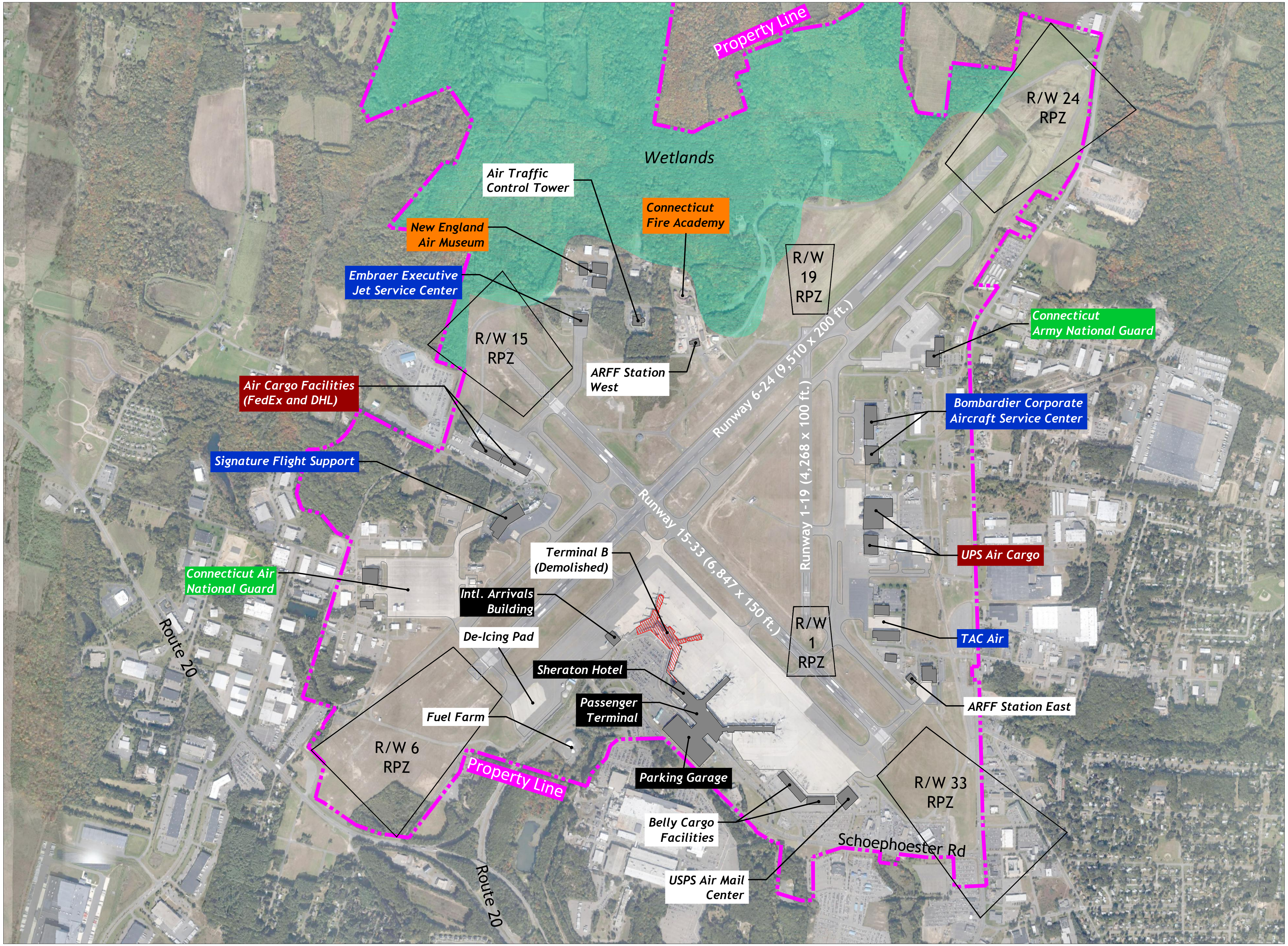

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GRAPHIC SCALE (FEET)

0 700 1400

LEGEND

- Passenger Service/ Terminal
- Air Cargo Facilities
- General Aviation
- Military
- Support Facilities
- Non-Aeronautical Use

Figure 2-1
Existing Facilities

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1 Federal Inspection Services Building (FIS)
2 Terminal B (Demolished)
3 Sheraton Hotel
4 Terminal A
5 Parking Garage
6 Fuel Receiving Station
7 Co-Generation Plant
8 Belly Cargo Facility #1
9 Belly Cargo Facility #2
10 USPS Air Mail Center
11 Rental Car Facilities (Multiple Agencies)
12 ARFF Station East
13 Airport Maintenance Building
14 Corporate Air Hangar
15 TAC Air (Terminal Building)
16 TAC Air (Hangar)
17 TAC Air (Fuel Farm)
18 UPS Air Cargo #1
19 UPS Air Cargo #2
20 Corporate Hangar (Travelers Ins.)
21 Corporate Hangar (Cigna)
22 Parking Office
23 Bombardier Facility #1
24 Bombardier Facility #2
25 Airport Maintenance Building
26 Airport Maintenance Building
27 Clouds and Robinson
28 Army Natl. Guard (Support Building)
29 Army Natl. Guard (Hangar #1)
30 Army Natl. Guard (Hangar #2)
31 CT Fire Training School (North)
32 CT Fire Training School (South)
33 ATCT & Yankee TRACON
34 New England Air Museum
35 New England Air Museum
36 New England Air Museum
37 Cargo Facility #1
38 Cargo Facility #2
39 Signature Flight Support (Terminal)
40 Signature Flight Support (Hangar)
41 CT Air National Guard (45 Buildings)
42 Fuel Storage Facility
43 Deicing Facility (Storage Tanks)
44 Deicing Facility (Apron)
45 Deicing Facility (Storage Building)
46 Deicing Facility (Storage Building)
49 Embraer

Figure 2-2
Building Diagram

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2.1.1 Runway System

The existing airfield configuration at BDL consists of three active runways: Runway 6-24, Runway 15-33, and Runway 1-19. Runway 6-24 serves as the primary air carrier runway and is 9,510 feet by 200 feet. Runway 15-33 serves as the secondary air carrier runway and is 6,847 feet by 150 feet. Runway 1-19 is used infrequently by general aviation (GA) traffic and is 4,268 by 100 feet. There is a 475-foot displaced threshold on the Runway 1 end. The 2005 Master Plan and Airport Layout Plan calls for ultimate closure of this runway. **Table 2-1** shows the runway specifications at BDL.

Table 2-1 – Existing Runway Specifications

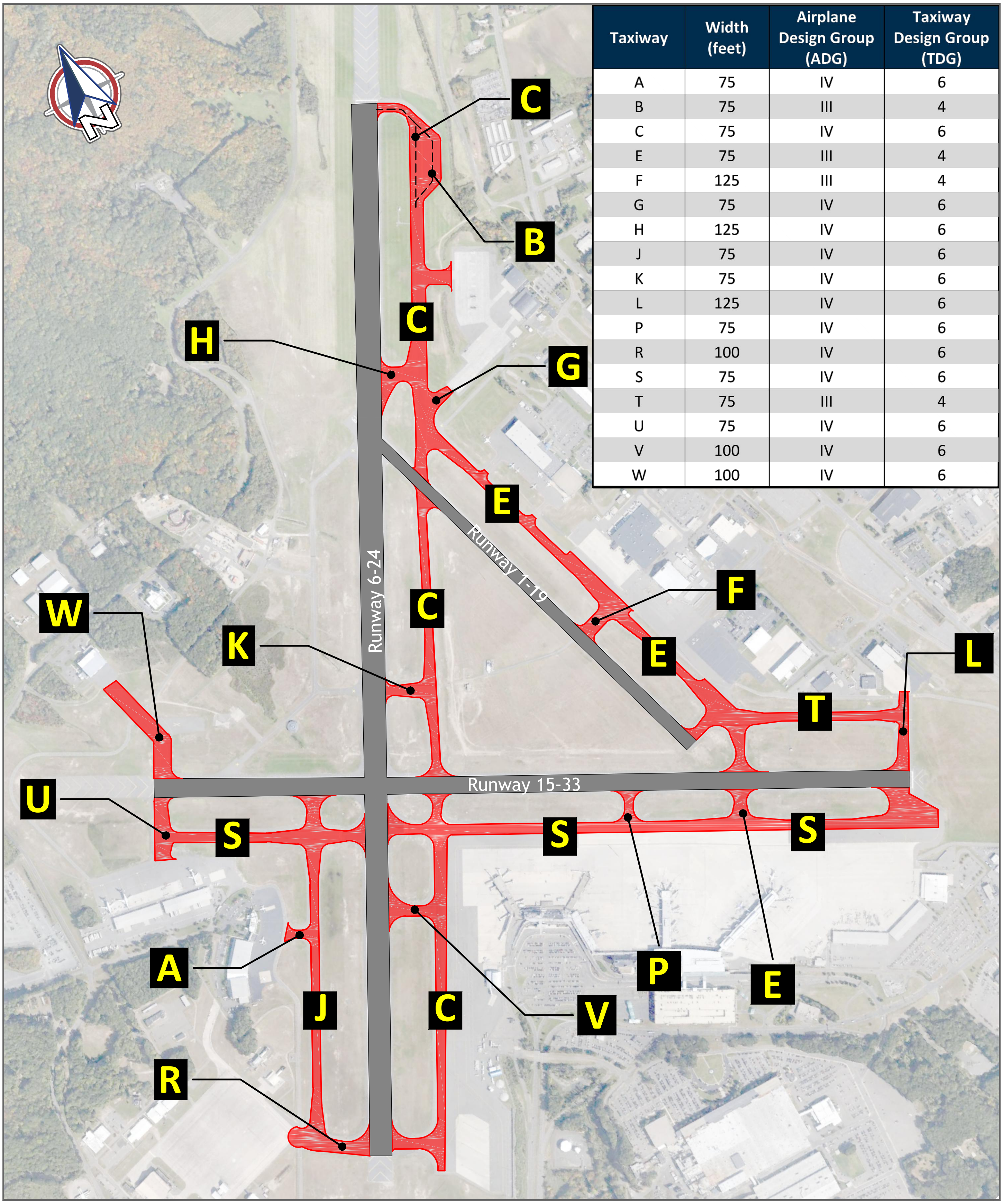
	6-24	15-33	1-19
Length (feet)	9,510	6,847	4,268
Width (feet)	200	150	100
Runway End Elevation (feet above MSL)	**Runway 6:** 172.9 **Runway 24:** 161.3	**Runway 15:** 168.7 **Runway 33:** 168.3	**Runway 1:** 170.6 **Runway 19:** 168.8
Pavement Type	Grooved Asphalt	Grooved Asphalt	Asphalt
Pavement Load Bearing	710,000 lbs. (Dual Double Tandem)	350,000 lbs. (Dual Tandem)	328,000 (Dual Tandem)
Effective Runway Gradient	0.1%	0.0%	0.1%
Aircraft Approach Category	D	C	B
Airplane Design Group	V	IV	II
Runway Markings	Precision	**Runway 15:** Non-Precision **Runway 33:** Precision	Basic
Runway and Approach Lighting	HIRL, C/L, TDZL **Runway 6:** ALSF-2, PAPI-4 **Runway 24:** MALSR, PAPI-4	HIRL **Runway 15:** PAPI-4, REIL **Runway 33:** PAPI-4, MALSF	MIRL
Navigational Aids	**Both Ends:** ILS/DME, GPS, RNP **Runway 6:** ILS CAT II-III **Runway 24:** ILS SA CAT I-II	**Runway 15:** GPS **Runway 33:** ILS/DME, GPS	None
Runway Design Code	D-V-1200	C-IV-4000	B-II-5000

Sources: AirNav.com, FAA 5010 Master Record

ALSF-2 – High Intensity Approach Lighting System with Sequenced Flashing Lights
C/L – Centerline Lights
HIRL – High Intensity Runway Lights
ILS – Instrument Landing System
ILS SA – "Special Authorization" ILS approach
MALSR – Medium-Intensity Approach Lighting System with Runway Alignment Indicator
PAPI-4 – Four-Box Precision Approach Path Indicator
REIL – Runway End Identifier Lights
RNAV – Area Navigation
TDZL – Touchdown Zone Lights

2.1.2 Taxiway System

An airport's taxiway system connects the runways to aircraft parking aprons, storage hangars and other facilities. **Figure 2-3** displays the existing taxiway system at BDL, as well of the specifications of each taxiway.



Taxiway	Width (feet)	Airplane Design Group (ADG)	Taxiway Design Group (TDG)
A	75	IV	6
B	75	III	4
C	75	IV	6
E	75	III	4
F	125	III	4
G	75	IV	6
H	125	IV	6
J	75	IV	6
K	75	IV	6
L	125	IV	6
P	75	IV	6
R	100	IV	6
S	75	IV	6
T	75	III	4
U	75	IV	6
V	100	IV	6
W	100	IV	6

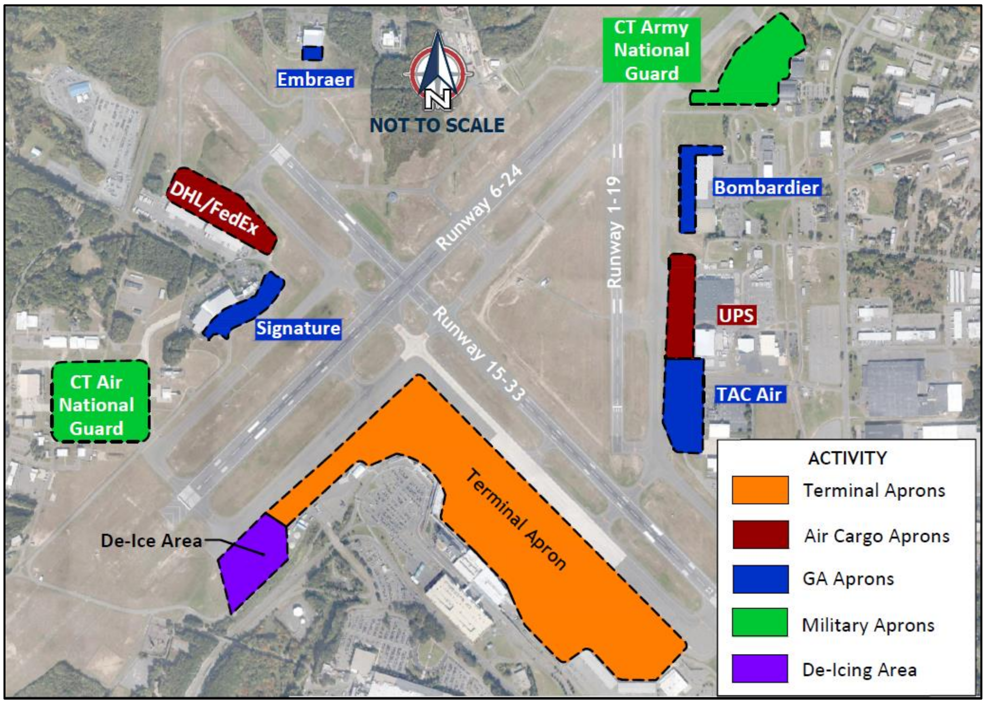
NOT TO SCALE

Figure 2-3
Existing Taxiway Configuration

2.1.3 Apron Areas

Aprons, also referred to as ramps, provide space for short- and long-term aircraft parking; and loading, unloading passengers and goods, and de-icing operations. As depicted in **Figure 2-4**, and described below, there are seven apron areas at Bradley International Airport.

Figure 2-4 – Apron Areas



Source: CHA, 2016.

Terminal Apron

The Terminal Apron consists of over 400,000 square yards (SY) of Portland cement concrete (PCC) pavement. Activities on the terminal apron primarily include passenger airline activity and belly cargo. The terminal has 23 gate positions. A schematic of the gate layout is presented in **Figure 2-5**.

General Aviation (GA) Use Aprons

These aprons provide parking for transient aircraft, allow access to the GA facilities and fixed-base operator facilities, and provide space for aircraft tie-downs.

- **Signature Flight Support** has an approximately 23,000 square yard (SY) apron on the west side of the airfield.
- **TAC Air** maintains an apron located at the east side of the Airport, that is approximately 45,000 SY.
- **Bombardier** has an apron for their service facility that is approximately 125 SY.
- **Embraer** has a similar service apron on the opposite side of the airfield that is approximately 50 SY.

Military Use Aprons

The military aprons provide parking for based airplane and helicopter fleets, as well as transient fixed-wing military aircraft. The Connecticut Air National Guard Apron is located at the far west side of the Airport property, and is approximately 108,000 SY. The Army National Guard Apron is located in the northeast area of the Airport, and is approximately 66,000 SY.

Air Cargo Use Aprons

There are two Air Cargo aprons, both used by the Air Cargo tenants for cargo transfer operations, aircraft storage and maintenance.

- The apron on the west side of the airfield, located near the Runway 15 threshold, is approximately 55,000 SY. This apron is used primarily by DHL and FedEx and is owned and operated by Aviation Facilities Company, Inc. (AFCO).
- The apron on the east side of airfield, east of Runway 1-19, is approximately 36,000 SY and is used by UPS.

Figure 2-5 – Gate Layout

Source: Bradley International Airport, CHA 2016.

2.1.4 Pavement Markings

FAA AC 150/5340-1L, *Standards for Airport Markings,* identifies the pavement marking requirements for commercial service airports, also known as Federal Aviation Regulation (FAR) Part 139 certificated airports. The latest version of this guidance was published in September 2013 and includes new standards for enhanced taxiway centerline markings, surface-painted hold sign markings and the extension of the runway holding position markings onto the paved shoulders. Upon visual inspection, BDL is compliant with the latest standards.

2.1.5 Airfield Signage

Upon visual inspection, lighted airfield signage currently found on the BDL airfield consists of all required signage for a Part 139 certificated airport including airfield location signage, mandatory instruction signage, and runway hold position signage.

2.1.6 Airside Pavement Condition

CAA has established a management program for the various airside pavements. The type and timing of needed pavement maintenance and repair is based on a structural integrity evaluation metric called the Pavement Condition Index (PCI). Pavements are evaluated in logical inspection units (small sections of pavement inspected in detail) then given a rating number of 0 – 100. A 100 rating means the pavement is in excellent condition. This pavement distress condition rating procedure is the process developed by the U.S. Army Corps of Engineers and adopted as the standard pavement evaluation procedure by the Federal Aviation Administration.

A 2015 Pavement Management Study determined that the overall condition of the pavement network at BDL was a PCI of 66. The results of this evaluation are presented in **Figure 2-6**. As depicted, both of the Airport's commercial runways and parallel taxiways are in generally good condition, rated in the "preventative maintenance" category. Aprons, supporting taxiways, and Runway 1-19 fall into the "major rehabilitation and reconstruction" categories, but no pavement is considered to be "failing". Following this study, CAA initiated a 5-year pavement rehabilitation program.

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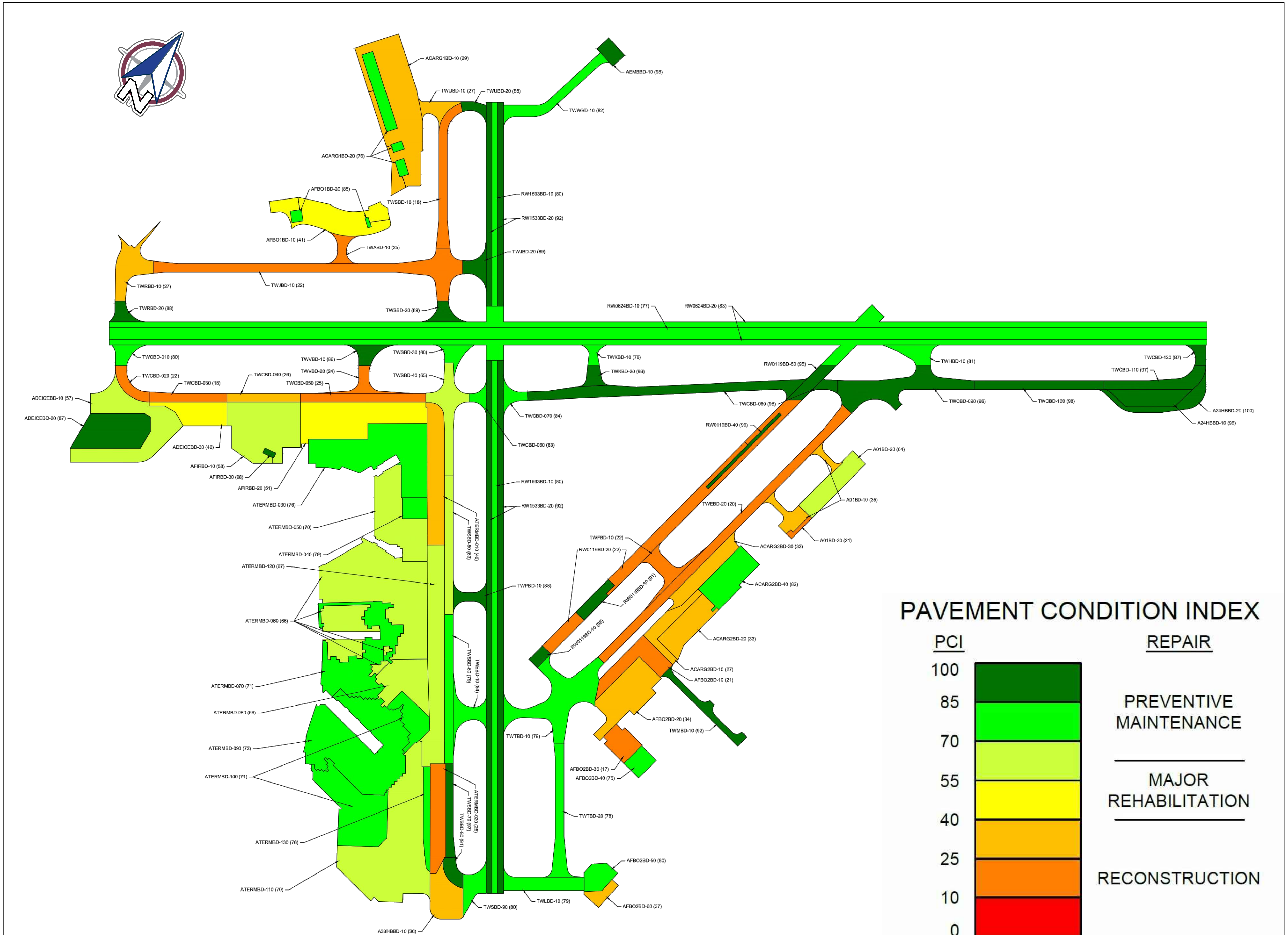

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Source:
Bradley International Airport Pavement Management Report
Hoyle Tanner and Associates, Applied Pavement Technology, 2015.

Figure 2-6
Airside Pavement Condition

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2.2 NAVIGATIONAL AIDS (NAVAIDS) AND INSTRUMENT PROCEDURES

Airport NAVAIDs are any device that provides point-to-point navigational guidance to pilots. This includes electronic or visual air guidance systems (ground-based or airborne), approach lights, airfield lights, and associated supporting equipment. NAVAIDs assist pilots in safely and efficiently locating airports, landing aircraft, and navigating the airfield during all meteorological conditions. **Table 2-2** summarizes the Airport's existing navigational and lighting aids by runway end.

Table 2-2 – Navigational Aids and Airfield Lighting

Runway	Runway Markings	Navigational Aids	Lighting	Minimum Ceiling (AGL) /Visibility	Instrument Approach Types
6	Precision	ILS/DME, GPS, RNP	ALSF-2, PAPI-4, HIRL, TDZL, C/L	100 ft. / < ¼ mile	ILS CAT II-III (DME), ILS SA CAT I (DME), ILS CAT I (DME), RNAV (GPS), RNAV (RNP)
24	Precision	ILS/DME, GPS, RNP	MALSR, PAPI-4, HIRL, TDZL, C/L	100 ft. / < ¼ mile	ILS SA CAT I-II (DME), ILS CAT I (DME), RNAV (RNP) RNAV (GPS)
15	Non-Precision	GPS	PAPI-4, HIRL, REIL	250 ft. / ¾ mile	RNAV (GPS)
33	Precision	ILS/DME, GPS	MALSF, PAPI-4, HIRL	200 ft. / ¾ mile	ILS CAT I (DME), RNAV (GPS)
1	Non-Precision	None	MIRL	1,000 ft. / 3 miles	None
19	Non-Precision	None	MIRL	1,000 ft. / 3 miles	None

Source: FAA Airport Master Record (Form 5010), Accessed 2016.

ALSF-2 – High Intensity Approach Lighting System with Sequenced Flashing Lights
C/L – Centerline Lights
DME – Distance Measuring Equipment
GPS – Global Positioning System
HIRL – High Intensity Runway Lights
ILS – Instrument Landing System
ILS SA – "Special Authorization" ILS approach
MALSF – Medium-Intensity Approach Lighting System with Sequenced Flashers
MALSR – Medium-Intensity Approach Lighting System with Runway Alignment Indicator
MIRL – Medium-Intensity Runway Lighting
PAPI-4 – Four-Box Precision Approach Path Indicator
REIL – Runway End Identifier Lights
RNAV – Area Navigation
RNP – Required Navigational Performance
TDZL – Touchdown Zone Lights

2.2.1 En-Route NAVAIDs

En-Route NAVAIDs assist pilots during navigation between airports. These facilities are usually ground-based and electronically emit signals that are received by aircraft on a specific radio frequency. They are almost always used in some manner by pilots operating on Instrument Flight Rule (IFR) flight plans but can also be used during Visual Flight Rule (VFR) flights for position information. While there are no longer any ground-based en-route NAVAIDs located at BDL, there are some located at nearby airports, including the BAF VORTAC, CEF VORTAC, and HFD VOR/DME.

2.2.2 Standard Terminal Arrival Routes (STARs)

Standard Terminal Arrival Routes are published procedures describing specific criteria for descent, routing, and communications on an IFR flight plan, just before reaching a destination airport. STARs usually cover the phase of flight that lies between the last point of the route in the flight plan and the first point of the approach to the airport, normally the initial approach fix (IAF).

Bradley International Airport has two procedures for air traffic arriving to the Windsor Locks and Hartford region. The *DEER PARK THREE* arrival utilizes the *MADISON* VORTAC, which feeds traffic from the south. The *STELA ONE* arrival utilizes the *CANAN* intersection, which feeds traffic from the north.

2.2.3 Instrument Approach Procedures (IAPs) and NAVAIDs

Instrument approach procedures assist properly trained flight crews and properly equipped aircraft to operate at the Airport during poor weather conditions. Until recently, instrument approach procedures relied on ground-based electronic NAVAIDs and were classified as either "precision" or "non-precision". Non-precision approaches provide only lateral guidance, whereas precision instrument approaches provide both lateral and vertical guidance. The NAVAIDs supporting traditional ground-based precision approaches are collectively called an Instrument Landing System (ILS) and include a Localizer (providing lateral guidance), a Glideslope (providing vertical guidance) and an approach lighting system (providing close-in visual guidance). New advances in Global Positioning System (GPS) based technology have allowed "vertically-guided instrument approach procedures" and 'ILS-like' approach capability without the need for all of the traditional ground-based ILS NAVAID components. Based on current FAA classifications, the four types of approach categories include:

- **Visual (V)**: Approaches performed under visual flight rules only, when meteorological conditions include a cloud ceiling height of 1,000 feet or greater and visibility of 3 miles or greater. At BDL, Runway 1 – 19 provides only visual approaches.
- **Non-Precision Approach (NPA)**: Instrument approach procedures providing only lateral guidance with a ceiling minimum of 400 feet above the threshold. These can include VHF Omnidirectional Range (VOR), non-directional beacon (NDB), area navigation (RNAV), lateral navigation (LNAV), localizer performance (LP), and localizer (LOC) equipment. At BDL, Runways 6, 15, 24, and 33 all have an NPA procedure.
- **Approach Procedure with Vertical Guidance (APV)**: Instrument approach procedures providing vertical guidance to 250 feet above the threshold and visibility minimums as low as ¾ mile. These can include an ILS, LNAV/Visual Navigation Aids (VNAV), Localizer Performance with Vertical Guidance (LPV) or Area Navigation (RNAV) Required Navigation Performance (RNP). Runways 6, 15, 24, and 33 maintain this procedure.
- **Precision Approach (PA)**: Instrument approach procedures providing vertical guidance to less than 250 feet above the threshold and visibility minimums lower than ¾ mile. These can include an ILS, LPV, and Global Navigation Satellite System (GNSS) Landing System (GLS). This category applies to Runways 6, 24, and 33.

The Airport maintains a Category-III ILS (CAT-III) on Runway 6, Category-II ILS (CAT-II) ILS on Runway 24, and a Category-I ILS (CAT-I) on Runway 33. Higher categories are more accurate and provide lower approach minima (i.e., ceiling and visibility). The ILS systems are owned and maintained by the FAA. Additionally, each of the ILS systems make use of Distance Measuring Equipment (DME), which properly equipped aircraft can use to determine their distance from the land-based transponder.

While not a ground-based navigation system, new advances in Global Positioning System (GPS) - based technology have allowed "vertically-guided instrument approach procedures" and ILS-like approach capability without the need for traditional ground-based ILS NAVAID equipment. Four of the six runway ends have GPS approaches available. **Table 2-3** depicts each instrument approach by runway end at BDL.

Table 2-3 – Instrument Approach Procedures

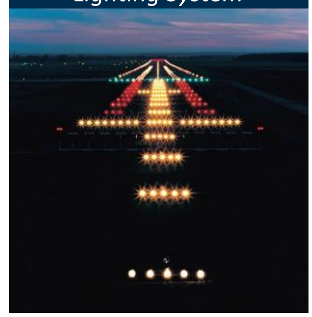
Runway End	Approach Type	Approach Method	Minimums – Ceiling (AGL) / Visibility
Runway 6	PA	ILS CAT II-III	100' / < ¼ mile
		COPTER ILS OR LOC	100' / ¼ mile
		ILS "SA" CAT I	150' / < ½ mile
		ILS CAT I	200' / ½ mile
	APV	RNAV (GPS)	200' / ½ mile
		RNAV (RNP)	400' / ¾ mile
	V	Visual	1,000' / 3 miles
Runway 24	PA	ILS "SA" CAT I-II	150' / < ½ mile
		ILS CAT I	200' / ½ mile
	APV	RNAV (GPS)	200' / ½ mile
		RNAV (RNP)	500' / 7/8 mile
	V	Visual	1,000' / 3 miles
Runway 15	APV	RNAV (GPS)	300' / ¾ mile
	V	Visual	1,000' / 3 miles
Runway 33	PA	ILS CAT I	200' / ¾ mile
	APV	RNAV (GPS)	200' / ¾ mile
	V	Visual	1,000' / 3 miles
Runway 1	V	Visual	1,000' / 3 miles
Runway 19	V	Visual	1,000' / 3 miles

Source: AirNav.com, accessed 10/06/2016
V – Visual Approach
NPA – Non-Precision Approach
APV – Approach Procedure with Vertical Guidance
PA – Precision Approach

Approach Lighting Systems (ALS)

The third component of an ILS (in addition to the localizer and glideslope) is the approach lighting system (ALS). The ALS provides a lighted approach path along the extended centerline of the runway. Runway alignment indicator lights flash in sequence as a series of white lights moving toward the runway threshold. These lights brilliantly emphasize runway centerline alignment. Roll indication is emphasized by a single row of white lights located on either side of and symmetrically along the column of approach lights.

Typical Approach Lighting System



Runway 6 is equipped with a High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2). The ALSF-2 consists of 247 steady burning lights: including green threshold lights (49 lights), red side row-bar lamps (9 rows, 54 lamps), and high intensity steady burning white lights (144), plus an additional 15 flashing lights commonly referred to as strobes.

The strobes flash in sequence starting with the strobe farthest from the runway and ending with the strobe closest to the runway threshold. The lights are spaced at 100' intervals from the runway threshold outward to 2400'.

Runway 24 is equipped with a Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR). A typical MALSR uses 18 lamps (parabolic aluminized reflector [PAR] 56) along the runway threshold spaced 10’ apart, 9 light bars with 5 lights (PAR 38) separated every 200’ and 5 sequenced flashers also separated every 200’ over a distance of 2,400’ from the runway threshold. At the 1,000’ point there are three light bars (15 lamps) for added visual reference for the pilot on final approach. Sequenced flashing lights provide added visual guidance down the runway centerline path. Planned approach visibility is at least 2,400’ to .5 miles, with a decision height of 200’.

Runway 33 is equipped with a Medium-Intensity Approach Lighting System with Sequenced Flashers (MALSF). A MALSF is a typical approach lighting system, however as opposed to a MALSR, it features three sequenced flashing lights on the last three light bars, similar to the ALSF-2. These are utilized when the approach area identification is difficult.

A Runway Visual Range (RVR) transmissometer is located for use on the approaches for Runway 6, 24, and 33. The RVR measures the light intensity of the runway edge lighting (discussed in the subsequent section) to determine visibility. These measurements allow air traffic controllers and pilots to evaluate visibility while on the ground at multiple areas on the airfield.

2.2.4 Standard Instrument Departures (SIDs)

Standard instrument departure (SID) routes, also known as departure procedures, are published flight procedures followed by aircraft on an IFR flight plan immediately after takeoff from an airport. SIDs provide an easy to understand coded departure procedure that airports use to balance terrain and obstacle avoidance, noise abatement (if necessary), and other airspace management considerations.

Bradley International Airport has two published SIDs – *BRADLEY TWO* and *COASTAL SIX*. Each provides procedures with initial headings predicated on avoiding noise sensitive areas.

2.2.5 Airfield Lighting

In addition to the visual aids previously described, lighting on the airfield includes the rotating beacon, Precision Approach Path Indicator (PAPI) lights, runway threshold lighting, runway edge lighting, Runway End Identifier Lights (REILs), runway centerline lights, Runway Touchdown Zone Lights (TDZLs), taxiway edge lighting and apron lighting. All are described below:

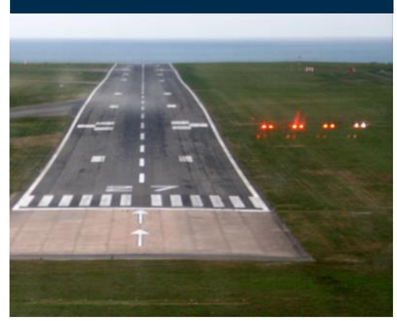
Rotating Beacon:

The rotating beacon functions as the universal indicator for locating an airport at night. For a civilian airport, it has one clear and one green lens, 180 degrees apart, and is generally visible 10 miles from the airport. The rotating beacon at BDL is located on North Street, north of the UPS Air Cargo facility.

Precision Approach Path Indicator (PAPI) Lights:

A PAPI is a system of lights located near a runway end. It provides pilots with visual descent guidance information during an approach to the runway. PAPIs typically have a visual range of approximately four miles, weather permitting, and inform pilots if they are high, low or on the correct approach descent path the threshold. Runways 6, 24, 15, and 33 are equipped with PAPI-4 (four-light unit) systems.

Typical PAPI Lighting System



Runway Threshold Lighting:

Threshold identification lights have a two-color lens, red and green. The green half of the lens faces the approaching aircraft and indicates the beginning of the usable runway. The red half faces the airplane on the rollout or takeoff, indicating the end of the usable runway. Runways 6, 24, 15, and 33 are equipped with threshold lights.

Runway Edge Lighting:

Runway edge lighting is used to outline the edges of a runway during periods of darkness or restricted visibility. These systems are classified according to their intensity or brightness. Runways 6-24 and 15-33 are equipped with High-Intensity Runway Light (HIRL) systems. Runway 1-19 is equipped with Medium-Intensity Runway Lights (MIRL).

Runway End Identifier Lights (REILs):

The REIL system consists of two synchronized, unidirectional flashing lights. The lights are positioned on each corner of the runway landing threshold, facing the approach area and aimed at an angle of 10 to 15 degrees. Runway 15 is equipped with REILs.

Runway Centerline Lights:

Runway centerline lights are installed on some precision approach runways to facilitate landing under adverse visibility conditions. They are located along the runway centerline and are spaced at 50-foot intervals. When viewed from the landing threshold, the runway centerline lights are white until the last 3,000 feet of the runway. The white lights begin to alternate with red for the next 2,000 feet, and for the last 1,000 feet of the runway, all centerline lights are red. Runway 6-24 has installed runway centerline lights.

Runway Touchdown Zone Lights (TDZL):

The TDZLs indicate the touchdown zone when landing under adverse visibility conditions. They consist of two rows of transverse light bars disposed symmetrically about the runway centerline. The system consists of steady-burning white lights which start 100 feet beyond the landing threshold and extend to 3,000 feet beyond the landing threshold or to the midpoint of the runway, whichever is less. Both ends of Runway 6-24 have installed TDZLs.

Taxiway Edge Lighting:

Taxiway lighting delineates the taxiway's edge and provides guidance to pilots during periods of low visibility and at night. The most commonly used type of taxiway lighting is a series of blue fixtures set at 200-foot intervals along the taxiway edges. All of the Airport's taxiways are equipped with Medium-Intensity Taxiway Lighting (MITL) systems.

Apron Lighting:

Apron floodlight systems illuminate the Terminal Apron, both FBO/General Aviation Aprons, the Connecticut Air National Guard Apron, and both Air Cargo Aprons.

2.3 PASSENGER TERMINAL BUILDING

As part of the Airport Master Plan the study team conducted an assessment of the BDL passenger terminal. This assessment is based on site visits and tenant interviews conducted over a two-day period in October 13 and 14, 2016, as well as high-level reviews of previous studies provided. The intention of this effort was to develop a general understanding of the existing terminal building.

Documents Reviewed:

- Bradley International Airport Master Plan Update, December 2005
- Programming and Planning Study for a Federal Inspection Services Facility, November 2014
- Bradley International Airport Security Screening Checkpoint – Final Report, September 2015
- Bradley International Airport New Passenger Elevator Concept Design Alternatives – Final Report, January 2016

Tenants Interviewed:

- JetBlue Airlines
- Transportation Security Administration (TSA)
- US Customs and Boarder Protection (CBP)
- United Airlines
- American Airlines

2.3.1 Existing Terminal A

Terminal A is a conventional midsize two-level terminal which currently serves all airlines operating at Bradley International Airport. Departures processing and concourses are located on the upper level (**Figure 2-7**) with arrivals and apron support on the lower level (**Figure 2-8**). In addition to these two levels, a small mezzanine level (**Figure 2-9**) is located above the departures level. The existing Terminal Building Lease Map files were used to generate the area summary in **Table 2-4**.

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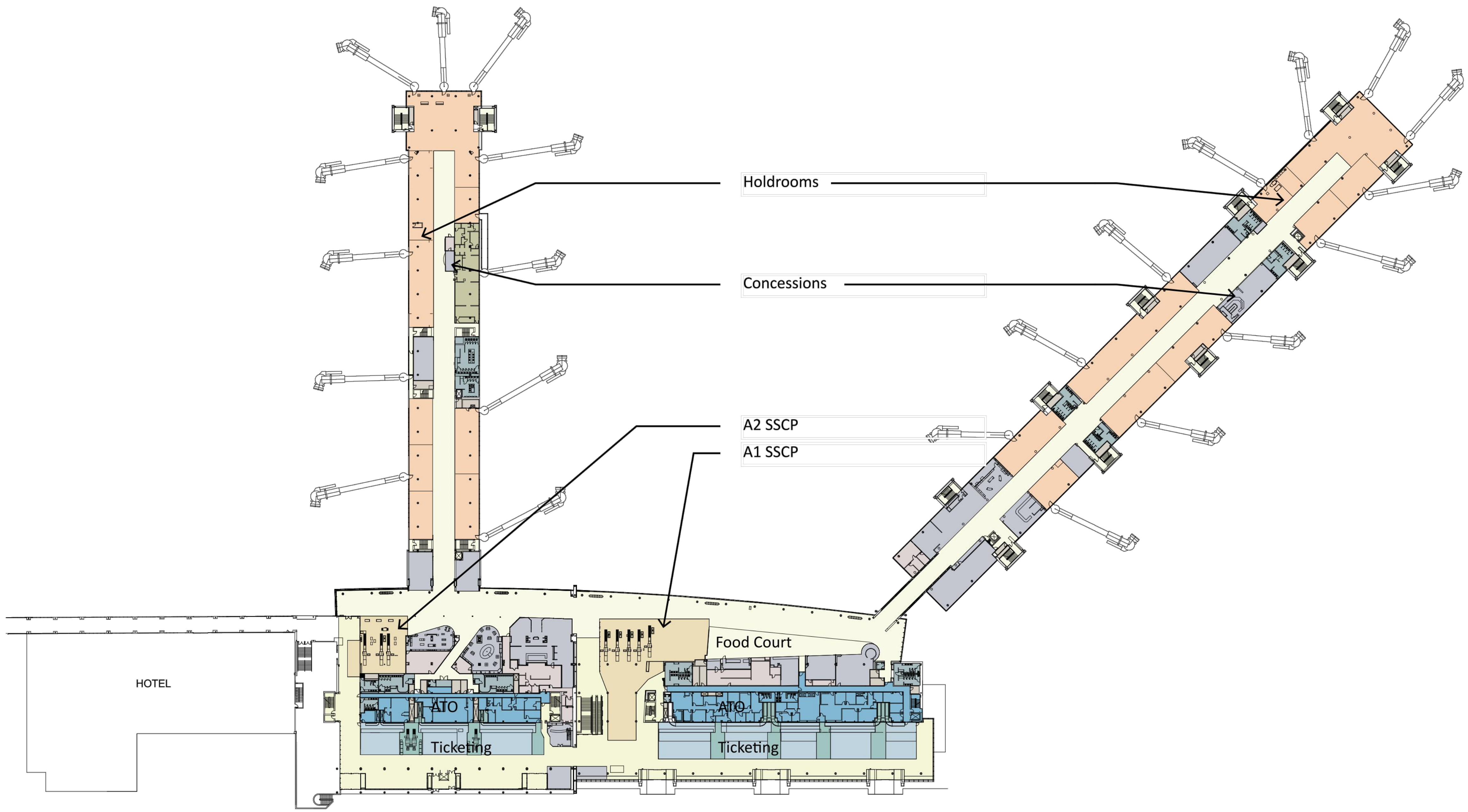

BRADLEY INTERNATIONAL

MASTER PLAN UPDATE

NOT TO SCALE

	Airline Ops
	Outbound Baggage
	Support + MEP
	Ticketing
	SSCP
	Circulation
	Restrooms
	Concessions
	ATO
	Holdrooms

Figure 2-7

Upper Level Terminal Layout

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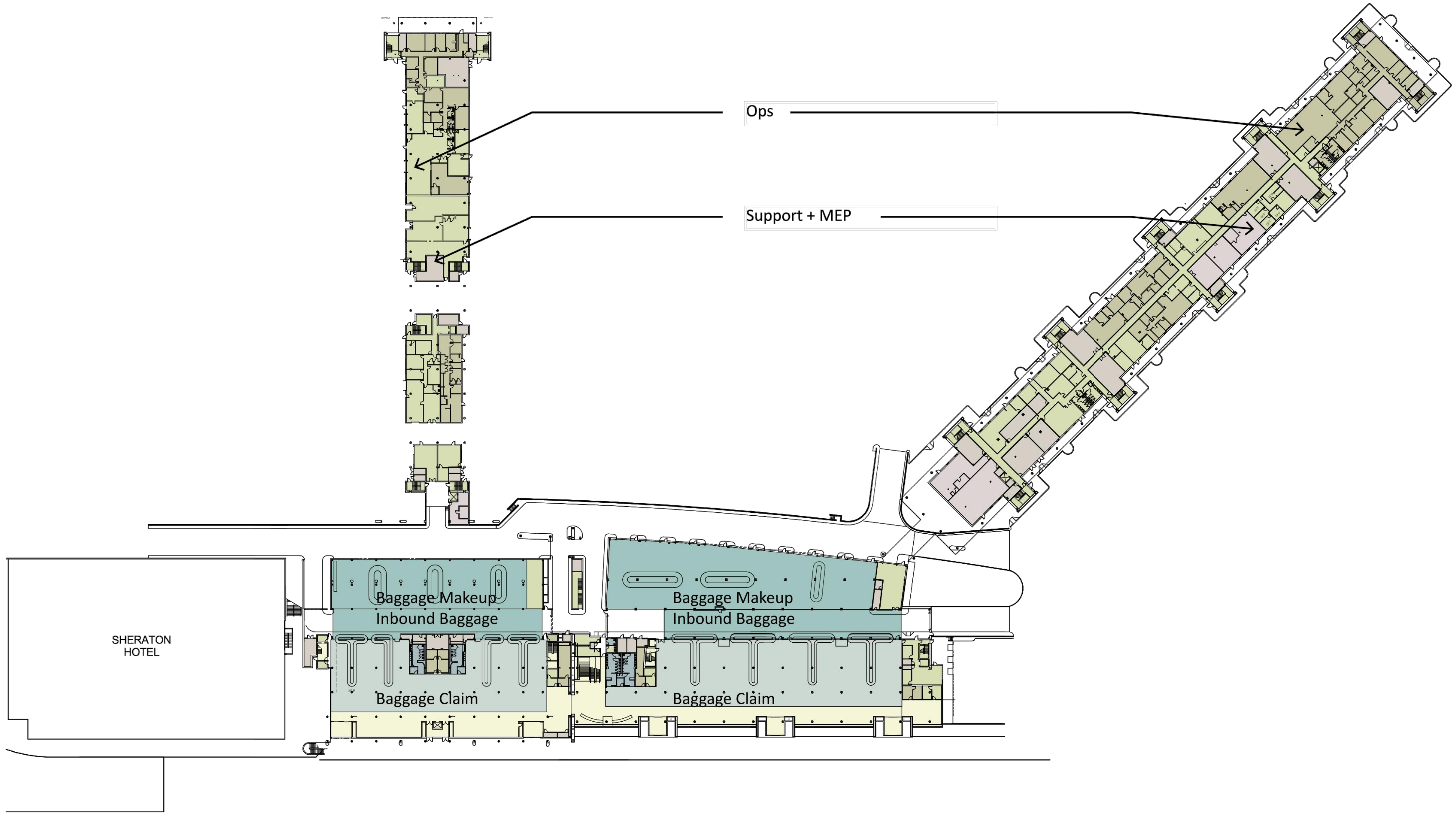

BRADLEY INTERNATIONAL

MASTER PLAN UPDATE

NOT TO SCALE

	Airline Ops
	Airport Ops
	Support + MEP
	Baggage Makeup
	Baggage Claim
	Circulation
	Restrooms
	Inbound Baggage

Figure 2-8
Lower Level Terminal Layout

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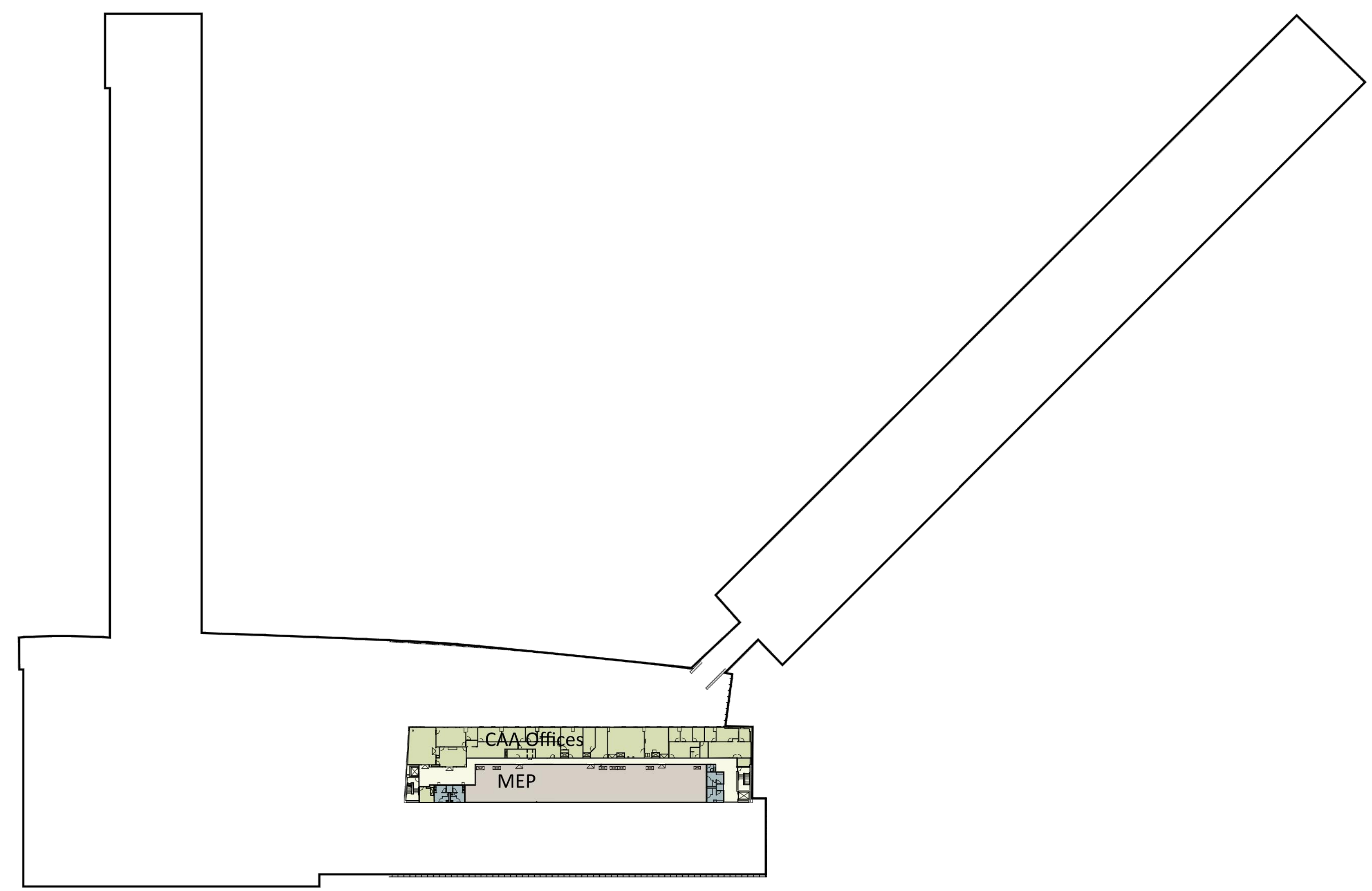

BRADLEY INTERNATIONAL
MASTER PLAN UPDATE

NOT TO SCALE

Circulation
Airport Ops
Support + MEP

Figure 2-9
Mezzanine Level Layout

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Table 2-4 – Terminal A Program Areas

	Arrivals Level	Departures Level	Mezzanine Level	*TOTAL*
Operations	60,000sf	2,700sf	8,200sf	***70,900sf***
Support + MEP	18,600sf	17,700sf	6,200sf	***42,500sf***
Inbound Baggage	11,400sf	---	---	***11,400sf***
Baggage Makeup	26,900sf	---	---	***26,900sf***
Baggage Claim	32,400sf	---	---	***32,400sf***
Circulation	16,900sf	84,400sf	3,100sf	***104,400sf***
Restrooms	2,100sf	7,500sf	800sf	***10,400sf***
Concessions	---	31,500sf	---	***31,500sf***
Ticketing	---	17,800sf	---	***17,800sf***
Security Screening	---	11,800sf	---	***11,800sf***
Holdrooms	---	41,400sf	---	***41,400sf***
TOTAL	***168,300sf***	***214,800sf***	***18,300sf***	***401,400sf***

Source: CAA Terminal Building Lease Maps, 2016.
Note: Area calculations based on floor space diagrams. Area calculations will vary based on source and parameters used.

The check-in hall is of linear configuration with check-in desks along the back wall. The entry to the main security checkpoint, Checkpoint A1, is located in the center of Terminal A along the demarcation line between the original and expanded portions of the terminal. Approximately 40% of the overall check-in facilities are located in the western (original) portion of Terminal A with the remainder and Checkpoint A1 located in the newer eastern portion.

Located intermittently between airline check-in zones, free-standing Computed Tomography X-Ray (CTX) devices allow TSA to conduct checked-baggage screening. Passengers drop-off their bags at these locations for screening prior to their induction into the baggage system. An in-line baggage screening system is being considered by CAA as part of a potential Federal Inspection Services (FIS) facility expansion project, which will remove these objects and allow for expansion of processing functions. A second security screening checkpoint, A2, is located at the western end of the check-in hall and operates during the morning peak, which adds three lanes of capacity to A1's seven. Situated on either side of Checkpoint A1 (and between the public landside and airside portions of the terminal processor) are airline ticket office (ATO), utility, storage, and concessions support spaces.

Following screening, passengers enter the airside's food court and the connecting gallery which leads to the two concourses. The airside gallery is a double height space with expansive views of the apron and airfield activity. Arriving passengers also move through this space as they make their way from their gate to Baggage Claim. They are brought to the center of the terminal and descend to the Arrivals Level along the edge of the A1 Checkpoint. Due to the heavy volume of both arriving and departing passengers, this area becomes a significant bottleneck for competing flows of passenger traffic.

The concourses are laid-out in traditional fashion; a central circulation zone with gates on either side. The linear run of gate holdrooms is broken by support zones (restroom, utility space, etc.) and concessions. The western concourse has 11 gates (three United, four American, and four CAA gates) while the eastern has 12 gates (three Southwest, one Air Canada, one JetBlue, four Delta, and three CAA). Generally, the western concourse appears more worn and has less natural light and ceiling height than the newer eastern concourse. The concession offerings in both are limited and, coupled with passengers' unwillingness to return to the main concessions offerings along the connecting gallery, leave some passengers wanting. A small duty free zone is located near the end of the eastern concourse as an amenity for the international passengers (Aer Lingus to Dublin). The end holdrooms on both concourses were identified as undersized and subject to crowding by the airlines interviewed.

On the Arrivals Level, the majority of Airline and Airport Operations is situated under both concourses with direct apron access. Baggage Makeup and Inbound Baggage are located below the airside and ATO/support zones of the terminal processor. The public Baggage Claim spans the entire length of the terminal building with direct access to the arrivals curb. Baggage Claim, like Check-In above, is organized around the central vertical circulation core connecting the Arrivals and Departures Levels. Both the eastern and western halls have four bag claim devices each, for a total of eight through-the-wall flatplate devices. The public circulation zone along the buildings front façade offers opportunities for natural light with exterior south-facing glass and openings in the floorplate above creating double-height light wells.

2.3.2 Federal Inspection Services (FIS) facility

International arrivals are processed in a separate International Arrivals Building located to the northwest of Terminal A. Interviews with CBP found that the current facility's processing capacity is approximately 200 passengers per hour (PPH) with current staffing levels. However, queue space both at bag claim and primary inspection is constrained (CBP noted that at times the queue extends back on to the jetbridge and to the aircraft door). The FIS possess a single bag claim device (approximately 100 linear feet of claim) and a small non-secure meeter / greeter lobby. Those passengers terminating at BDL are then able to access parking and ground transportation while connecting passengers must collect their baggage and take a shuttle bus to Terminal A for check-in and flights. Beyond processing flights, the CBP facility at BDL also has services for walk-in Global Entry application processing. A potential new FIS facility is being considered as a western expansion to Terminal A.

2.4 PARKING AND ACCESS

This section details the existing inventory of parking, both on- and off-airport, as well as the existing traffic conditions at the departure and arrival levels of the airport. The data presented was gathered from a variety of sources, including on-site observations, information provided by the CAA's parking operator (SP Plus Corporation, or SP+), previous studies of the airport, and other public data sources.

The on-site observations were conducted on Tuesday, November 15, 2016. Tuesday is typically a busy weekday at BDL.

2.4.1 On-Airport Parking

The on-airport parking facilities are owned by the CAA and are operated by SP+, the largest parking operator in the United States. These facilities provide parking for a combination of public parkers, employees of airport vendors, airlines, and CAA.

Existing CAA Facilities

Parking facilities owned and controlled by the CAA consist of one parking garage, nine surface parking lots and additional parking spaces in close proximity to the airport designated for use by the CAA. In total, the CAA controls 8,362 parking spaces, of which 7,442 are for public parking and 920 are for airport employees and CAA staff.

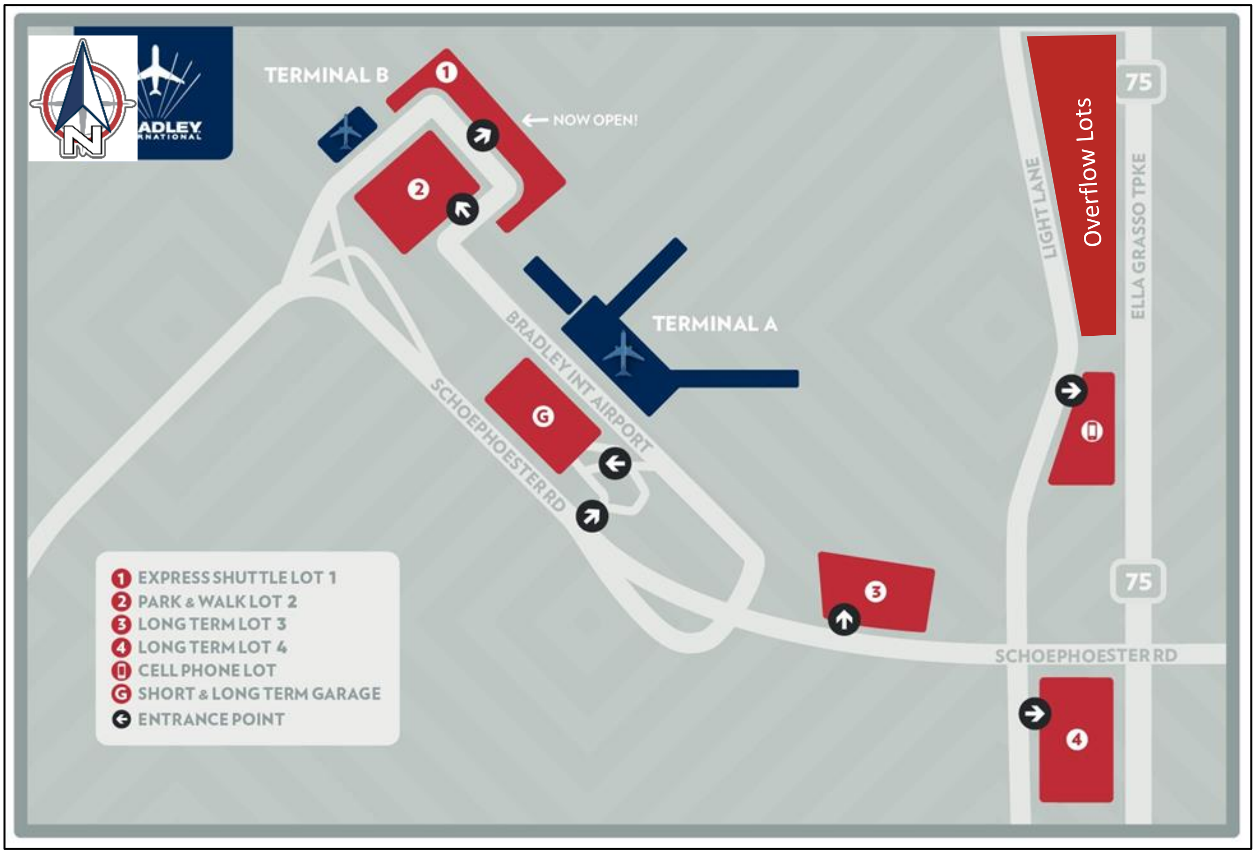
Table 2-5 presents a detailed listing of the existing CAA parking inventory by facility and type of user served. As shown in the "Facility ID" column in the table, each facility, aside from the parking garage, is identified by a number and/or letter, which corresponds to the labelling system used by the CAA. The geographical locations of the parking facilities are shown in **Figure 2-10**.

Table 2-5 – Existing CAA Parking Facilities

Facility ID	Public Parking Inventory	Employee Parking Inventory	Total Parking Inventory
Lot 1	794	0	794
Lot 2	794	0	794
Lot 3	728	0	728
Lot 4	577	0	577
Lot 5A (overflow)	377	0	377
Lot 5B (overflow)	572	0	572
Lot 5C (employee)	0	830	830
Cell Phone Lot	58	0	58
Garage	3414	0	3414
Garage Overflow Lot	128	0	128
VIP	0	90	90
TOTAL PARKING INVENTORY	**7442**	**920**	**8362**

Source: CAA, 2019

Figure 2-10 – On-Airport Parking Facilities



Source: CAA, 2019

A few items of note related to the existing on-airport parking inventory:

- The Garage inventory is divided into 3,017 spaces for long-term parkers and 397 spaces for short-term parkers, spaces which are physically separated within the Garage
- The VIP facility indicates spaces in close proximity to the passenger terminal, which may only be used by managers of airport tenants, not public parkers or other employees working at the airport
- At the time of the on-site observations, Lot 5A was not in use

Shuttle buses are used to move public parkers from lots 1, 3, 4, and 5B to the terminal building, as well as employees who park in Lot 5C. Employees and public parkers who park in Lot 2B, as well as public parkers from the Garage, walk from their parking location to the terminal.

Observed Occupancy

The on-site observations of parking and traffic activity on a Tuesday was intended to capture typical peak activity levels at the airport. Tuesday is a day when airports, including Bradley, experience typical weekly peak levels of activity. While the absolute peak activity period for most airports in the U.S. is the Thanksgiving holiday period, in terms of providing an adequate quantity of parking capacity, the goal is to accommodate the typical peak demand, not a period of extraordinary demand. If parking spaces were constructed to accommodate occasional demand spikes, a large number of spaces would sit empty for all but a few days of the year.

During the survey, the available CAA's public parking facilities, except for Lot 5B, were full and closed to additional parkers by noon. Signs were posted at the entrances to each of the facilities indicating that they were full, while additional signs directed parkers to Lot 5B.

In addition to the available capacity in Lot 5B, as noted previously, Lot 5A was not in use on the survey day. This parking facility contains an additional 377 spaces that could be used to accommodate surges in demand above the typical peak level.

Current Parking Rates

Table 2-6 presents the current rates charged for public parking in each of the CAA's facilities.

Table 2-6 – Existing CAA Public Parking Facility Rates

Facility ID	Public Parking Inventory	Current Parking Rates
Lot 1	520	Up to 1 Hr. - $4.00 1 – 2 Hrs. - $5.00 2 – 3 Hrs. - $6.00 Each Add. Hr. - $1.00 Daily Max. - $12.00 Weekly Max. (5-7 days) - $72.00
Lot 2B	401	Up to 1 Hr. - $4.00 1 – 2 Hrs. - $5.00 2 – 3 Hrs. - $6.00 Daily Max. - $10.00 Weekly Max. (6-7 days) - $60.00
Lot 3	728	Up to 1 Hr. - $4.00 1 – 2 Hrs. - $5.00 2 – 3 Hrs. - $6.00 Each Add. Hr. - $1.00 Daily Max. - $8.00 Weekly Max. (6-7 days) - $48.00
Lot 4	577	Up to 1 Hr. - $4.00 1 – 2 Hrs. - $5.00 Daily Max. - $6.00 Weekly Max. (6-7 days) - $36.00

Source: CAA, 2016

Table 2-5 – Existing CAA Public Parking Facility Rates (Continued)

Facility ID	Public Parking Inventory	Current Parking Rates
Cell Phone Lot	58	FREE (only for very short-term use)
Garage	3414	Up to ½ Hr. - $3.25 ½ – 1 Hr. - $5.50 1 – 1 ½ Hrs. - $7.25 Each Add. 30 Mins. or Part - $1.75 Daily Max. (Long Term) - $28.00 Daily Max. (Short Term) - $32.00 Weekly Max. (4-7 days LT) - $112.00
Garage Overflow Lot	128	Same as LT Garage Rates

Source: CAA, 2019

In addition to the parking fees listed in the above table, the State of Connecticut adds a 6.35% tax to the total parking charge. CAA currently outsources the operation of its on-airport parking facilities to SP+, which coordinates parking, transportation, curbside management and related services at BDL.

2.4.2 Off-Airport Parking

In addition to the more than 7,400 public parking spaces offered on-site by the CAA, a significant number of private companies operate off-airport parking in the vicinity of Bradley Airport. Of the 14 competing parking facilities identified, all but 2 of the facilities are located within a three-mile drive of the airport entrance. At an estimated 11,500 spaces combined, these facilities eclipse the total supply of CAA's public parking by 70%.

Existing Competing Facilities

Competing public parking is offered in 14 individual locations, all of which are surface parking lots. A few of the facilities provide a small number of covered parking spaces, but most of the spaces are open-air. Additionally, while a majority of the spaces are self-park, several locations also offer valet parking. As with the CAA's more remote on-airport parking locations, each of the off-airport parking competitors offers shuttle service from their parking facility or facilities to and from the terminal.

Table 2-7 presents a detailed list of the existing competing off-airport parking locations including the: facility name/owner/operator, address, estimated parking capacity, type of operation, and driving distance from the parking location to the airport entrance. In addition, the table includes a "Facility ID", which corresponds to the map of facility locations presented in **Figure 2-11**.

Table 2-7 – Competing Off-Airport Parking Facilities

Facility ID	Facility Name/ Owner/Operator	Facility Address	Estimated Capacity	Type of Operation	Driving Distance to Airport
A	Z Airport Parking	3 International Dr., East Granby, CT 06026	790	Self-Park/Valet	2.6 mi.
B	Executive Valet Parking	1186 South Street, Suffield, CT 06078	1760	Valet	2.8 mi.
C	Dollar Airport Parking	593 Elm St., Windsor Locks, CT 06096	140	Valet	1.0 mi.
D	Days Inn	185 Ella Grasso Tpke., Windsor Locks, CT 06096	146	Self-Park	0.7 mi.
E	Econo Lodge Inn & Suites	34 Old Country Rd., Windsor Locks, CT 06096	190	Self-Park	1.2 mi.
F	Roadway Inn & Suites	161 Bridge St., East Windsor, CT 06088	290	Self-Park	6.2 mi.
G	Baymont Inn & Suites	260 Main St., East Windsor, CT 06088	132	Self-Park	4.9 mi.
H	LAZ Fly Economy Parking	110 Ella Grasso Tpke., Windsor Locks, CT 06096	1060	Self-Park/Valet	0.8 mi.
I	La Quinta Inn & Suites	64 Ella Grasso Tpke., Windsor Locks, CT 06096	107	Self-Park	1.0 mi.
J	LAZ Fly Premier Parking	35 Ella Grasso Tpke., Windsor Locks, CT 06096	859	Self-Park	1.1 mi.
K	Quality Inn	5 Ella Grasso Tpke., Windsor Locks, CT 06096	191	Self-Park	1.1 mi.
L	LAZ Fly Premier Parking	24 Ella Grasso Tpke., Windsor Locks, CT 06096	1360	Valet	1.1 mi.
M	Roncari Valet Parking	9 Schoephoester Rd., Windsor Locks, CT 06096	3410	Valet	0.3 mi.
N	Galaxy Self-Park	9 Schoephoester Rd., Windsor Locks, CT 06096	1047	Self-Park	0.3 mi.

Source: CAA, 2016

Figure 2-11 – Competing Off-Airport Parking Facilities

Source: Desman, 2016

It should be noted that, for the self-park facilities, the parking capacities were counted from aerial photographs dated April 2016. For the valet or self-park/valet locations, the parking capacities were estimated based on the assumption that, at maximum efficiency, a valet parking facility can accommodate one vehicle in each 250 square feet of space.

Observed/Calculated Occupancy

For the off-airport competing parking lots, occupancy was estimated, but public data is not available for these facilities.

An examination of aerial photographs dated April 2016 provided an additional data point. In these aerials, aside from the hotel properties, all of the off-site competing parking locations appear to be very well utilized, with occupancy of the striped spaces in excess of 80%. On site observations at the largest off-airport parking locations confirm this general observation.

While this utilization data is mostly anecdotal, in combination with the high level of demand observed first-hand at all of the on-airport parking facilities, it is reasonable to conclude that, during peak demand periods, there is currently little surplus parking capacity available to serve the airport.

Current Parking Rates

Table 2-8 presents the rates charged (November 2016) at each of the competing off-airport parking locations.

Table 2-8 – Existing Parking Rates Charged by Off-Airport Competitors

Facility ID	Facility Name/ Owner/Operator	Estimated Capacity	Type of Operation	Current Parking Rates (per day)
A	Z Airport Parking	790	Self-Park/Valet	$9.99/Self-Park; $11.99/Valet
B	Executive Valet Parking	1760	Valet	$10.00
C	Dollar Airport Parking	140	Valet	$7.99
D	Days Inn	146	Self-Park	$7.00
E	Econo Lodge Inn & Suites	190	Self-Park	$6.00
F	Roadway Inn & Suites	290	Self-Park	$6.00
G	Baymont Inn & Suites	132	Self-Park	$6.00
H	LAZ Fly Economy Parking	1060	Self-Park/Valet	$5.95/Self-Park; $9.95/Valet
I	La Quinta Inn & Suites	107	Self-Park	$7.50
J	LAZ Fly Premier Parking	859	Self-Park	$7.49
K	Quality Inn	191	Self-Park	$6.00
L	LAZ Fly Premier Parking	1360	Valet	$11.99
M	Roncari Valet Parking	3410	Valet	$10.95
N	Galaxy Self-Park	1047	Self-Park	$5.95

Source: Company Websites, 2016

As noted with the on-airport parking rates, each of the off-site competitors charges a 6.35% tax (paid to the State of Connecticut), along with a fuel surcharge, on top of the daily parking charge.

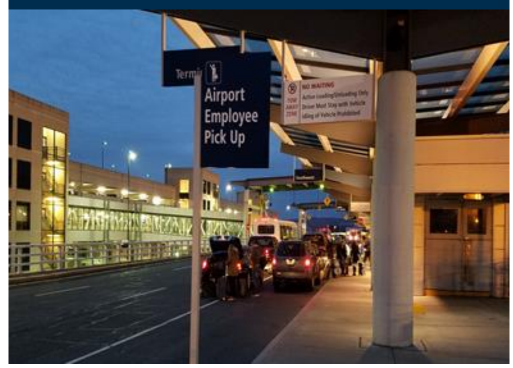
It is also important to note that, while these are the posted rates on the various company's websites and advertised at the facilities, a number of these facilities offer discount coupons, frequent parker programs or other incentives which many reduce the per day price paid to park.

2.4.3 Curb Front Traffic

In order to determine the capacity of the airport curb front to accommodate future levels of vehicular activity, it is necessary to first understand the functionality of the curb front during current periods of peak demand. For this reason, observations of traffic flow and congestion were performed at the airport on the same day as the observations of parking activity, Tuesday, November 15, 2016. On this day, vehicle volumes were recorded for a sample time period, traffic backups were noted of the current conditions.

Observations

Vehicle volumes were observed on the Departures level of the airport roadway from 6AM – 6:30AM on the survey day. This time period was chosen as a period of peak departure activity. During this time period, the number of different types of vehicles that passed the terminal building on this level were recorded. The type and number of vehicles recorded were as follows:



Terminal Curbside Pickup

- Passenger Cars: 114
- Taxi Cabs: 4
- Parking Shuttles: 32
- Hotel Shuttles: 5
- Rental Car Shuttles: 9
- Other Vehicles: 3

A few items of note related to the observations:

- Passenger cars were not distinguishable between family or friends dropping off passengers versus riding sharing services (i.e. Uber, Lyft, etc.).
- The "Parking Shuttle" figure includes both those from off-site competitors and the CAA's shuttles from the more remote on-airport parking lots.
- The "Other Vehicles" category accounts for Police vehicles, delivery trucks and vehicles that did not fall into another category.

The majority of loading and unloading activity observed occurred at the near end of the terminal building, closest to the entrance to the airport roadway. This is the location of the Southwest and JetBlue ticket counters, as well as the location of the pick-up/drop-off airport for the airport employee shuttle, although no employee shuttles were observed during this time period. Unloading, especially by passenger cars, seemed to occur as close as possible to the near end of the terminal building – this is the most visible area of curb to a vehicle approaching the terminal. Many vehicles, particularly CAA and third party parking shuttles, unloaded from the 2nd lane from the curb. This type of activity even occurred, on occasion, when the curb lane was open.

In addition to the traffic volumes and unloading activities, in general, passenger vehicles were observed to slow down significantly upon approach to the terminal looking for an open curb to unload. This, in turn, caused delays to vehicles behind the slowing vehicle. Several passenger vehicles were also observed parked on the airport roadway, near the employee shuttle stop, with no one in the vehicles. Vehicles were not observed queuing past the end of the departure level bridge. In other words, no traffic backups were observed during the survey.

2.5 SUPPORT FACILITIES

Support facilities provide vital functions related to the overall operation of the Airport, and typically include facilities related to air traffic control, fuel storage, aircraft rescue and firefighting (ARFF), snow and ice control, and Airport storage and maintenance.

2.5.1 Air Traffic Control Tower (ATCT)

The current Air Traffic Control Tower (ATCT) opened in 1999. and is located north of the intersection of Runways 6-24 and 15-33. In addition to administrative and support facilities for local FAA operations at BDL, this facility also houses the Yankee Terminal Radar Approach Control (Yankee TRACON). This TRACON is the responsible air traffic control center for the 40-mile airspace around BDL, and all airports within that range. Yankee TRACON operates five radar positions and has a staff of approximately 30 individuals.

2.5.2 Aircraft Fueling

Bradley International Airport's fuel farm complex is located southwest of the terminal area, across the access drive from the International Arrivals Building. This fuel farm is supplied via underground pipelines originating in New Haven, Connecticut. The storage capacity of the fuel facility is approximately 2,670,000 gallons of Jet-A, and 55,000 gallons of Avgas. Fueling services at BDL are handled by Aircraft Services International Group (ASIG), which is under the same ownership as FBO, Signature Flight Support.

2.5.3 Aircraft Rescue and Fire Fighting (ARFF)

There are two Aircraft Rescue and Fire Fighting (ARFF) facilities at Bradley International Airport. The east facility (Fire Station No. 1) is located near the threshold of Runway 33 along Taxiway 'T', and was built in 2000. The west ARFF facility (Fire Station No. 2) is located along an airside service road on the north side of the Airport. The Connecticut Fire Training School is affiliated with the Airport and operates from this ARFF station. The Fire Training School is further discussed in **Section 2.9.2**.

The ARFF level of service, or index, is determined by the longest scheduled passenger aircraft with at least five daily departures. The Airport currently operates with an ARFF Index of 'D' corresponding to the Boeing 757 aircraft. **Table 2-9** identifies the ARFF Index requirements mandated by the FAA.

Table 2-9 – ARFF Index Requirements

Index	Aircraft length (Feet)	Vehicles	Extinguishing Agents
A	<90	1	Either 500 pounds of sodium-based dry chemical, Halon 1211 or clean agent; or 450 pounds of potassium-based dry chemical and water with a commensurate quantity of AFFF to total 100 gallons for simultaneous dry chemical and AFFF application
B	90 to <126	1	500 pounds of sodium-based dry chemical, Halon 1211 or clean agent and 1,500 gallons of water and the commensurate quantity of AFFF for foam production
		2	One vehicle carrying the extinguishing agents as specified for Index A; and one vehicle carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by both vehicles is at least 1,500 gallons
C	126 to <159	2	One vehicle carrying the extinguishing agents as specified for Index A; and one vehicle carrying water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by both vehicles is at least 3,000 gallons
		3	One vehicle carrying the extinguishing agents as specified for Index A; and two vehicles carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 3,000 gallons
D	159 to <200	3	One vehicle carrying the extinguishing agents as specified for Index A; and two vehicles carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 4,000 gallons
E	>200	3	One vehicle carrying the extinguishing agents as specified for Index A; and two vehicles carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 6,000 gallons

Source: 14 CFR Part 139, Aircraft Rescue and Firefighting, 2016.

2.5.4 Snow and Ice Control

During the winter seasons, snow removal personnel at BDL are on-call at all times to ensure adequate response to weather events. The on-duty airfield maintenance/operations staff is responsible for monitoring the current and/or forecast weather conditions. Conditions are monitored throughout the day and/or as often as conditions dictate. Sources of weather information include National Weather Service, the Meterlogix subscription service, the Airport's Automated Surface Observation System (ASOS) weather station, and the Airport's pavement sensor system.

Airfield maintenance/operations personnel are responsible for clearing contaminants from all surfaces located within the Airfield Operations Area (AOA). The objective is to ensure the safe transition of aircraft, vehicles and personnel at all times. Runways and taxiways are cleared with a combination of rotary high-speed brooms, plows and/or snow blowers. Various methods and techniques are employed at the discretion of the Airport staff (i.e., V-formation, close wing formation, etc.). Runways are cleared both full length and width. Ramp and terminal areas are cleared with a combination of ramp blades, brooms, plows and/or blowers. The primary maintenance facility is located along Light Lane, with access to taxiways ‘C’ and ‘E’. A second facility is located on Fire House Road, with access to Taxiway ‘T’. Most equipment is stored in heated indoor facilities in order to ensure proper operations when needed.

The deicing apron at BDL is approximately 48,800 SY, and is located parallel to the south end of Taxiway ‘C’, just southwest of the terminal area. This apron is capable of servicing up to three aircraft simultaneously.

2.6 AIR CARGO FACILITIES AND ACTIVITIES

Bradley International Airport leases property for two separate air cargo-dedicated areas. The facility on the west side is made up of two multipurpose processing buildings occupied primarily by FedEx and DHL. The facility on the east side is operated and maintained by UPS. Typical belly cargo operations carried out by scheduled air carriers are handled from two multipurpose buildings east of the terminal area. The U.S. Postal Service operates an air mail facility adjacent to the belly cargo hangars, however they typically utilize belly freight loaded onto scheduled airline flights for actual operations. The total existing cargo building area is approximately 270,000 square feet of handling space.

2.7 GENERAL AVIATION (GA) FACILITIES AND ACTIVITIES

There is a mix of general aviation activity at Bradley International Airport, supporting the operations of corporate tenants and users.

2.7.1 Fixed-Base Operators (FBOs)

As discussed previously, there are two FBOs at BDL, providing hangar storage and typical GA support services.

- **Signature Flight Support** provides 25,400 square feet of hangar storage in their facility, as well as aircraft maintenance, pilot lounges, on-call customs, Avgas and Jet-A fueling, deicing, and ground handling.
- **TAC Air** provides 10,000 square feet of hangar storage, as well as aircraft maintenance, pilot lounges, on-call customs, Avgas and Jet-A fueling, and deicing, as well as overnight and extended stay hangar and tiedown facilities.

2.7.2 Aircraft/Cargo Storage

A mix of public and private buildings serves the various aircraft storage and maintenance needs at BDL. More than 50 buildings, many with hangar and office space, currently exist on airport property. **Table 2-10** lists hangar and cargo facilities at BDL, with their respective Building Number corresponding to their location depicted on **Figure 2-2**. Vehicle garages are not included in the table.

Table 2-10 – Storage Facilities

Building	Building Number	Owner/Leasee	Approximate Square Footage
Belly Cargo Facility #1	8	CAA	77,600
Belly Cargo Facility #2	9	CAA	32,800
U.S.P.S Air Mail	10	United States Postal Service	53,500
Corporate Hangar	14	TAC Air	50,900
Corporate Hangar/FBO Terminal	15	TAC Air	35,500
Corporate Hangar	16	TAC Air	35,500
UPS Air Cargo	18	UPS	59,600
UPS Air Cargo	19	UPS	16,500
Corporate Hangar	20	Travelers Insurance	24,100
Corporate Hangar	21	Cigna Insurance	41,000
Bombardier Hangar	23	Bombardier	55,600
Bombardier Hangar	24	Bombardier	87,000
Army National Guard Hangar	29	Army National Guard	41,800
Army National Guard Hangar	30	Army National Guard	33,200
New England Air Museum Hangar #1	34	Connecticut Aeronautical Historical Association	43,000
New England Air Museum Hangar #2	35	Connecticut Aeronautical Historical Association	38,000
New England Air Museum Hangar #3	36	Connecticut Aeronautical Historical Association	20,000
Cargo Facility #1	37	CAA	50,800
Cargo Facility #2	38	CAA	50,800
Signature Flight Support Hangar	40	Signature Flight Support	98,700
CT Air National Guard Hangars	41	Connecticut A.N.G.	87,000 (combined)
Embraer Hangar	49	Embraer	75,300

Source: BDL Building Tennant List and BDL Staff, revised October 2016.
Note: Approximate square footage accounts for total building size (obtained from latest aerial survey).

2.8 MILITARY FACILITIES AND ACTIVITIES

The Connecticut Air National Guard operates a large complex of hangars, apron, and support facilities at the southwest end of the airfield. This base is home to the 103d Airlift Wing and the 118th Airlift Squadron. The squadron operates the Lockheed C-130, based at the Airport, and handles regular operations involving the KC-135R and C-17 aircraft. In addition, the Connecticut Wing Civil Air Patrol functions from this facility.

The Connecticut Army National Guard (ANG) operates a facility in the northeast section of the airfield with two hangars, an apron, and support facilities. This post is home to the ANG's 169th, 104th and 142nd Aviation Regiments, which handle various Army Operations, MedEvac, and Air Assault support with a fleet that include the UH60 Blackhawk and CH47 Chinook helicopters, and C12 Fixed Wing aircraft.

2.9 NON-AERONAUTICAL ACTIVITIES

In addition to the activities directly related to aviation explained above, Bradley International Airport also provides space for activities that are indirectly related to aviation.

2.9.1 New England Air Museum

The New England Air Museum is located near the Embraer facilities and ATCT, on the north edge of the airfield. While on airport property, the Museum is not connected to the airport's taxiway system, or within the airfield operations area (AOA). The museum is operated by the independent Connecticut Aeronautical Historical Association, and consists of several display buildings, a storage yard, and a visitor's center.

2.9.2 Connecticut Fire Training School

The Connecticut Fire Training School is located on Airport grounds at a facility shared with the ARFF Station West. The school is used for training fire and rescue personnel throughout the state, and includes training grounds, a training tower, pump house, tank farm, 'burn building', and use of the functional BDL ARFF facility for student training.

2.10 AIRSPACE ENVIRONMENT

The U.S. National Airspace System (NAS) is an integrated collection of controls, procedures and policies implemented and regulated by the FAA to ensure safe and efficient air operations. The NAS is divided into airspace classes to designate the level of service and operating rules for a given area. The following sections describe the airspace classifications, aeronautical charts and instrument approach capabilities at BDL.

2.10.1 Airspace Classification

The NAS has been divided into airspace classes to designate the level of Air Traffic Control (ATC) service and operating rules for a given area. Classes A, B, C, D and E are the controlled airspaces and Class G is uncontrolled.

Class A airspace is the most restrictive of the airspace classes. It covers the entire nation and is applied to airspace between 18,000 feet above mean sea level (MSL) and 60,000 feet MSL. Within Class A airspace, the aircraft must be operating under instrument flight rules (IFR). This requires the aircraft to have filed a flight plan with the FAA and to operate the aircraft in a certain manner.

Class B airspace surrounds the busiest airports in the nation (either greater than 3.5 million enplanements or operations greater than 300,000 annually, of which 50 percent are air carrier operations). Class B airspace is generally from the surface to 10,000 feet MSL. This airspace is designed to contain arriving and departing commercial air traffic operating under IFR. Any aircraft operating in the Class B airspace must have ATC clearance. Boston-Logan, New York-JFK, New York-LaGuardia, and Newark Liberty are all located in Class B airspace.

Class C airspace surrounds airports with moderate traffic (greater than 75,000 annual instrument operations or greater than 250,000 enplanements annually). Class C airspace generally ranges from the surface to 4,000 feet MSL. Bradley International Airport is located within Class C airspace, extending from the runway surface up to 4,200' MSL for a 5 nm radius. The Class C area identifies the airport as a busy commercial facility, and requires two-way communication by all aircraft with ATC. Air traffic services are provided to all aircraft within Class C airspace and aircraft must be equipped with a transponder providing both horizontal and vertical position information. The Class C area also has an outer 10 nm ring that exists between 2,100' and 4,200' MSL. As shown in **Figure 2-13**, two general aviation airports are location beneath this outer ring. Procedures are in place to enable safe operations at these small airports and BDL.

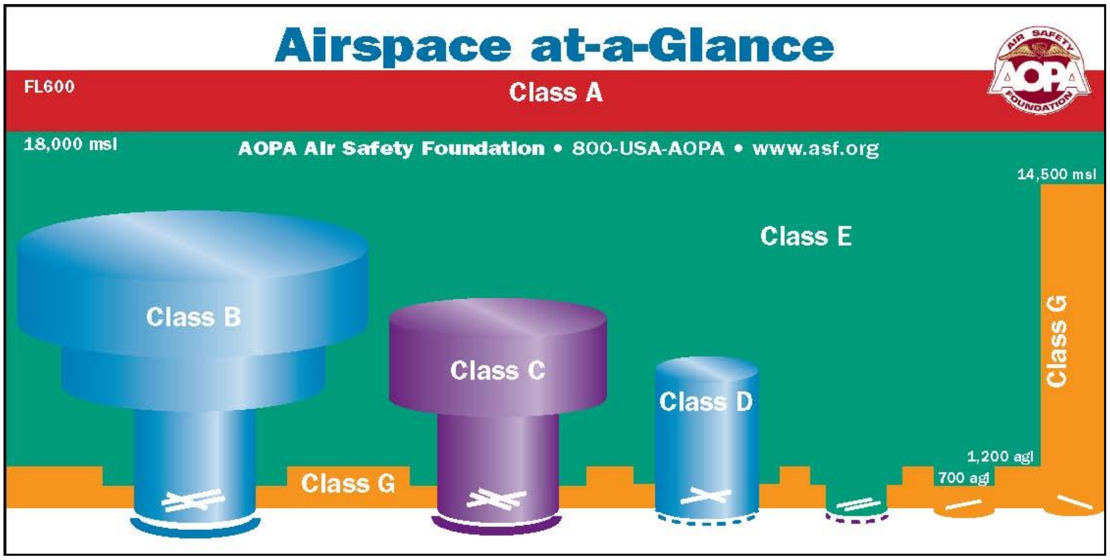
Class D airspace is used for smaller airports that have a control tower and do not meet the criteria established for Class C airspace. It generally ranges from the surface to 2,500 feet MSL. Aircraft operating in Class D airspace must establish two-way radio communication with ATC prior to entering the airspace. Hartford-Brainard Airport to the south, and Westfield-Barnes Regional Airport to the north are located in Class D airspace.

Class E airspace represents all other controlled airspace. This class of airspace ranges from the surface to 18,000 feet above MSL at Class E airports and, when specified, from 700 feet above ground level (AGL) to 18,000 MSL. Airports within this class of airspace do not require a control tower but do have cloud clearance and visibility requirements. Class E airspace can also be considered the “filler” airspace under Class A, above Class G and between Classes B, C and D and has the same operational requirements there as other Class E environments. The nearby Simsbury and Skylark airports are located in Class E airspace.

Class G airspace is uncontrolled airspace. It represents a mantle of low-lying airspace beginning at the surface up to 700 feet AGL. In very remote areas, it has an upper limit at 14,500 feet MSL.

A graphic of the NAS classification is presented in **Figure 2-12**.

Figure 2-12 – U.S. Airspace Classification



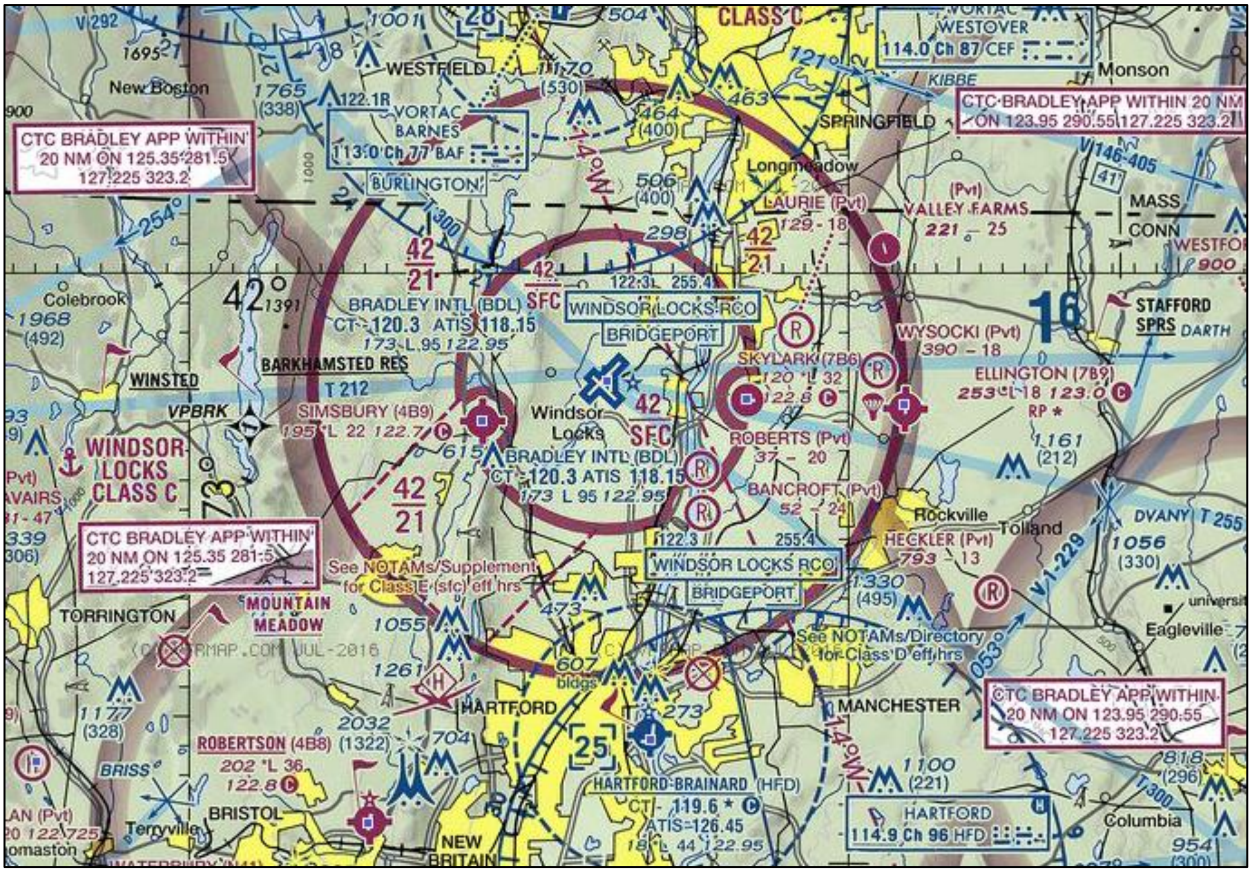
Source: AOPA Online, 2016.

2.10.2 Aeronautical Charts

The National Aeronautical Charting Office (NACO) of the FAA publishes special aeronautical charts used by pilots to navigate through the National Airspace System. These charts are called sectional charts or sectionals. A sectional chart provides detailed information on airspace classes, ground-based NAVAIDS, radio frequencies, longitude and latitude, navigational waypoints and navigational routes. It also offers topographical features, such as terrain elevations and ground features that are important to aviators, such as landmarks that will be identifiable from altitude. Although these charts are used for Visual Flight Rule (VFR) and Instrument Flight Rule (IFR) navigation, they are a VFR pilot’s primary navigation tool.

Figure 2-13 displays a segment of the New York Sectional Chart, centered on BDL.

Figure 2-13 – BDL Aeronautical Chart



Source: SkyVector.com, 2016.

2.11 METEOROLOGICAL CONDITIONS

Winds, precipitation and temperature conditions influence decisions pertaining to NAVAIDS, runway orientation and required runway length at an airport. BDL is equipped with an Automated Surface Observation System (ASOS). This is a weather data sensing, processing and dissemination system, designed to support weather forecast activities and aviation operations. Controlled and maintained by the FAA, ASOS observes, formats, archives and transmits observations automatically, and transmits a special report when conditions exceed preselected weather element thresholds through an automated VHF airband radio frequency (118.150 MHz) to pilots operating at or near BDL. These messages are also available by calling 860-627-9732.

2.11.1 Local Climate

The average annual temperature is 50.6 degrees Fahrenheit; the average low is 40.3 degrees Fahrenheit; and the average high is 60.8 degrees Fahrenheit. The mean temperature of the hottest month (July) has an average temperature of 85 degrees Fahrenheit. Average monthly precipitation ranges from 2.87 inches to 4.37 inches, with an annual average of 45.8 inches. Average monthly snowfall ranges from 1 inch to 12 inches (November to April), with an annual average of 39 inches. The local climate requires the Airport to support snow removal and aircraft deicing services. This climate data for Windsor Locks, Connecticut was obtained from the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS).

2.11.2 Wind Coverage

In addition to climate data, the ASOS (Station 725080 – Windsor Locks, CT) at BDL collects wind speed and direction data, which can influence airfield development decisions on runway orientation and length at an airfield. Ideally a runway is oriented with the prevailing wind, as landing and flying the aircraft into the wind enhances its performance and improves safety. It is the recommendation of the FAA that the primary runway at an airport have at least 95 percent wind coverage, which means that 95 percent of the time, the wind at an airport is within certain limits of crosswind conditions. Wind coverage is calculated using the highest crosswind component that is acceptable for the type of aircraft expected to use the runway system. Larger aircraft have a higher tolerance for crosswinds than smaller aircraft due to their size, weight and operational speed.

Table 2-11 provides the standard crosswind component by aircraft size.

Table 2-12 outlines the weather classification criteria and the number of recorded observations at BDL between 2005 and 2015.

Table 2-11 – Crosswind Components

Aircraft Category	Maximum Crosswind Component
A-I and B-I aircraft	10.5 knots
A-II and B-II aircraft	13.0 knots
A-III, B-III, C-I through C-III D-I through D-III	16.0 knots
A-IV, B-IV, C-IV through C-VI, D-IV through D-VI	20.0 knots
E-I through E-VI	20.0 knots

Source: FAA AC/5300-13A *Airport Design*

Table 2-12 – Weather Classification Criteria

Weather Class	Recorded Observations at BDL (2005-2015)
All Weather	119,314
VFR Conditions	91,749
IFR Conditions	18,459

Source: NOAA, National Climate Center; Station 725080 (2005-2015)

VFR – Visual Flight Rule

IFR – Instrument Flight Rule

The combination of the crosswind and the weather classification allows for the calculation of the wind coverage, BDL as presented in **Table 2-13**.

Table 2-13 – BDL Wind Coverage

	Runway	10.5 Knots	13 Knots	16 Knots	20 Knots
AW	6-24	89.31%	94.19%	98.32%	99.64%
	15-33	95.66%	98.13%	99.55%	99.9%
	1-19	93.41%	96.28%	98.7%	99.69%
	All Combined	99.53%	99.88%	99.98%	100.0%
VFR	6-24	88.88%	93.87%	98.25%	99.64%
	15-33	95.54%	98.03%	99.52%	99.9%
	1-19	92.46%	95.75%	98.52%	99.66%
	VFR Combined	99.47%	99.86%	99.98%	100.0%
IFR	6-24	91.0%	95.43%	98.5%	99.62%
	15-33	96.42%	98.62%	99.64%	99.89%
	1-19	98.0%	98.87%	99.52%	99.8%
	IFR Combined	99.81%	99.91%	99.96%	99.99%

Source: NOAA, National Climate Center; Station 725080 (2005-2015)

Weather observations are presented in a format that is specifically designed by the FAA to be useful for evaluating weather conditions at an airport. Wind direction is grouped according to a 16-point compass rose (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW and NNW). Wind speed is tabulated into groups of 0-3, 4-12, 13-15, 16-18, 19-24, 25-31 and 32 knots per hour or greater. This data is typically displayed on a wind rose for each weather classification. The all-weather, VFR, and IFR windroses are depicted in Error! Reference source not found..

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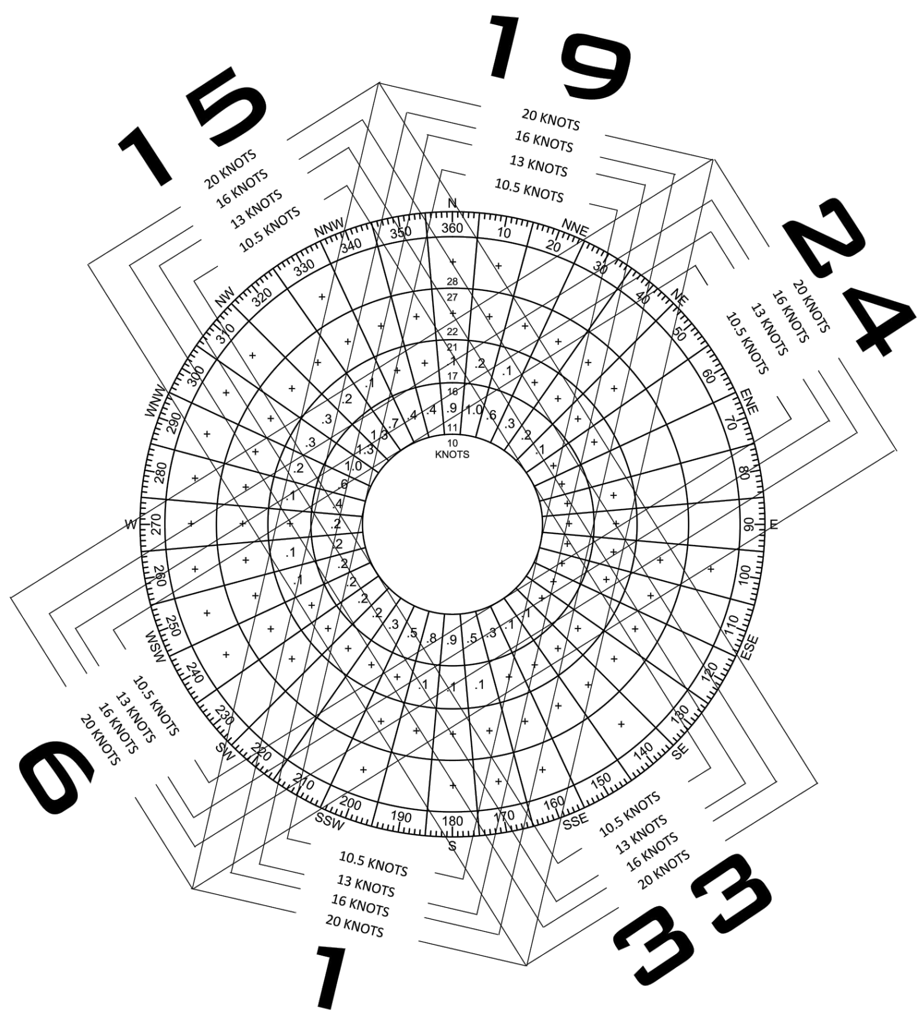
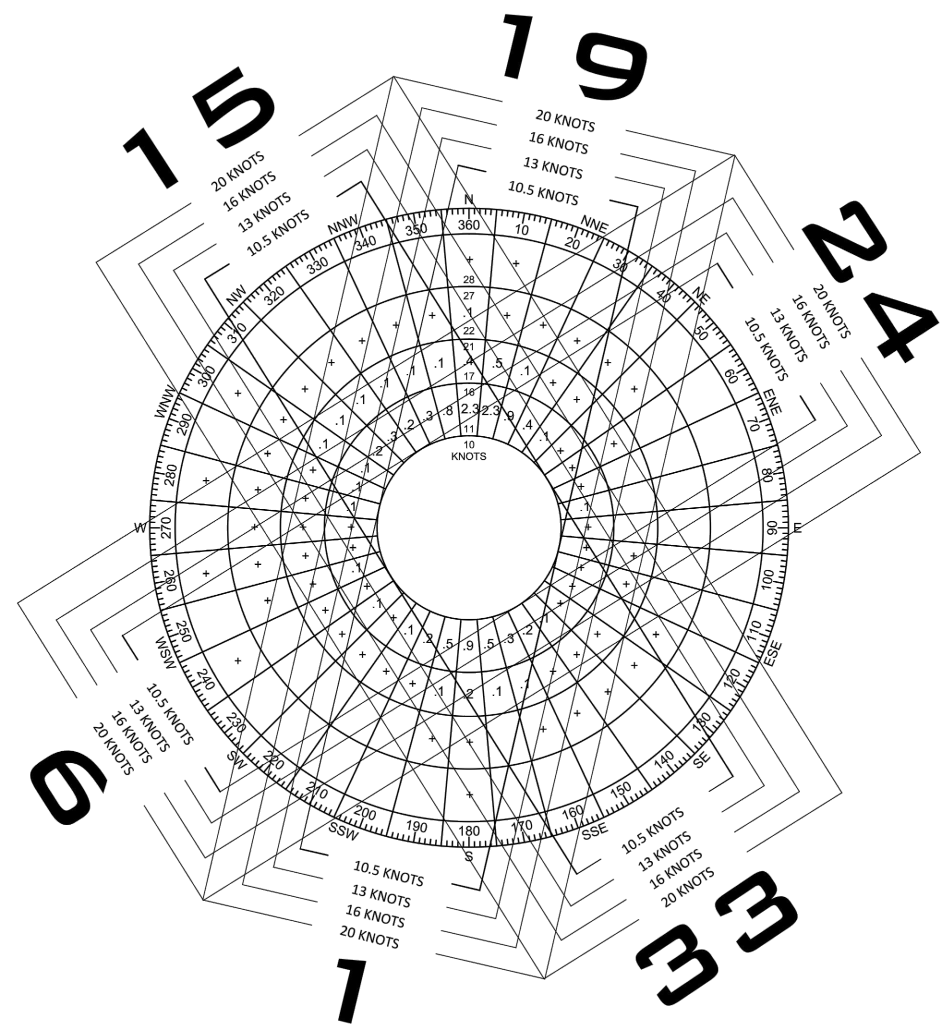
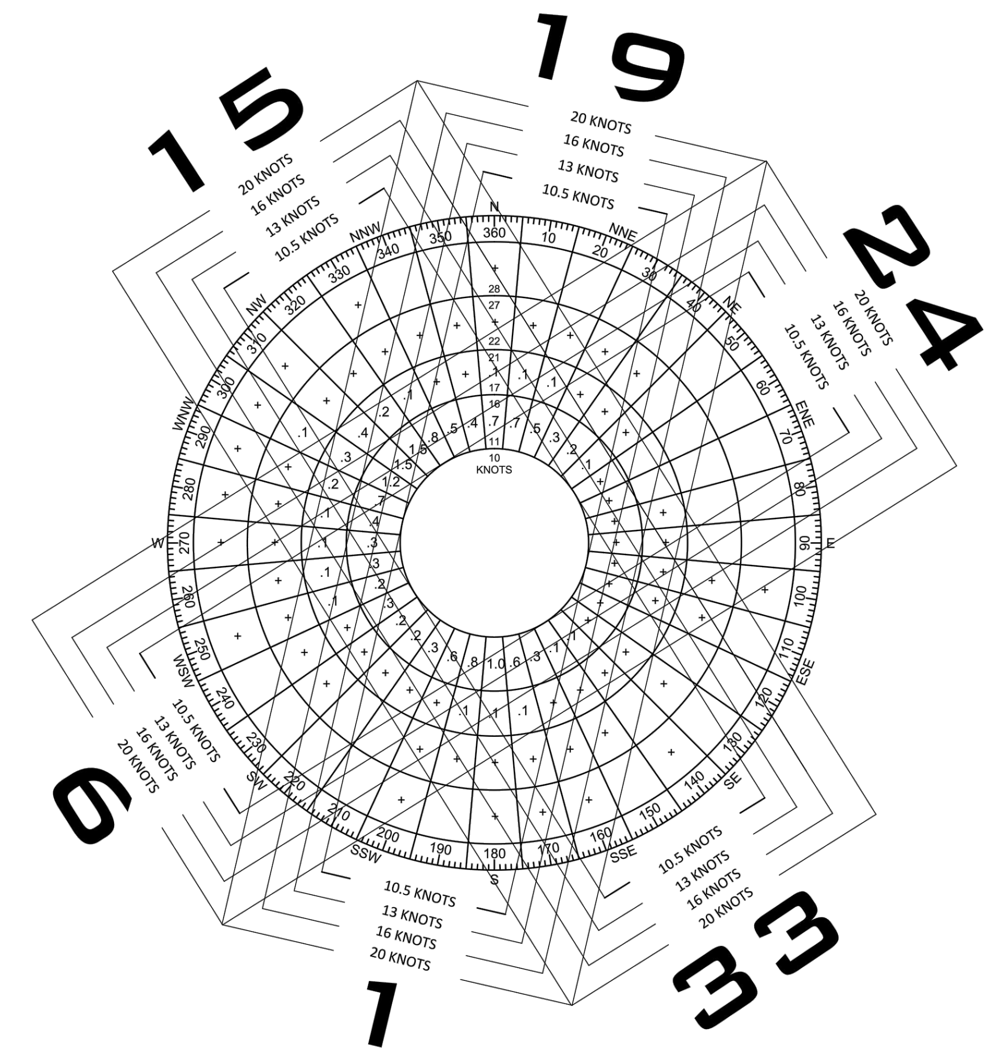
All-Weather Conditions



IFR Conditions



VFR Conditions



All Weather Conditions

Runway	10.5 Knots	13 Knots	16 Knots	20 Knots
6-24	89.31%	94.19%	98.32%	99.64%
15-33	95.66%	98.13%	99.55%	99.9%
1-19	93.41%	96.28%	98.7%	99.69%
All Combined	99.53%	99.88%	99.98%	100.0%

IFR Conditions

Runway	10.5 Knots	13 Knots	16 Knots	20 Knots
6-24	91.0%	95.43%	98.5%	99.62%
15-33	96.42%	98.62%	99.64%	99.89%
1-19	98.0%	98.87%	99.52%	99.8%
All Combined	99.81%	99.91%	99.96%	99.99%

VFR Conditions

Runway	10.5 Knots	13 Knots	16 Knots	20 Knots
6-24	88.88%	93.87%	98.25%	99.64%
15-33	95.54%	98.03%	99.52%	99.9%
1-19	92.46%	95.75%	98.52%	99.66%
All Combined	99.47%	99.86%	99.98%	100.0%

Figure 2-14
All-Weather, IFR, and VFR Windroses

3 FORECASTS OF AVIATION ACTIVITY

3.1 INTRODUCTION

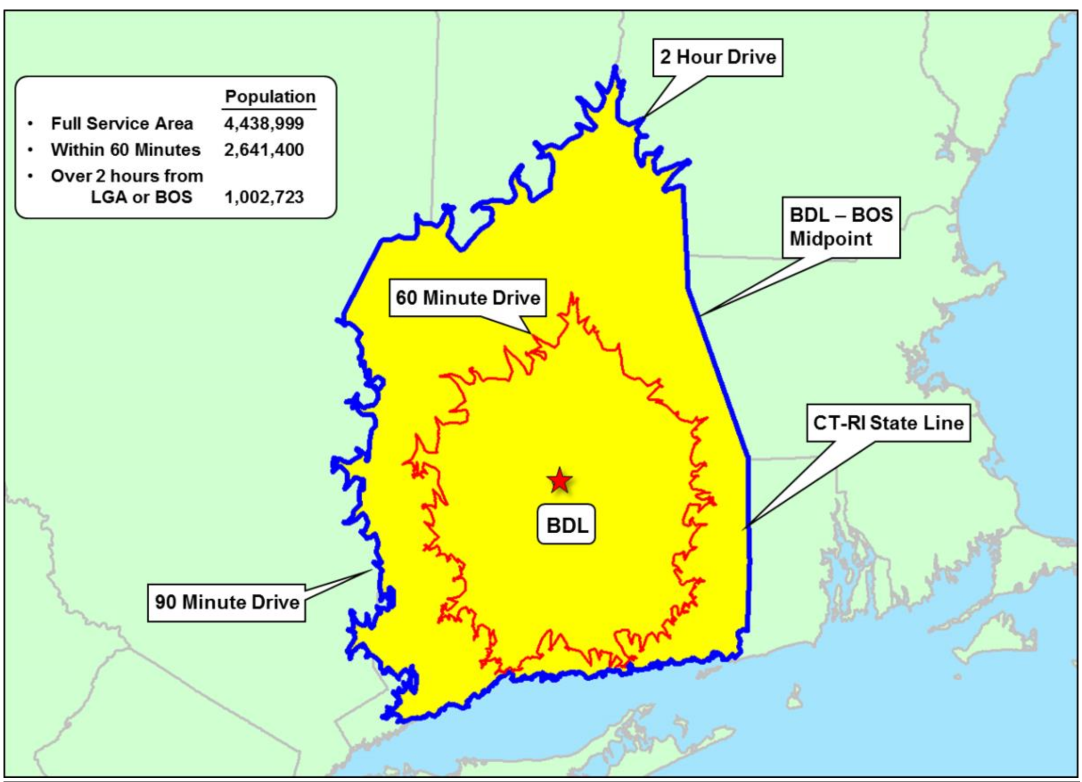
This paper presents the overall airport activity forecast for the 5, 10, and 20-year planning horizons. It includes the commercial passenger and cargo forecasts for Bradley International Airport Master Plan Update (BDL) through 2037. The forecast analysis is based on publicly available data, interviews and in-house expertise on BDL's commercial air service and cargo work.

The findings and projections in this forecast are subject to a number of assumptions that should be reviewed and considered. No assurances can be given that the projections and expectations discussed in the forecast will be achieved. Actual results may differ from the forecasts in this report.

3.1.1 BDL Catchment and Core Area

The catchment area for BDL traffic covers the state of Connecticut (except for the southern part of Fairfield County), western Massachusetts and small portions of New York, Vermont and New Hampshire. The catchment area is bounded on the east by the CT/RI border, on the northeast by the approximate driving mid-point between BDL and Boston (BOS), on the north by a 2-hour drive time, on the west by a 90-minute drive time, and on the south by the Long Island Sound. Approximately 80-85% of BDL's originating passengers reside in the catchment area. **Figure 3-1** depicts the Airport's catchment area and average distance to its boundaries.

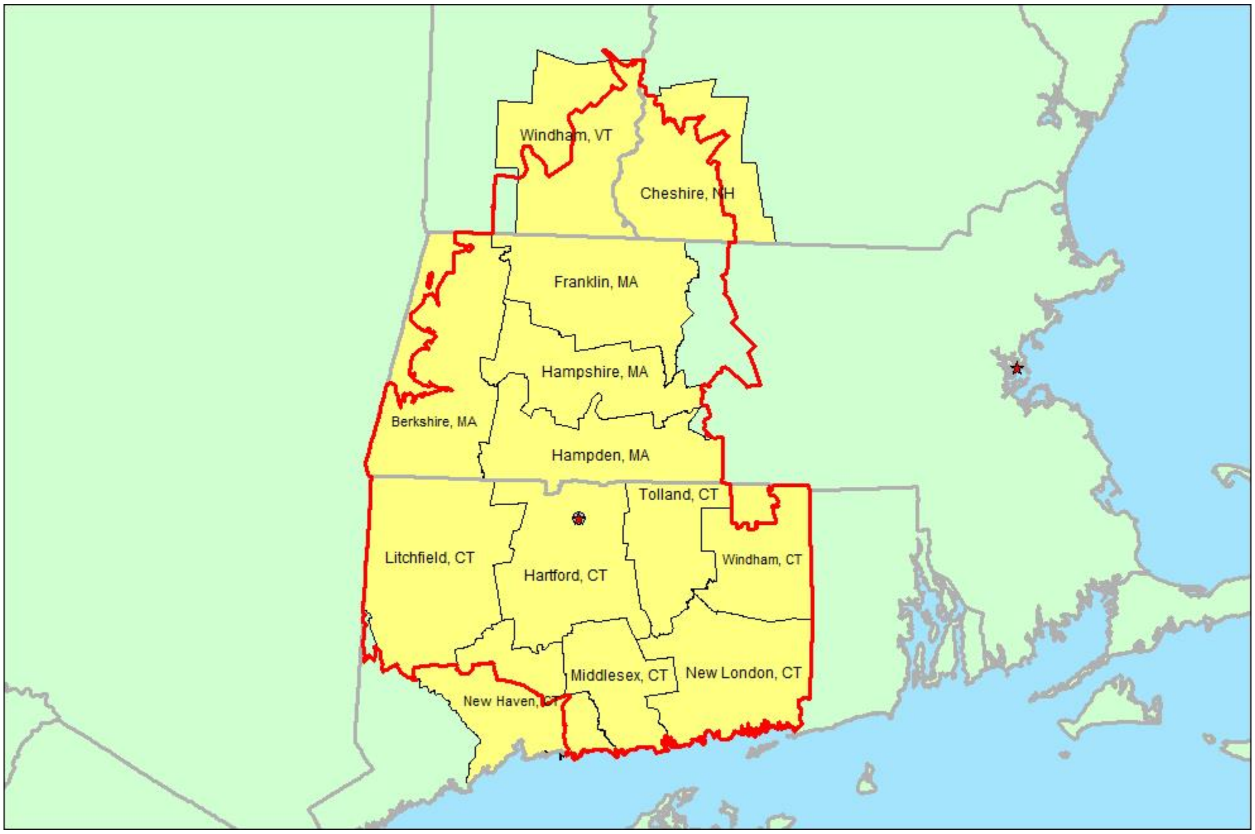
Figure 3-1 – BDL Catchment Area



Source: U.S. Census Bureau 2014

Based on its location relative to major airports in the New York and Boston metropolitan areas, BDL depends on a core area within its catchment area for a large portion of its passenger activity (67% of the airport's domestic passengers and 79% of its international passengers). **Figure 3-2** shows that this core area outlined in red which includes most of the 13 counties in Connecticut, Massachusetts, Vermont and New Hampshire.

Figure 3-2 – BDL Core Area



Source: Campbell-Hill Aviation Group

3.1.2 Socioeconomic Data

The economic and demographic growth patterns for this core area will have a major impact on future demand for air services at BDL.

The Hartford metropolitan statistical area (MSA) (including Hartford, Middlesex and Tolland counties) had a population of 1.2 million in 2015 while the larger 13-county core area included 3.8 million persons. Core area population growth between 2000 and 2015 averaged 0.3% per year which was below the national average of 0.9% as well as below the New England regional average of 0.4%[1].

The core area accounted for $188 billion of household income for 2015 (in current dollars) with the Hartford MSA accounting for about one-third of that total. The average household income

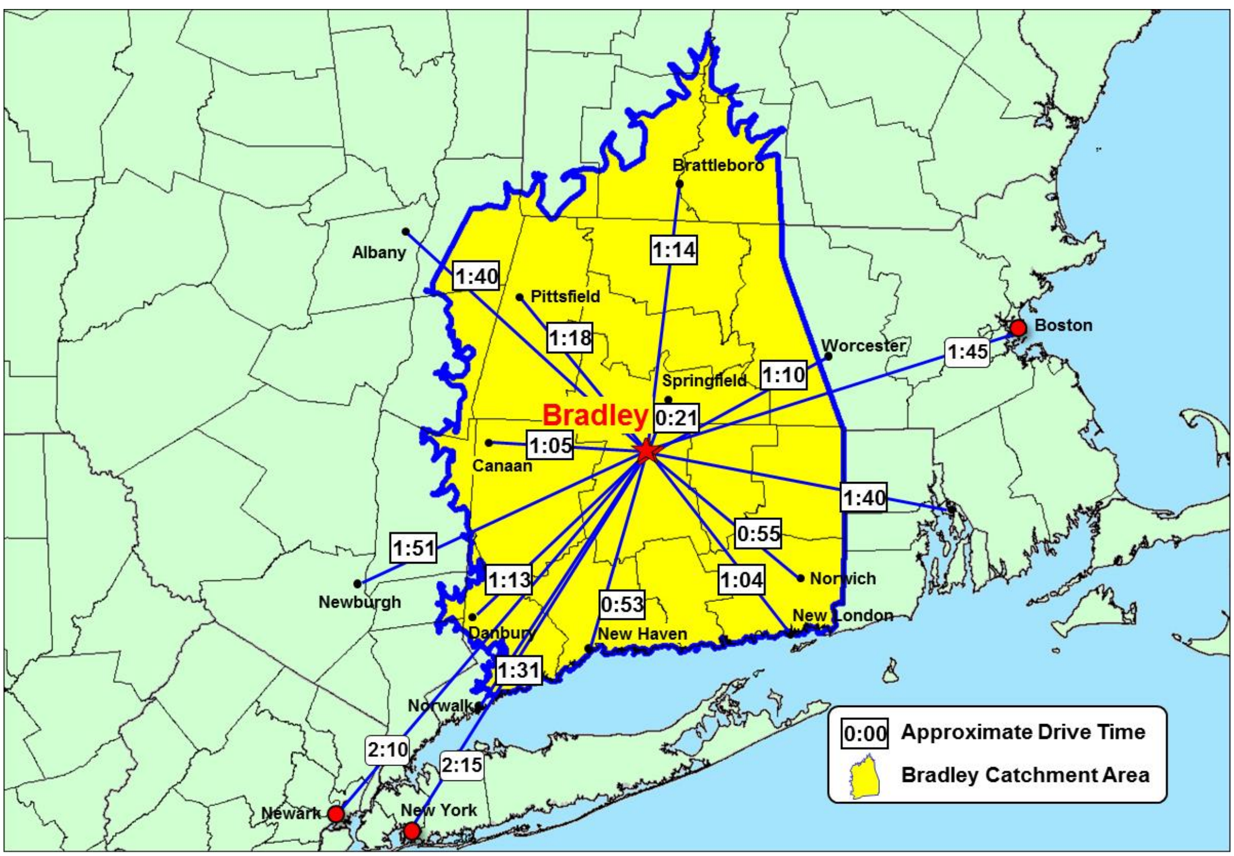
[1] Source: Woods and Poole 2016 CEDDS data.

of $122,627, in the core area, slightly exceeded the national average of $118,206 but was below the New England regional average. Average income for the Hartford MSA was $136,517 which was slightly below the regional average. Income growth for the core area from 2000 to 2015 was below the national and regional averages in terms of both total and average household income. In terms of industrial production, the core area's gross regional product growth of 1.1% from 2000 and 2015 was also below the national (1.9%) and regional (1.3%) averages.

Growth in the core area's population base and economy through 2037 is also projected to be less than national averages. Population growth is projected to average 0.4% per year compared to 0.9% for the U.S. and 0.5% for the region. In real terms, average household income is projected to match national growth rates (1.5% per year), although lower population and household growth yields lower growth in total income. The core area's gross regional product growth is projected at 1.8% per year (in real terms) which is equal to MSA and regional growth but below the national projection.

BDL has significant upside to grow the number of passengers that use the airport due to its convenient location to a large base of population as shown in **Figure 3-3**.

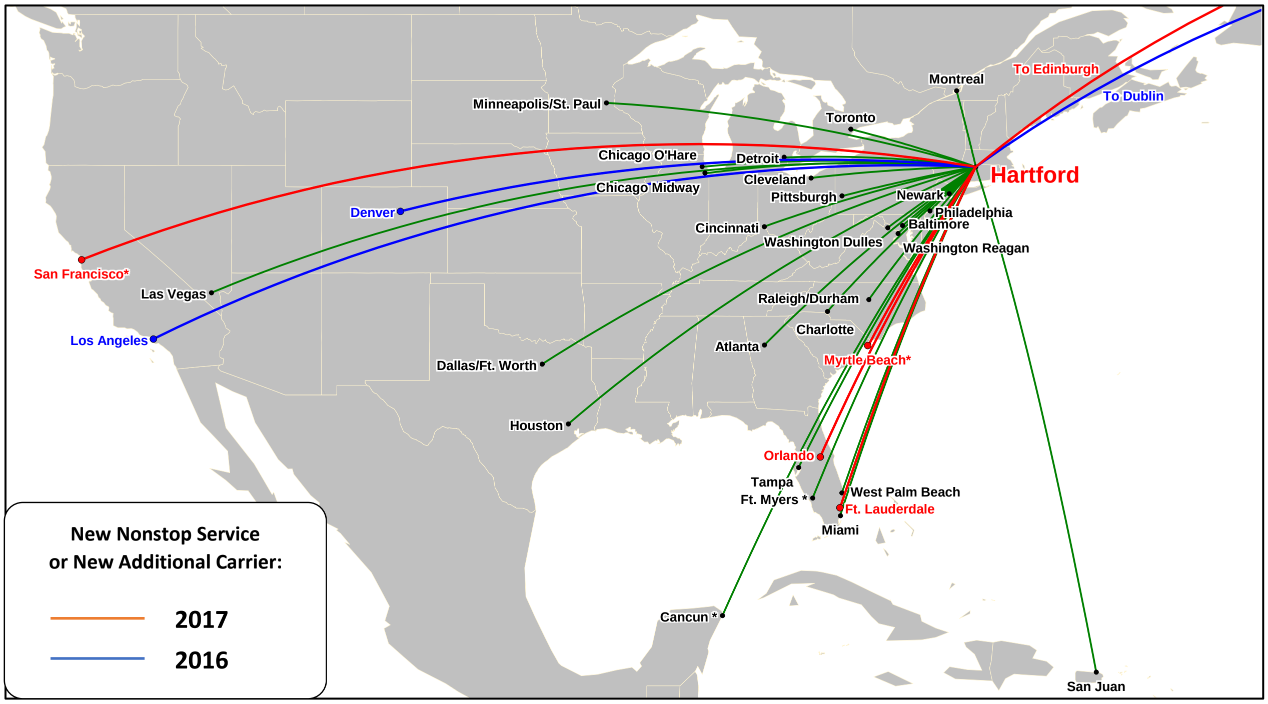
Figure 3-3 – BDL Location in the Region



Source: Google Maps

As of the March 2017 published schedule, BDL has service to 34 destinations from eight carriers shown in **Figure 3-4**. The largest airline at BDL in terms of seat-departures[2] is Southwest Airlines, which is the largest airline in the U.S. based on domestic Origin and Destination (O&D) passengers for the 12 months ending September 2016[3]. American Airlines is the second largest airline at BDL. Delta, JetBlue and United also have a large presence at the Airport.

Figure 3-4 – BDL Nonstop Route Map



Source: Innovata Schedule
Note: Service map includes recently announced non-stop routes launching in 2017

Ultra-low cost (ULCC) Spirit Airlines recently announced it will begin nonstop service from BDL in late April, 2017. They will serve Orlando (MCO) and Myrtle Beach (MYR), and in June began service to Fort Lauderdale (FLL). In addition to the new Spirit service, United Airlines began non-stop service to San Francisco (SFO) in early June, 2017.

3.1.3 Nearby Large Hubs

As shown in **Figure 3-5**, there are four major airports located within 130 miles and a 2 ½ hour drive of downtown Hartford.

[2] Based on March 2017 published schedules.

[3] The latest quarter for which public information is available for from the DOT.

Figure 3-5 – Drive Time to Nearby Major Airports

Source: Google Maps

As shown in **Table 3-1**, these four airports, Boston Logan International Airport (BOS), LaGuardia Airport (LGA), John F. Kennedy International Airport (JFK) and Newark Liberty International Airport (EWR) all are major hub airports with nonstop flights, both domestic and international, to significantly more markets than BDL.

Table 3-1 – Regional Airport Comparison

	BDL	BOS	EWR	JFK	LGA
Nonstop Destinations	33	119	167	181	72
Avg. Daily Flights	98	563	593	645	529

Source: Innovata Schedule, August 2017

The availability of nonstop service at these airports draws travelers[4] from throughout Connecticut and western Massachusetts.

Historical Airline Reporting Corporation (ARC) ticketing data, and several years of air service work with the airport, have shown that these four airports have had a large influence on the region's travelers, while other smaller nearby airports, T.F. Green Airport (PVD), Westchester County Airport (HPN) and Albany International Airport (ALB) have only had a small influence and are not considered in this report.

[4] Passengers using an airport other than the airport closest to them is defined as leakage.

3.2 COMMERCIAL FORECAST AND RECOMMENDATIONS

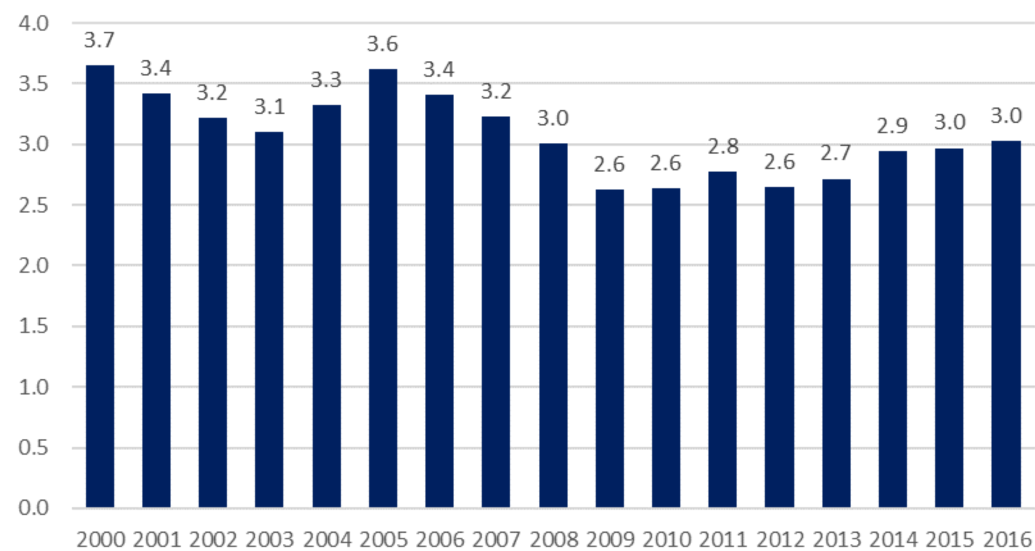
This section provides a quick overview of recent commercial aviation trends at the airport, then lays out four different methodologies analyzed for developing the commercial forecast, and makes the final recommendation for commercial passengers and operations through 2037. Cargo trends, and the forecast will be covered in later in the chapter.

3.2.1 Historical Trends

Enplanements

BDL enplanement had peaks in both 2000 and 2005 as shown in **Figure 3-6**. The decline in enplanements 2001 through 2003 was driven by the aftermath of 9/11, but enplanements began to improve again in 2004 and 2005. Southwest was one of the drivers in the improvement in enplanements as it grew nearly 50% between 2003 and 2005. Enplanements dropped to a low of 2.6 million in 2009 for reasons covered in subsequent sections and has since rebounded to 3.0 million in 2016. BDL's enplanements ranked 54th among U.S. airports in 2015. However, it should be noted that enplanements at BDL remain well below their highs of the early 2000s.

Figure 3-6 – Enplaned Passengers at BDL (in Millions)



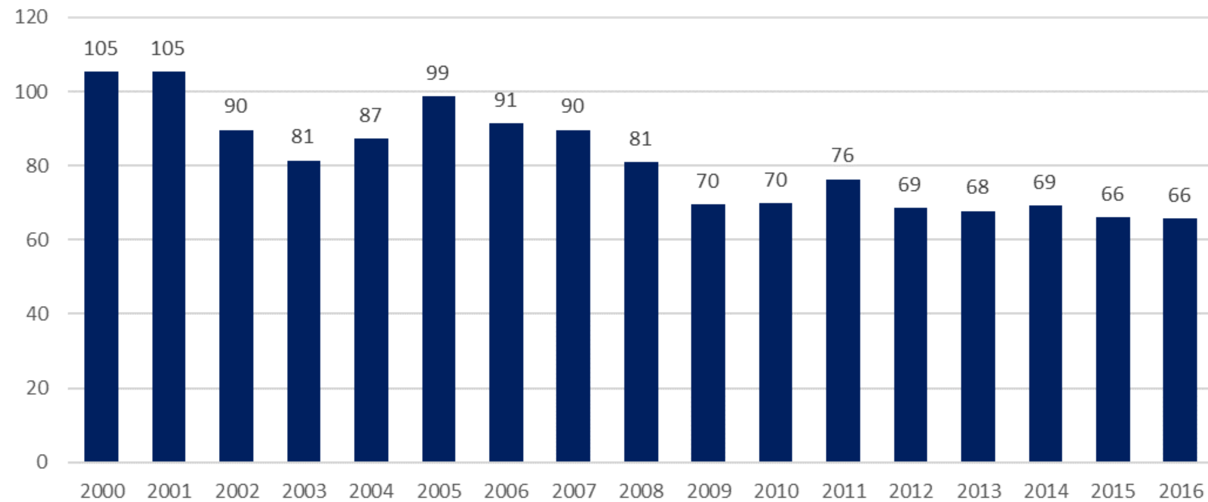
CAGR Change in Enplanements		
3-year	5-year	10-year
3.6%	1.8%	-1.2%

Source: FAA Reports and BDL Airport Statistics

Commercial Operations

Commercial operations include those of the scheduled air carriers including their regional partners. **Figure 3-7**, below, shows the large decline in scheduled operations at the airport starting in 2005. Airline bankruptcies, carrier consolidation, high fuel prices, and the Great Recession drove operations down nearly 30% by 2009 driven by reductions in hub/focus city flying (i.e. Philadelphia-Southwest, Atlanta-Delta, Chicago O'Hare-American, Charlotte/Philadelphia-US Airways) and Delta nonstop service to Florida (Orlando, Tampa, Fort Lauderdale, and Palm Beach).

Figure 3-7 – Commercial Operations at BDL (in Thousands)



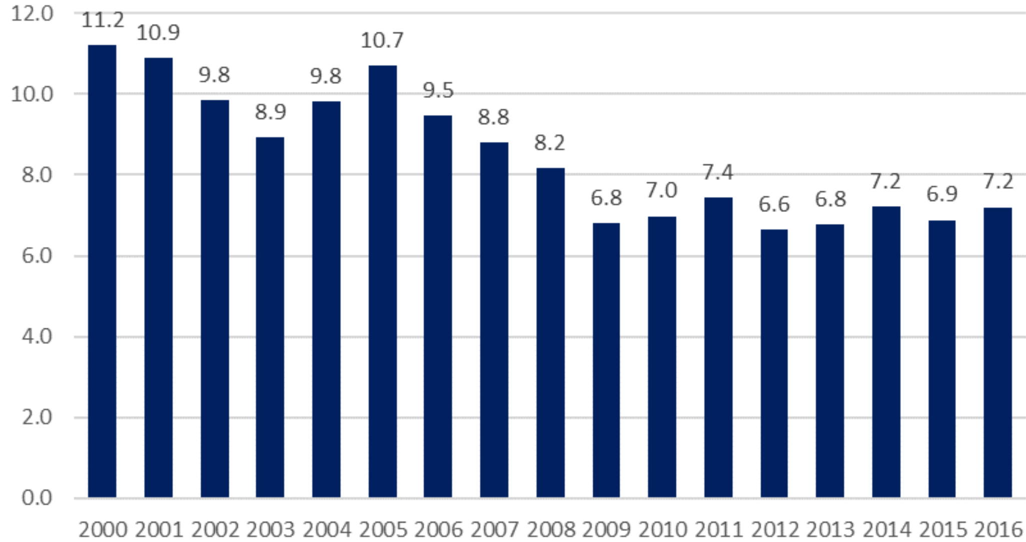
CAGR Change in Operations		
3-year	5-year	10-year
-1.0%	-3.0%	-3.3%

Source: Innovata Schedules

Commercial Seats and Average Aircraft Size

BDL's 7.2 million scheduled seats in 2016 is relatively consistent with the previous seven years, 2009 through 2015. As shown in **Figure 3-8**, 2000 was the peak with 11.2 million seats, falling to 8.9 million in 2003 after 9/11. Seats increased to 10.7 million in 2005 but then fell to 6.8 million by 2009.

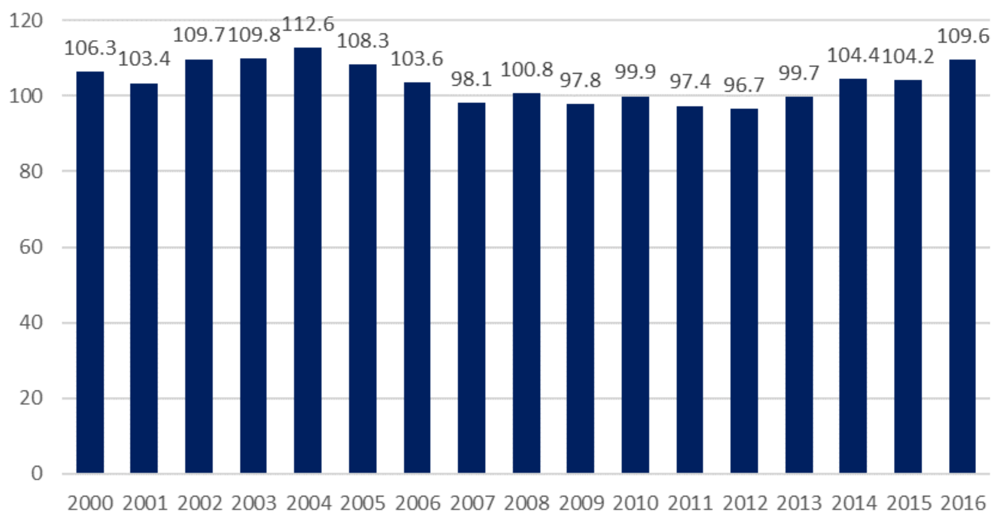
Figure 3-8 – Scheduled Seats at BDL (in Millions)



CAGR Change in Seats		
3-year	5-year	10-year
2.1%	-0.6%	-2.7%

Source: Innovata Schedules

Figure 3-9 – Average Seats per Departure



Source: Innovata Schedules

The types of commercial aircraft serving BDL in a typical week in July 2006, 2011 and 2016 are shown in **Table 3-2** below. A July schedule is shown for seasonal continuity.

Table 3-2 – Aircraft Serving BDL

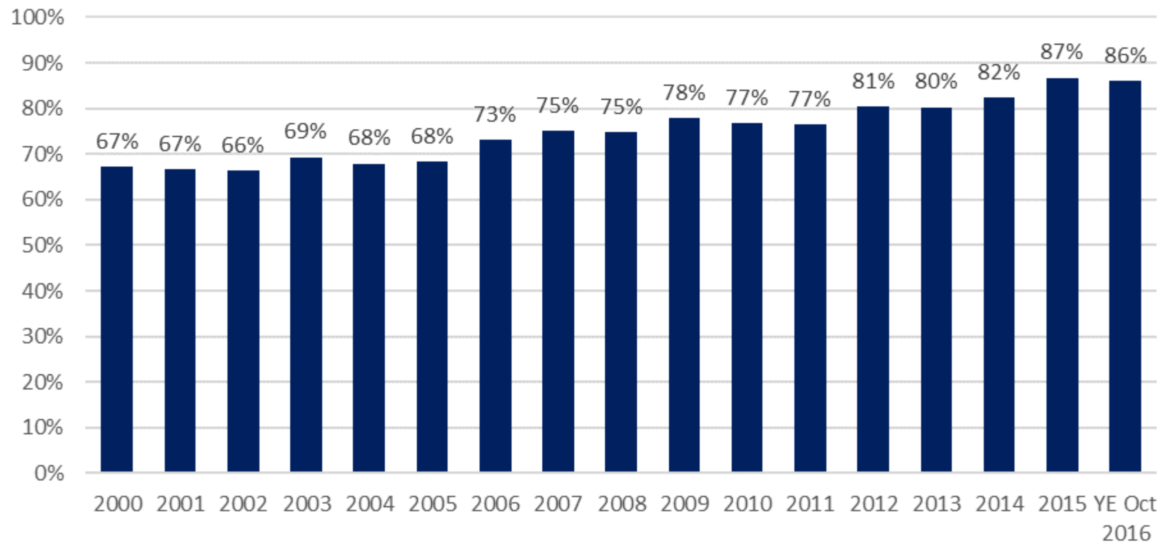
	Weekly Operations		
Aircraft	2006	2011	2016
B737-700 Winglets			212
A320	90	70	165
CRJ-700	72	114	126
A319	110	128	124
B737-800 Winglets			122
MD-88	82	108	108
CRJ-200			86
CRJ-900		2	66
Beech 1900D	52	72	64
E-175		80	40
DHC-8-300			36
E-175 Enhanced Winglets			36
DHC-8-100	38	14	28
B737-900			21
Beech BE400			20
DHC-8-200		26	16
A321	14		14
B717-200			14
E-190			12
B757	14	10	10
ERJ-145	36	24	4
E-170	108	38	2
B737-700	220	210	
CRJ	92	204	
ERJ	148	138	
B737-800	128	70	
B737-400	12	66	
B737-300	198	38	
DHC-8		34	
B737-500	12	26	
B757-200	86	14	
DC-9-50		10	
Saab 340	54		
ERJ-135	44		
328Jet	38		
MD-80	28		
MD-83	28		
A300-600	14		
DC-9	14		
ERJ-140	12		

Source: Innovata Schedule

Seat Factor

Seat factor, the percentage of seats occupied, has grown at BDL from the mid/high-60s to 86% by 12 months ending October 2016. Since 2011, BDL's seat factor has grown nearly 10 percentage points.

Figure 3-10 – Seat Factor - Percentage of Seats Filled



Source: U.S. DOT T-100 Report

3.3 ACTIVITY FORECASTS

Four different methodologies were considered and analyzed in the development of the recommended BDL enplanement forecast. Three of the forecast methods, the Market Share Analysis, the Regression Share Analysis and the Trend Analysis, are accepted techniques for forecasting aviation activity for an airport by the FAA per FAA AC 150/5070-6B *Airport Master Plans*. The fourth forecast method, the Air Service Analysis, is an alternative method that considers recent factors including such things as recent air service announcements and leakage that are not picked up by the other methods. Each of the methodologies with accompanying enplanement forecasts are shown below and then compared to each other.

Market Share Analysis – BDL's enplanement share of the National system was historically trended, and a future share trend developed. Future BDL enplanements were estimated by multiplying the future share trend and the Federal Aviation Administration's (FAA) Terminal Area Forecast (TAF) National enplanement numbers.

Regression Analysis – A statistical process for estimating the relationship between a dependent variable and an independent variable. Demographic projections for the catchment area were used to estimate growth at BDL.

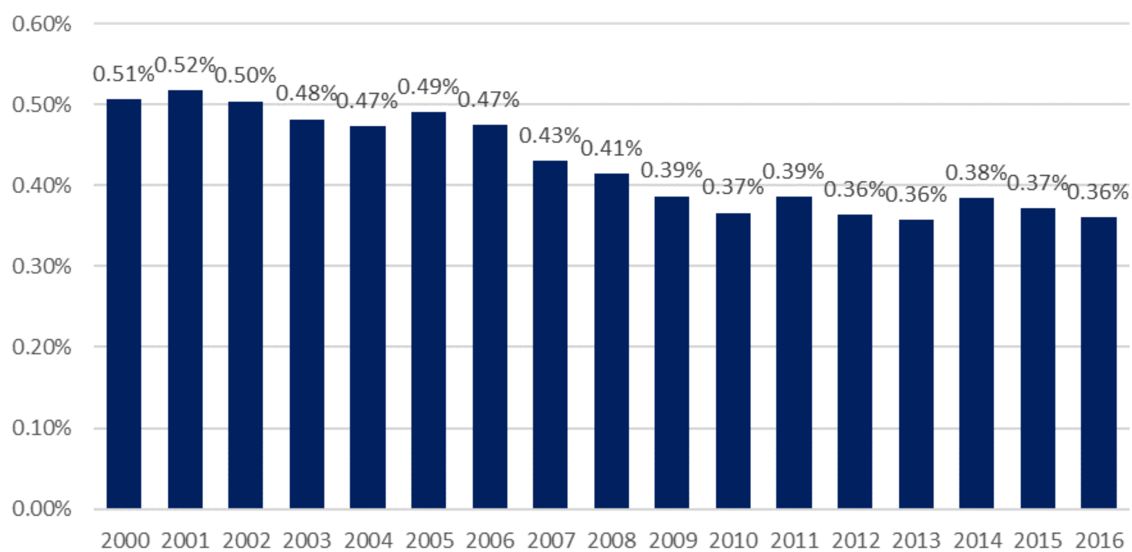
Trend Analysis – A method to predict the future based on past results. 3-, 5- and 10-year annual growth rates were calculated and used to estimate growth at BDL.

Air Service Analysis – BDL enplanements and operations were estimated based on 2017 schedules filed by the air carriers and includes expected service changes for 2017 through June 2022. Interviews were conducted with the Airport, Network Planners and Campbell-Hill's extensive experience working with the Airport doing air service development. Key forecast assumptions include expected schedule changes, average seats per departure and percentage of seats filled (seat factor). Beyond June 2022, longer-term regression variables were used.

3.3.1 Market Share Analysis

BDL enplanements are forecast based on BDL's share of the national enplanement total. **Figure 3-11** shows that between 2000 and 2005, BDL's share of the national enplanement total ranged between 0.4733% (2004) and 0.5174% (2001), averaging 0.4955% over the six-year period. Between 2005 and 2010, BDL's share of the national enplanement total has fallen as the airport's traffic has not kept pace with national trends (see subsequent section for explanation of decline in BDL's capacity). Since 2010, BDL's share of the national total has stabilized and has averaged 0.3698%.

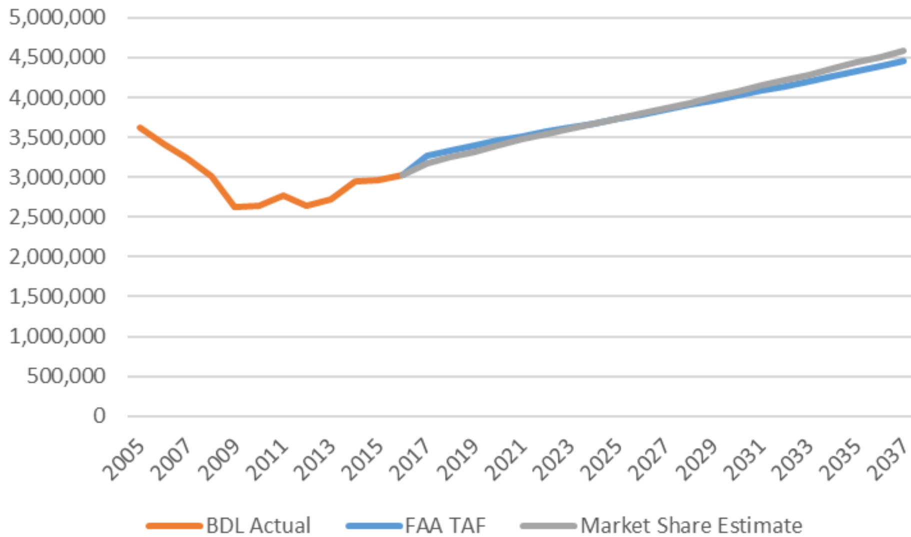
Figure 3-11 – BDL's Enplanements as a Percentage of National Enplanements



Source: FAA TAF

Assuming BDL's share of the national total continues to average 0.3698% in future years, applying this percentage to the TAF results in the enplanement estimate in **Figure 3-12** through 2037. By 2037, the Market Share Estimate results in BDL enplanements exceeding the TAF by 2.9%.

Figure 3-12 – BDL's Enplanement Estimate - Market Share Analysis



Year	BDL Actual	FAA TAF	Market Share Estimate BDL Enplanements	Percent Difference from TAF
2015	2,969,281			
2016	3,025,166			
2017		3,272,278	3,172,626	-3.0%
2022		3,568,575	3,536,411	-0.9%
2027		3,846,956	3,864,649	0.5%
2032		4,143,219	4,215,397	1.7%
2037		4,457,618	4,588,700	2.9%

Note: BDL actual is for calendar year
Source: Derived from FAA TAF

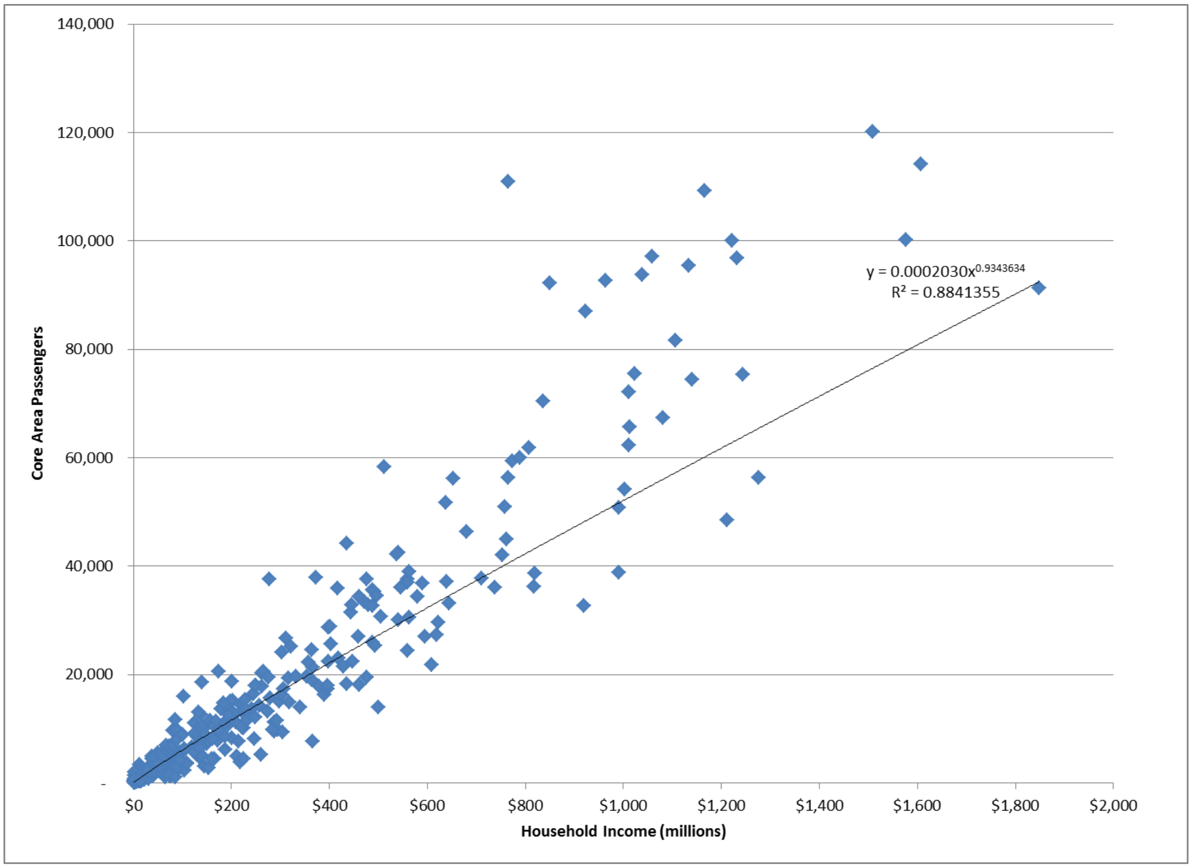
3.3.2 Regression Analysis

Several different economic-, income- and population-based regression analyses were performed. Because of BDL's proximity to other major hub airports, typical regressions (population, income, GRP) that apply to passenger forecasts for airports were found to have low correlation for BDL (see Appendix 1 for results). Alternative regressions were developed using detailed passenger travel and demographic data for BDL's core area that is the primary source of traffic for the Airport.

An alternative methodology was developed based on zip code-level passenger counts for the core area using ARC ticketing data compared to total and average household income from the U.S. Bureau of the Census for CY 2014. The advantage of using ARC data showing total passengers for the local area (not just those using BDL) is that the impact of service and leakage shifts can be minimized. The analysis examined both cross-sectional (zip-level) and time series (2011 vs. 2014) patterns with the former providing the most usable results.

Passenger traffic levels (domestic and international combined) were compared to total household income for all zip codes located within the BDL core area. As shown in **Figure 3-13** below, passenger traffic levels for individual zip codes correlate closely with the total household income. Using the derived regression equation, year-to-year growth in traffic levels was estimated using the projected growth in aggregate income for the core area. Over the forecast period from 2016 to 2037, traffic growth ranged from 1.3% to 2.1% per year and averaged 1.8% per year. These growth estimates were used for regression analysis and the long-term growth of the air service analysis.

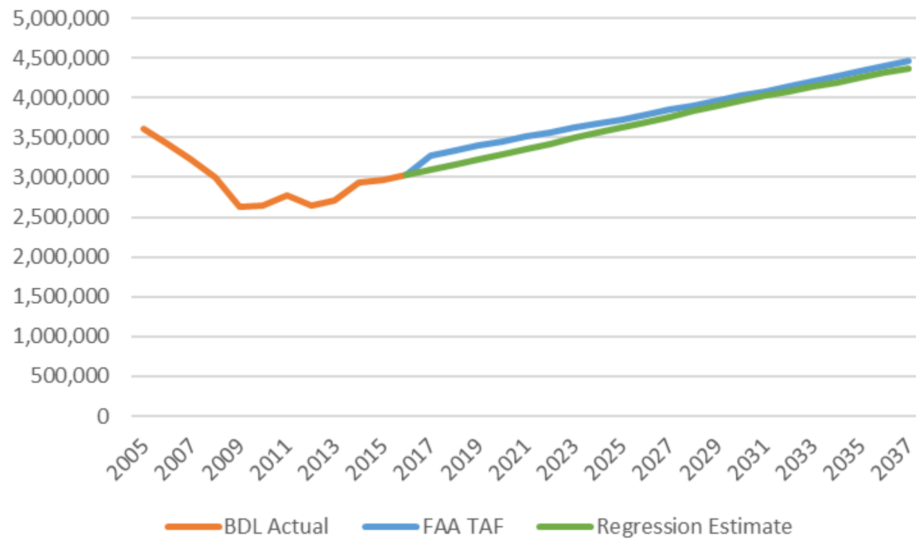
Figure 3-13 – BDL Core Area Passenger Traffic versus Total Household Income



Source: U.S. Bureau of the Census and ARC zip-level data for 2014

The enplanement estimate using the regression analysis is shown in **Figure 3-14** through 2037. By 2037, the Regression Estimate results in BDL enplanements is below the TAF by 1.9%.

Figure 3-14 – BDL's Enplanement Estimate - Regression Analysis



Year	BDL Actual	FAA TAF	Regression Estimate BDL Enplanements	Percent Difference from TAF
2015	2,969,281			
2016	3,025,166			
2017		3,272,278	3,089,602	-5.6%
2022		3,568,575	3,422,220	-4.1%
2027		3,846,956	3,762,872	-2.2%
2032		4,143,219	4,080,500	-1.5%
2037		4,457,618	4,373,813	-1.9%

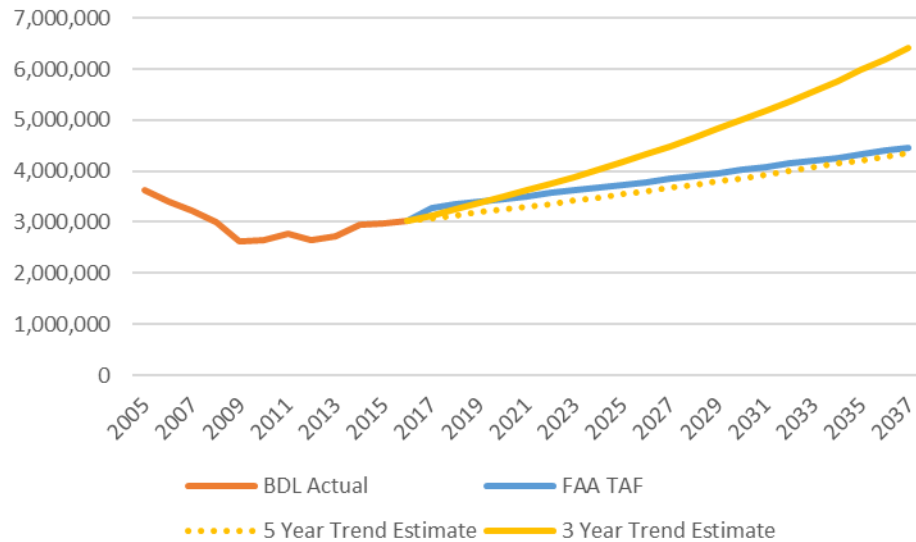
Note: BDL actual Regression Estimate are for calendar year
Source: Derived from ARC data and FAA TAF

3.3.3 Trend Analysis

The 3- and 5-year growth rates for BDL enplanements were used to estimate BDL enplanements. **Figure 3-15** below shows the wide range that these trends have on BDL's enplanement estimate.

The base year of the 5-year trend, 2011, was when BDL was at an upward blip in terms of enplanements (higher than the two years before and two years after). The base year of the 3-year trend, 2013, was when BDL was near its recent low in terms of enplanements. By 2037, the 5-year Trend Estimate results in BDL enplanements below the TAF by 2.1%, the 3-year Trend Estimate results in BDL enplanements above the TAF by 44.1%, outside of the range of TAF reasonableness.

Figure 3-15 – BDL's Enplanement Estimate - Trend Analysis



Year	BDL Actual	FAA TAF	5-year Trend Estimate BDL Enplanements	Percent Difference from TAF	3-year Trend Estimate BDL Enplanements	Percent Difference from TAF
2015	2,969,281					
2016	3,025,166					
2017		3,272,278	3,078,439	-5.9%	3,135,568	-4.2%
2022		3,568,575	3,359,210	-5.9%	3,751,035	5.1%
2027		3,846,956	3,665,589	-4.7%	4,487,310	16.6%
2032		4,143,219	3,999,912	-3.5%	5,368,106	29.6%
2037		4,457,618	4,364,727	-2.1%	6,421,789	44.1%

Note: BDL actual and Trend Estimate are for calendar year
Source: Derived from Airport reporting and FAA TAF

3.3.4 Air Service Analysis

Analysis is based on 2017 schedules filed by the air carriers at BDL with expected service changes for 2017 through 2022. Key forecast assumptions include:

- Expected schedule changes
- Average seats per departure
- Percentage of seats filled (seat factor)

Four different air service scenarios were analyzed ranging from a "Low" scenario to a "High" scenario.

Low Scenario

For the "Low" scenario, there are several new market opportunities that are anticipated, based on interviews with existing carriers. In early June 2017, United service to San Francisco International Airport (SFO) commenced operations[5]. Starting in late 2017, a domestic carrier

[5] United Airlines announced this new nonstop service in late February 2017 to begin in June, 2017.

is forecast to begin one weekly roundtrip to a destination in the Caribbean. In addition to the new services, another adjustment was made to the forecast with domestic carriers increasing peak-season (February through April) frequency to four daily trips to a Florida destination.

Medium-Low Scenario

For the “Medium-Low” scenario, the “Low” scenario is assumed, but several more additional market opportunities are added by June 2022. In early 2018, it is anticipated that a domestic carrier will begin daily nonstop service to a Florida market. It is also anticipated that a new carrier to BDL would begin daily nonstop service to a West Coast destination. Beyond 2018, it is anticipated that a new international carrier (a second new carrier at BDL) will begin less-than-daily nonstop service to a market in Europe. It is also anticipated that, in 2019, domestic airlines will increase frequency to hub locations [i.e., Charlotte (CLT), Chicago O’Hare (ORD), Atlanta (ATL)] with 3 additional weekly nonstop flights.

Medium-High Scenario

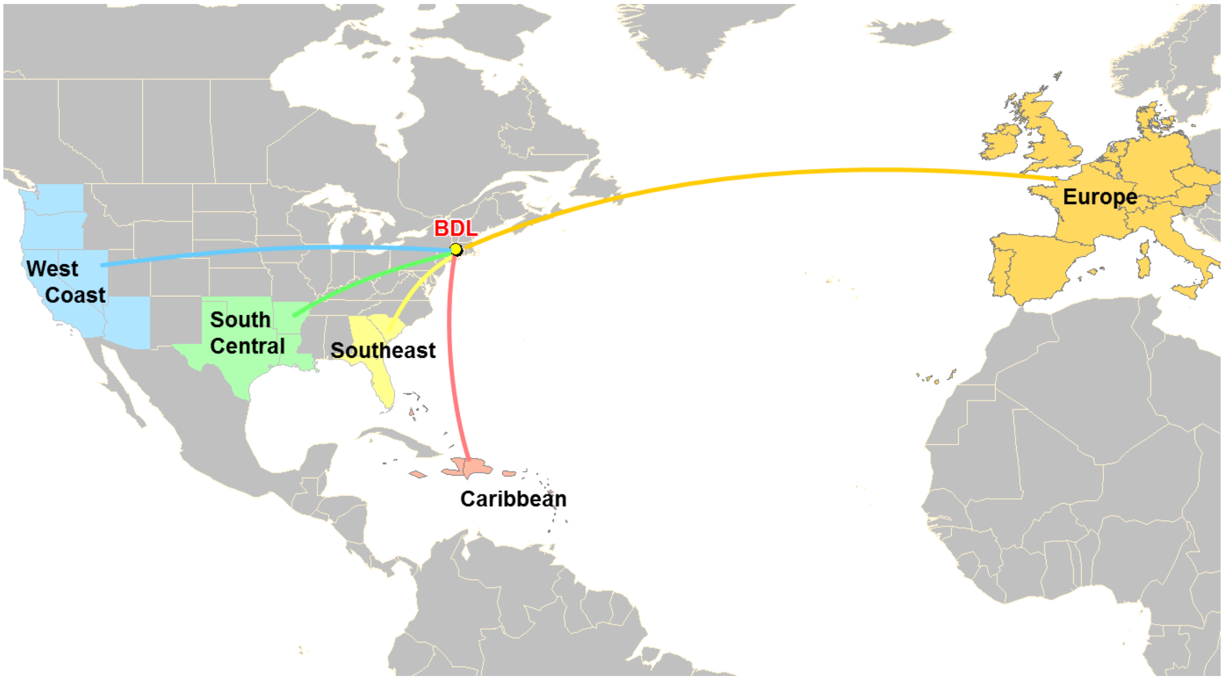
For the “Medium-High” scenario, the “Medium-Low” scenario is assumed and that a ULCC is forecast to begin service at BDL in 2018 with less-than-daily service to locations in the southern U.S. Several of these markets are in BDL’s top ten medium-haul domestic markets without nonstop service. Some of the markets will be served seasonally with less-than-daily nonstop service. Also, it is anticipated that nonstop domestic service to a south-western U.S. market will start in 2018 with one daily roundtrip. Similar to the Medium-Low scenario, beyond 2018, additional hub capacity increases are anticipated with three additional weekly flights.

High Scenario

For the “High” scenario, the “Medium-High” scenario is assumed, and additionally anticipates another international carrier beginning nonstop service to Europe with daily service beginning in 2020.

The four scenarios are highlighted in **Figure 3-16**.

Figure 3-16 – Scenarios – Air Service Analysis



Source: Forecast analysis

The short-term air service scenarios (2017 – 2022) are a supply driven model. Once the schedule, aircraft and frequency are established, passenger demand is forecasted. Passenger demand is forecasted by projecting the number of seats filled on each of the flights.

For existing nonstop flights, it is anticipated that the percentage of seats filled will continue to increase over time. Between F2005 and 12 months ending October 2016, the percentage of seats filled at BDL grew from 69% to 86%. It is not expected that this growth will continue at this rate, but it is expected to grow at a much more modest rate (overall approximately 0.5 seat factor points per year, with individual route seat factors reaching a maximum of 92.5% and the overall airport seat factor reaching 88.5%[6] in the long term).

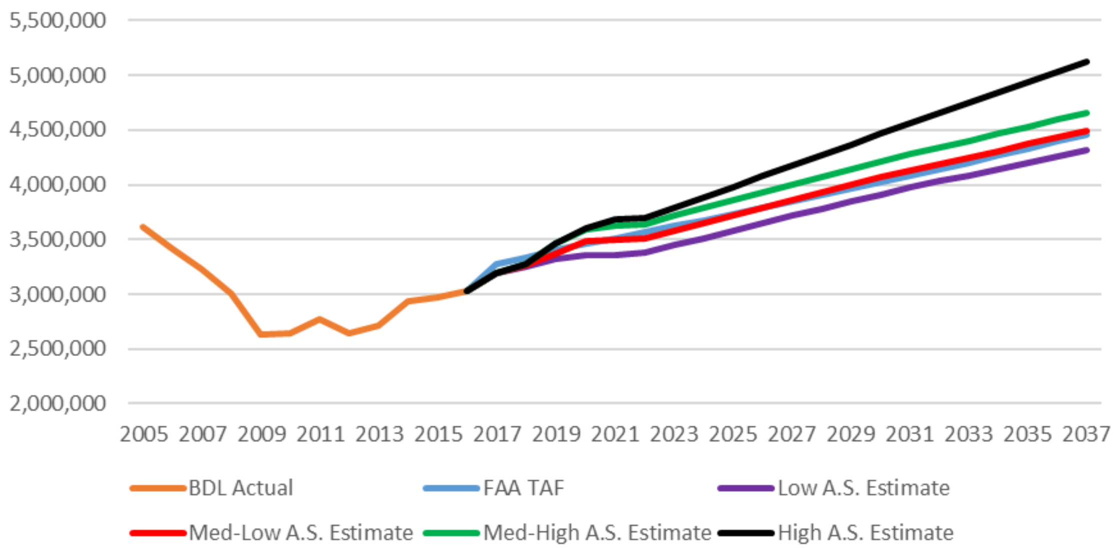
For new anticipated services, load factors on similar services by assumed carriers were evaluated. Multiplying seat-departures by expected percentage of seats filled results in the number of enplaned passengers by month and ultimately by year. Beyond 2022, the Regression Analysis year-over-year growth rates are applied to the 2022 Air Service estimate of enplanements to derive enplanement estimates through 2037. **Figure 3-17**, below, graphically shows the results of the four Air Service scenarios.

With Spirit Airlines' recent service announcement of a new ULCC beginning service at BDL, which should lead to significant growth in enplanements in 2018 (first full calendar year with service, growth will be less in 2017 with a partial year of service) and the potential for additional ULCC expansion, the Low and Medium-Low Scenarios are too low and will not be considered. The

[6] With ULCC Spirit Airlines starting BDL service, this will also contribute towards increasing the seat factor at the airport.

Medium-High and High Scenarios are both within the TAF range of reasonableness and will be considered for the final recommendation. The Medium-High and High Scenarios are 4.4% and 14.9% respectively above the TAF by 2037.

Figure 3-17 – BDL's Enplanement Estimate – Air Service Analysis



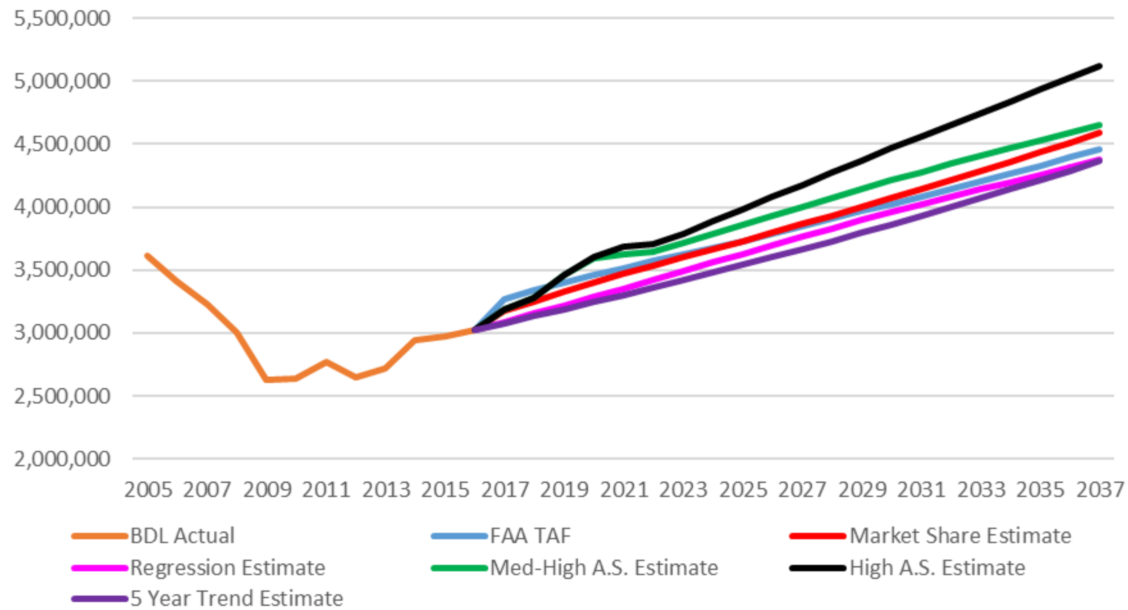
Year	BDL Actual	FAA TAF	Low A.S. Estimate BDL Enplanements	Percent Difference from TAF	Medium-Low A.S. Estimate BDL Enplanements	Percent Difference from TAF	Medium-High A.S. Estimate BDL Enplanements	Percent Difference from TAF	High A.S. Estimate BDL Enplanements	Percent Difference from TAF
2015	2,969,281									
2016	3,025,166									
2017		3,272,278	3,187,046	-2.6%	3,187,046	-2.6%	3,187,046	-2.6%	3,187,046	-2.6%
2022		3,568,575	3,379,510	-5.3%	3,514,188	-1.5%	3,640,759	2.0%	3,700,879	3.7%
2027		3,846,956	3,715,910	-3.4%	3,863,994	0.4%	4,003,164	4.1%	4,173,740	8.5%
2032		4,143,219	4,029,574	-2.7%	4,190,158	1.1%	4,341,075	4.8%	4,652,126	12.3%
2037		4,457,618	4,319,226	-3.1%	4,491,353	0.8%	4,653,118	4.4%	5,120,222	14.9%

Note: BDL actual and Air Service Estimate are for calendar year
Source: Forecast analysis.

3.3.5 Recommended Enplanement Forecast

Figure 3-18 below compares the enplanement estimates of the Market Share analysis, Regression analysis, Medium-High and High Scenarios of the Air Service analysis and the TAF.

Figure 3-18 – BDL Enplanement Estimate Comparison



Year	BDL Actual	FAA TAF	Market Share Estimate BDL Enplanements	Percent Difference from TAF	Regression Estimate BDL Enplanements	Percent Difference from TAF	5-year Trend Estimate BDL Enplanements	Percent Difference from TAF	Medium-High A.S. Estimate BDL Enplanements	Percent Difference from TAF	High A.S. Estimate BDL Enplanements	Percent Difference from TAF
2015	2,969,281											
2016	3,025,166											
2017		3,272,278	3,172,626	-3.0%	3,089,602	-5.6%	3,078,439	-5.9%	3,187,046	-2.6%	3,187,046	-2.6%
2022		3,568,575	3,536,411	-0.9%	3,422,220	-4.1%	3,359,210	-5.9%	3,640,759	2.0%	3,700,879	3.7%
2027		3,846,956	3,864,649	0.5%	3,762,872	-2.2%	3,665,589	-4.7%	4,003,164	4.1%	4,173,740	8.5%
2032		4,143,219	4,215,397	1.7%	4,080,500	-1.5%	3,999,912	-3.5%	4,341,075	4.8%	4,652,126	12.3%
2037		4,457,618	4,588,700	2.9%	4,373,813	-1.9%	4,364,727	-2.1%	4,653,118	4.4%	5,120,222	14.9%

Note: BDL actual, Regression and Air Service Estimate are for calendar year
Source: Forecast analysis

The recommended enplanement forecast for the Master Plan is the Medium-High Air Service Estimate. The Market Share, Regression, and 5-year Trend Estimates continue to fall below the TAF in 2022, and given the recent service announcements by Spirit Airlines, would be too low. The High Air Service Estimate is on the upper bounds of TAF reasonableness and is not being recommended.

3.3.6 Operation Forecast

The Operation forecast from 2017 to 2022 comes from the monthly schedule used for the creation of the Medium-High Scenario enplanement forecast. The schedule was broken down by market, airline and equipment type.

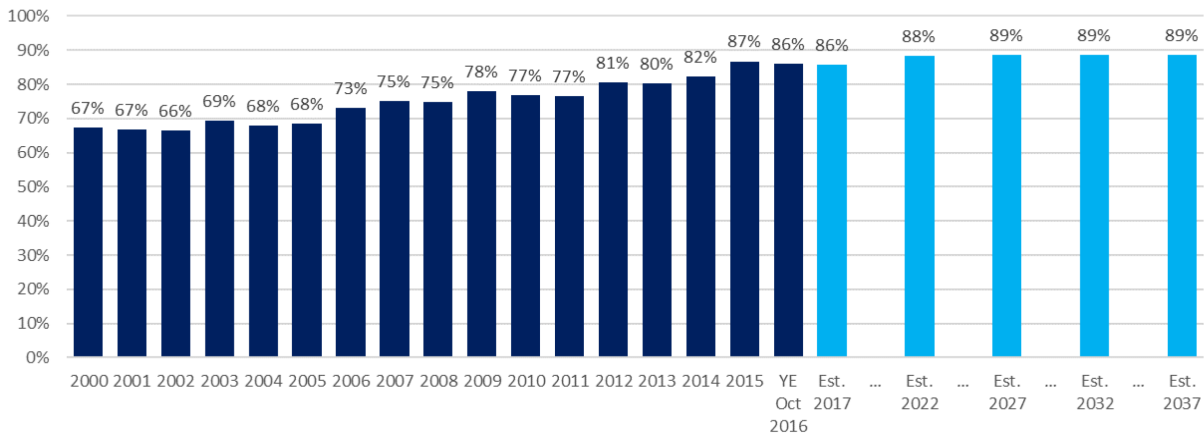
The Operation forecast from 2023 to 2037 is estimated by taking the recommended Medium-High Air Service enplanement forecast, growth trends in percentage of seats filled and average seats per departure to derive the long-term commercial operation forecast.

Estimated Seats

First, the forecast for BDL seats for 2023 through 2037 is calculated by dividing the forecasted enplaned passengers by the forecasted percentage of seats that are filled by year. The percentage of seats filled is estimated by taking the estimated 2022 percentage of seats filled and growing the seat factor very modestly each year through 2037[7]. Once the percentage of seats filled reaches 88.5% it is capped at this value for all future years. The FAA TAF has the national load factor continuing to grow each year through the end of the TAF period, capping between 86 and 87%.

The resulting estimate for percentage of seats filled for all scenarios are shown in **Figure 3-19**:

Figure 3-19 – BDL Percentage of Seats Filled



Source: Medium-High Forecast

Dividing forecast enplaned passengers by year by the estimated percentage of seats by filled by year results in the estimate for total seat-departures. Total operations are forecast by multiplying total seat-departures by 2 (to get to total seats) and then dividing by the forecast of seats per departure by year.

The forecast for average seats per departure is assumed to grow by 0.43% per year after 2022. The growth rate of 0.43% is a proxy from the 2015 National Forecast[8] for domestic average aircraft seats per mile. Assumed within the forecast by 2037 is the replacement of several equipment types currently flying at BDL with younger, more fuel-efficient aircraft of similar aircraft capacity.

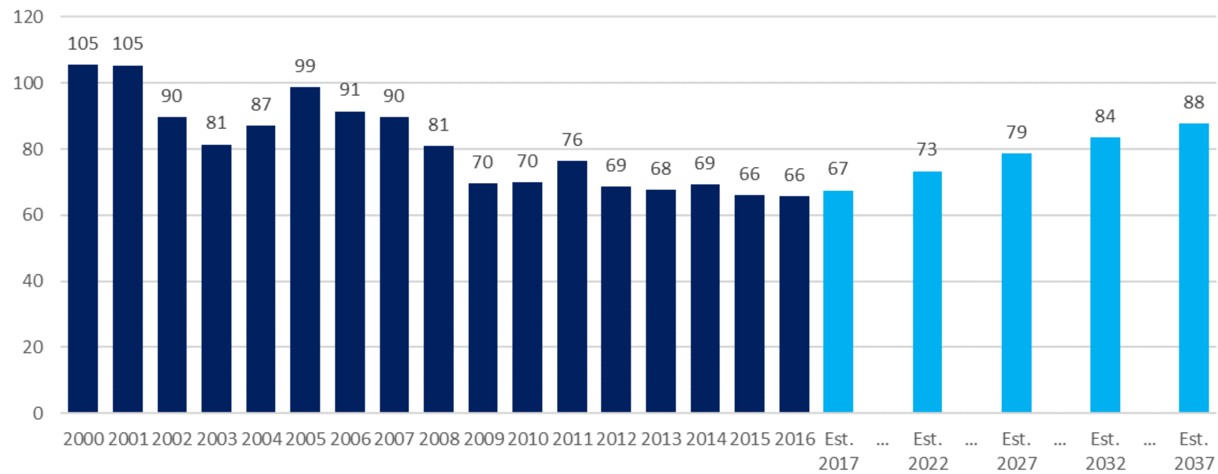
Operations

Dividing the forecasted total seats by year by the estimated average seats per departure by year results in the forecast for total operations as shown in **Figure 3-20**.

[7] Similar methodology to what was used in Section 3.2.4, but the growth rate is smaller as the planes are becoming more full.

[8] The 2016 National Forecast has not been released yet (The 2016 TAF has been released).

Figure 3-20 – BDL Estimated Total Operations (Thousands)



Source: Medium-High Forecast

Fleet Mix

For future facility planning purposes, annual commercial operations are converted in to operations by aircraft type for select years. The July 2017 fleet mix was taken as the baseline, with adjustments for retiring fleet types (e.g. MD-90s, Dash-8s, 50 seat regional jets) and reasonable replacement aircraft types through the forecast period. **Table 3-3** below shows the fleet mix and departures for the month of July in 2017, 2027 and 2037.

Table 3-3 – Fleet Mix by Year Select Years

Aircraft Type	July Departures 2017	2027	2037
A319	420	508	653
A320	214	526	586
B737-700	388	425	473
CRJ-900	173	146	465
B737-800	263	401	447
E-190	155	196	365
CRJ-700	356	463	217
Beech 1900 (or other <35 seat aircraft)	141	159	105
A321	31	33	72
E-175	114	122	69
Beech BE400 (or other <20 seat aircraft)	42	47	52
B788		33	52
ERJ	31	122	
DHC-8-100	62	65	
B757	31	33	
E-175 Enhanced	31	33	
E-170	31	29	
B767		14	
MD-90	200		
CRJ-200	119		
DHC-8-200	78		
MD-88	24		
B717	5		

Source: Forecast

A summary of the recommended commercial enplanement and operation forecast is as follows in **Table 3-4**. As mentioned earlier in this section, average aircraft size grows at 0.43% per year after 2022 similar to 2015 TAF change in domestic average aircraft seats per mile and the percentage of seats filled is capped at 88.5%. The forecast by year can be found in the Appendix.

Table 3-4 – Recommended Commercial Forecast

Year	Enplanements	Operations	Average Aircraft Size	Percentage Seats Filled
2017	3,187,046	67,482	110.6	85.7%
2022	3,640,759	73,366	112.4	88.3%
2027	4,003,164	78,788	114.8	88.5%
2032	4,341,075	83,625	117.3	88.5%
2037	4,653,118	87,734	119.9	88.5%

Source: Forecast

3.4 ALL CARGO FORECAST HISTORY, METHODOLOGY, AND FORECAST

This section analyzes historical trends in air cargo traffic and aircraft operations and develops forecasts of cargo traffic and all-cargo aircraft operations by type. In addition to the domestic air cargo analysis, an international cargo demand evaluation was also completed. However, for the purposes of this forecast, and due to the fact that BDL's international cargo market is very limited, the full international cargo demand evaluation will be provided in **Appendix B** of this report.

3.4.1 Historical Trends

BDL's cargo activity ranked 33rd among U.S. airports in 2015 (in terms of enplaned and deplaned weight).[9] BDL's cargo activity is dominated by domestic traffic for the U.S. integrated air carriers[10], FedEx and UPS, which accounted for 93-94% of the airport's total traffic weight over the last 5 years (**Table 3-5**). A minor amount of all-cargo traffic (2,161 tonnes[11] in 2016) moved on ad-hoc charter flights with over twice that amount carried in the bellies of passenger flights. The integrator traffic increased 4% from 2012 to 2016 while the other traffic declined (18% for all-cargo and 24% for passenger traffic).

Table 3-5 –BDL All-Cargo Traffic Weight by Carrier Type (2012-2016)

Fiscal	BDL All-Cargo Traffic (MT)			
Year	Integrators	Other All-Cargo	Passenger	Total
2012	110,871	3,054	5,599	119,524
2013	105,488	2,336	5,388	113,211
2014	111,789	2,896	5,114	119,799
2015	112,584	2,258	4,729	119,571
2016	115,660	2,161	4,571	122,392

Source: U.S. DOT, T-100 statistics

A total of 6,738 all-cargo operations occurred in 2016 over 92% of which were integrator flights (see **Table 3-6**).

[9] Airports Council International – North America

[10] Integrated air carriers provide door-to-door transportation of documents and small packages via dedicated ground and air equipment (supplemented with contract labor and equipment and third-party transportation services). The U.S. carriers, FedEx and UPS, are the only integrated carriers providing air-based services to third party shippers on a comprehensive basis at this time.

[11] 1 metric tonne (MT) = 2,204.6 pounds

Table 3-6 – BDL All-Cargo Flight Operations by Carrier Type (2016)

	BDL All-Cargo Operations		
Aircraft Type	Integrators	Other All-Cargo	Total
Turboprop	440	114	554
Narrowbody Jet	2,240	510	2,750
Widebody Jet	3,428	6	3,434
	6,108	630	6,738

Source: Connecticut Airport Authority, All-Cargo Data Reports

The integrator flights at BDL connect the local market with the U.S. domestic express network.[12] FedEx operates daily jet flights to its national hubs in Memphis (MEM) and Indianapolis (IND) with additional flights added during peak periods. For 2016, FedEx averaged 11 inbound flights per week from MEM and seven inbound flights per week from IND.[13] FedEx also operated inbound turboprop flights (4 inbound flights per week) from Newark (EWR)[14], its regional hub and international gateway to Europe. There were also a minor number of ad hoc flights operated to/from other airports (17 operations in 2016).

UPS similarly operated daily jet flights to and from its national hub in Louisville (SDF) which averaged 17 weekly inbound flights in 2016 (11 of which returned to SDF with the remainder outbound to other airports). UPS also operated inbound flights from its regional hub/European gateway at Philadelphia (PHL), its Midwest regional hub in Rockford (RFD), and two service airports in Albany (ALB) and Providence (PVD) with each airport averaging about 4 inbound flights per week. Several other airports averaged less than one inbound flight per week (Boston, Ontario, Des Moines and Newark) which were probably repositioning or seasonal traffic flights.[15]

The service area for the integrators can be defined based on the location of surrounding airports that also have hub flights including EWR, Boston (BOS), and Manchester (MHT). For this analysis, it is assumed that the service area includes the points that are within a 1 ½ hour drive of BDL and closer than other service airports. This area includes all of Connecticut except Fairfield County and the four Western Massachusetts counties (Berkshire, Franklin, Hampden and Hampshire).

Most of the other domestic all-cargo flights are operated by Southern Air which operated a total of 258 outbound flights in 2016 almost all of which were destined for Rochester (ROC) with some returning via New York – JFK (JFK). Southern Air also operated 13 inbound flights from Cincinnati (CVG). It is likely that these flights are transferring large shipments (e.g., aircraft engines) in support of local industry.

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[12] International traffic can also be routed via these flights but is not specifically identified in any data source.

[13] All-cargo flight counts available for specific O&D airports are based on T-100 statistics that only include revenue flights, and therefore may differ slightly from the airport's statistics.

[14] The EWR turboprop flights are operated by Wiggins Airways for FedEx using Cessna 208B aircraft. Wiggins also operated 50 inbound flights using Beechcraft B-99 turboprops that are not included in the T-100 statistics so the traffic and marketing carrier is not known.

[15] Some of the inbound flights return directly to the originating airports, while others continue to another airport served with few or no inbound flights. Some of these flights may be through routings to/from the hub airports and may not carry any local traffic.

3.4.2 Traffic Forecast

The future growth of cargo activity at BDL will primarily depend on growth in the demand for integrated cargo services provided by FedEx and UPS. Most of the traffic is next-day and second-day delivery traffic which is affected by local consumer and business demand for both inbound and outbound services, in particular the continued expansion of e-commerce-based traffic. Traffic carried on other all-cargo operations and passenger aircraft will likely continue to contribute a minor amount of traffic. While there is currently no scheduled international all-cargo service at BDL, the level of demand within BDL's service area could possibly attract direct air services away from traditional international gateway airports such as JFK in the future (as discussed below).Each of these factors will be discussed separately below and represented in the forecasts.

Integrated Carrier Cargo Traffic

As described above, the domestic operations at BDL for FedEx and UPS are based on their networks of local O&D airports that serve specific service areas as determined by the location of nearby airports and the ability to meet weekday delivery deadlines and hub flight schedules. As a result, individual airports serve relatively compact service areas and the carriers operate to a high number of U.S. airports. In 2016, FedEx directly served 112 U.S. airports from its MEM hub (with at least three flights per week), while UPS served 78 from its Louisville hub. While there might be some marginal changes to the service areas (with minor impacts on activity levels if any), it is unlikely that traffic and activity would shift from surrounding airports (as both carriers serve EWR, MHT and BOS and FedEx also serves PVD).

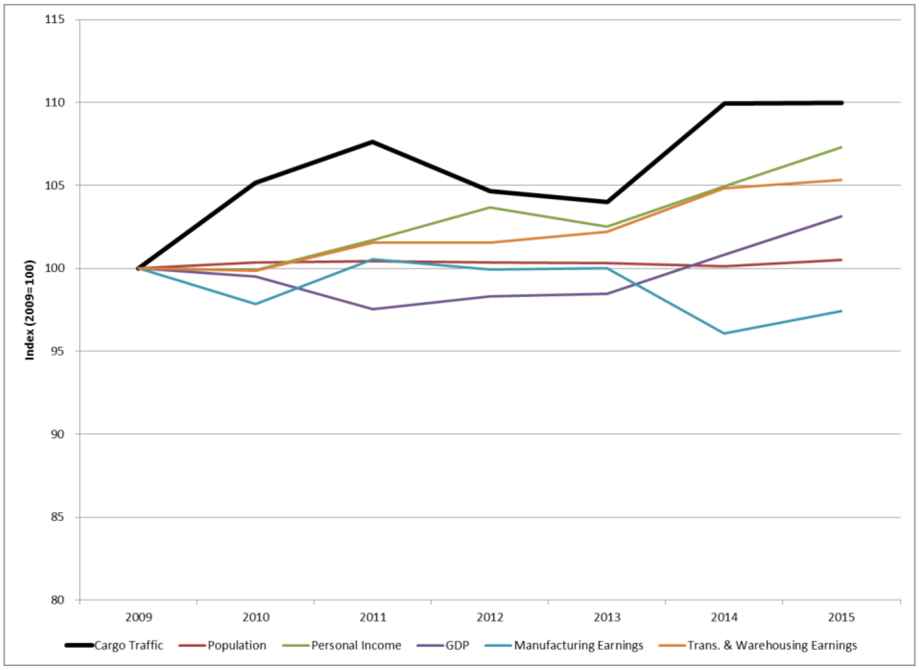
BDL currently has strong service to regional hubs and international gateways in the integrated carrier networks beyond the services to and from their national hubs. BDL is one of 49 U.S. airports served directly from FedEx's IND hub and one of 21 airports with service from its EWR gateway. Similarly, BDL is one of 14 airports served from UPS' RFD hub and one of 15 airports served from its PHL gateway. It is likely that this current pattern of service would be maintained and adjusted in the future to meet increased traffic demand.

Therefore, the current and historical traffic levels for the integrated carriers at BDL should be representative of the demand for integrated cargo services and can be used as a basis for forecasting future demand. Various techniques for forecasting demand levels include: (1) economic and demographic growth for the local service area; and (2) general air cargo forecasts by FAA, Airbus and Boeing.

As the integrator traffic growth and its service patterns have been stable for some time, it is reasonable to base future growth on the local economy (as represented by the cargo service area). As shown in **Figure 3-21**, the pattern of growth since 2009 for integrator traffic has been steady (other than a spike in 2011) and the growth is most closely matched to the growth in personal income and earnings[16] for the transportation and warehousing sector (as measured in real terms).

[16] Real employee earnings for individual industrial sectors are used to measure the output for those sectors as revenue data is not available at the county level.

Figure 3-21 – BDL Cargo vs. Service Area Growth (2009-2015)



Source: U.S. DOT, T-100 statistics and Woods & Poole

Regression analysis was used to compare growth patterns in integrated carrier traffic at BDL from 2003 to 2015 with economic and demographic factors for the BDL cargo service area. Direct correlations with population, GDP and manufacturing earnings produced low R-squared values (less than 0.27) and/or coefficients that were illogical (e.g., increased manufacturing earnings negatively affected traffic levels). The same correlations for gross domestic product and employee earnings for the transportation and warehousing sector produced relatively high R-squared values (over 0.70) and rational coefficients. A regression based on both GDP and transportation and warehousing earnings produced a relatively high R-squared (0.83) and the following equation:

$$Ln(Cargo\ Traffic) = -8.475 + 0.925 * ln(GDP) + 1.139 * ln(Trans./Warehousing\ Earnings)$$

This equation was used to produce the "Regression" traffic forecast using projected changes to the statistics for the period 2017-2037.[17] Integrator traffic growth averaged 3.2% per year for this forecast. Since the "Regression" forecast growth was well outside the range of the other forecasts, it was eliminated from consideration.

An alternative "Transportation and Warehousing" traffic forecast was based on the projected Woods & Poole growth rates in earnings for the service area's transportation and warehousing sector (with average growth of 1.3%).

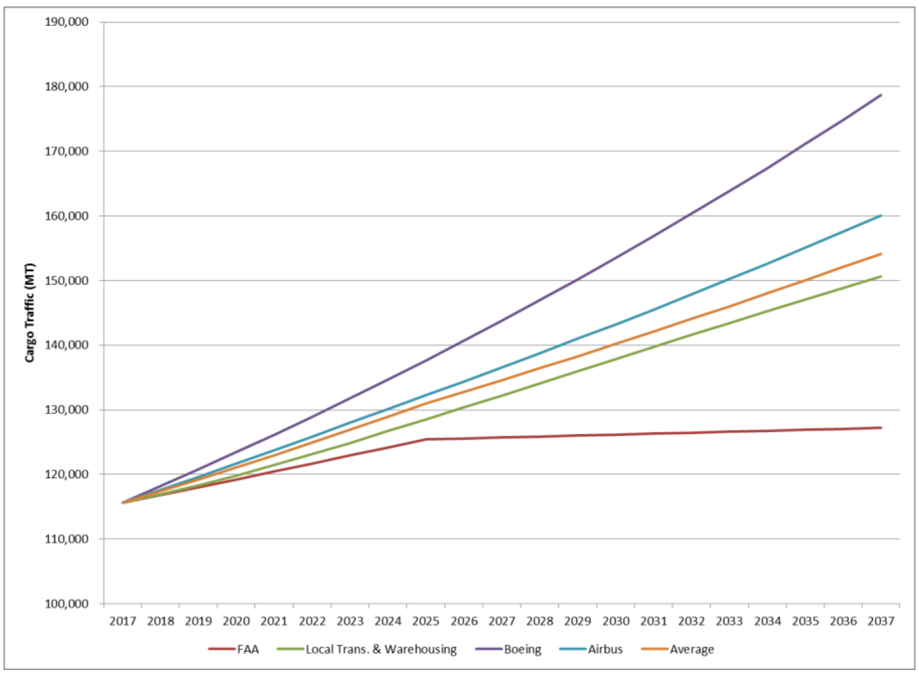
[17] Growth between fiscal years ending June 30 were calculated as the average between projected growth for the two calendar years (e.g., FY 2018 growth is the average of CY 2016-CY 2017 and CY 2018-CY 2018 growth rates).

Other forecasts were based on national-level air cargo forecasts as produced by the Boeing Company[18], Airbus[19] and the FAA[20]. Boeing projects North American domestic cargo traffic (which is dominated by the integrated carriers) to average 2.2% annual growth between 2016 and 2035. In contrast, the FAA projects relatively low growth (1.0% per year from 2016 to 2025 and 0.1% annual growth from 2025 to 2026). Airbus' projected growth falls in between with 1.7% per year from 2015 to 2025 and 1.6% from 2025 to 2035.

The growth rates for 2018 through 2037 were applied to an estimate of 2017 traffic assuming the same traffic level as 2016. While integrator traffic for the twelve months ending November 30, 2016 was up 3% over the prior year, traffic for the first five months of FY 2017 (July-November) was almost exactly the same as the same period in 2015 so no growth is projected.

As shown in **Figure 3-22**, the Boeing forecast produces the highest growth rate while the FAA forecast has the lowest growth.

Figure 3-22 – Comparison of Forecasts (2017-2037)



Source: Forecast

The resulting traffic levels for each of the traffic forecasts are shown in **Table 3-7** The recommended forecast is the average of the four remaining forecasts (i.e., excluding the "Regression" forecast) which falls between the Airbus-based and "Local Transportation and Warehousing" forecasts.

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[18] The Boeing Company, The Boeing World Air Cargo Forecast 2016/2017

[19] Airbus, Global Market Forecast 2016-2035

[20] FAA, FAA Aerospace Forecast, Fiscal Years 2016-2036

Table 3-7 – Integrated Cargo Traffic Forecasts (2017-2037)

Fiscal Year	Trans. & Warehousing	National FAA	National Airbus	National Boeing	Average
2017	115,660	115,660	115,660	115,660	115,660
2022	123,138	121,671	125,831	128,955	124,899
2027	132,218	125,716	136,561	143,778	134,568
2032	141,586	126,443	147,841	160,305	144,044
2037	150,622	127,175	160,053	178,732	154,145

Source: Forecast

Other All-Cargo and Passenger Traffic

The forecasts for the other categories of traffic ("Other All Cargo" and "Passenger") have been irregular over time and there is no indication of any future growth in flight or traffic activity. Therefore, the FY 2017 levels are set at the FY 2016 levels and kept constant throughout the forecast period.

Combined Traffic Forecast

The combined traffic forecast for all categories is shown in **Table 3-8**.

Table 3-8 – Combined Cargo Traffic Forecasts (2017-2037)

Fiscal	BDL All-Cargo Traffic (MT)			
Year	Integrators	Other All-Cargo	Passenger	Total
2017	115,660	2,161	4,571	122,392
2022	124,899	2,161	4,571	131,631
2027	134,568	2,161	4,571	141,300
2032	144,044	2,161	4,571	150,776
2037	154,145	2,161	4,571	160,877

Source: Forecast

3.4.3 All-Cargo Operations Forecast

The operating patterns for the integrated carriers have been relatively stable in recent years while that of the other all-cargo activities has varied on a year-to-year basis. The operations forecast for the integrators assumed the same growth rates as for the traffic forecast. **Table 3-9** shows the forecasted totals in this scenario.

Table 3-9 – All-Cargo Operations Forecast (2017-2037)

Fiscal	BDL All-Cargo Operations		
Year	Integrators	Other All-Cargo	Total
2017	6,108	630	6,738
2022	6,596	630	7,226
2027	7,107	630	7,737
2032	7,607	630	8,237
2037	8,140	630	8,770

Source: Forecast Analysis

3.4.4 Fleet Mix Forecast

The historical fleet mix for all-cargo operations at BDL was predominantly driven by the service patterns of the integrated carriers and a stable role for BDL within their domestic networks. While more varied in terms of traffic and operating levels, other all-cargo flight activity can also be forecast based on historical patterns. The fleet mix forecasts for all-cargo operations are described below.

Integrated Carrier Operations

The integrated carriers serve the BDL market with a mix of narrow body and wide body jet aircraft as well as some turboprop flights. The standard weekday hub flights are supplemented with additional peak capacity supplied by (1) more flights from the hubs and other airports and (2) the use of larger aircraft in some cases. The standard service patterns (in terms of routes and aircraft type) can also be changed for ad hoc point-to-point flights and fleet maintenance.

Over 99% of the BDL integrator traffic is moved via jet aircraft. As shown in **Table 3-10** the jet aircraft types that are used fit into three general categories based on average traffic load: narrow body (10.8 tonnes per operation with B-757's), standard wide body (26.5-28.4 tonnes per operation with A-300's and B-767's) and large widebody (34.6-44.6 tonnes per operation with DC-10's and MD-11's). In terms of traffic, 81% of the cargo moved on widebodies mostly on A-300's and B-767's with B-757's used for the narrow body traffic. The larger DC-10's were also used on a regular basis while there were also some ad hoc MD-11 flights (with both types operated by FedEx). While accounting for an insignificant amount of traffic, the turboprop operations using Cessna 208 aircraft (operated by a contract carrier for FedEx) generated a total of 397 operations in 2016.

Table 3-10 – Integrated Carrier Fleet Mix at BDL (2016)

Aircraft Type	Average Age	Traffic (MT)	% of Total	Number of Operations	% of Total	MT per Operation
Narrow-body Jets						
Boeing 757-200	24.6	22,162	19%	2,240	37%	9.9
Wide-body Jets						
Airbus A300	18.4	43,123	37%	1,708	28%	25.2
Boeing 767-300	8.6	28,452	25%	1,118	18%	25.4
DC-10	39.0	21,611	19%	596	10%	36.3
MD-11	23.6	179	0%	6	0%	29.9
Subtotal - Jet		115,527	100%	5,668	93%	20.4
Turboprop						
Cessna 208	25.8	155	0%	440	7%	0.4
		115,682	100%	6,108	100%	18.9
Other All-Cargo						
Boeing 737-400		2,043	0%	508	0%	4.0
Other Narrow-body Jets		21		2		10.6
Wide-body Jets		96		6		16.0
Turboprops		0		114		0.0
		2,160		630		3.4

Note: Combined traffic and operations for FedEx and UPS with the average age based on their combined fleets.
Source: U.S. DOT, T-100, CAA, DIIO Fleet database (Feb. 2017)

FedEx handled 59% of its 2016 traffic at BDL using Airbus 300 wide body aircraft that accounted for 51% of the operations. The larger wide body DC-10 accounted for 40% of the traffic and 24% of the operations. The Cessna turboprop fleets accounted for 18% of the operations but less than 1% of the traffic. Irregular flights using narrow body Boeing 757's and wide body MD-11's were responsible for just 1% of operations and a smaller share of traffic.

As with FedEx, UPS operates a combination of narrow body and wide body jet aircraft at BDL. For 2016, UPS handled 46% of its traffic using the wide body Boeing 767 with the narrow body Boeing 757 handling 35% of the traffic and the Airbus 300 with 19%. Based on varying average loads, the Boeing 757 accounted for 61% of the operations compared to 27% for the Boeing 767 and 12% for the Airbus 300.

Integrated Carrier Fleet Mix

Future patterns should be relatively similar to current patterns considering the consistency of average flight loads for the integrators, the stability of BDL's role in their networks, the long operating life for freighter aircraft, and the ability to add converted passenger aircraft to replace aging freighter models. It is likely that the split between narrow body and wide body jets will be maintained although it is probable that there will be some shift between wide body jet aircraft types as determined by the likely future composition of FedEx's and UPS's fleets.

In June 2015, FedEx announced plans to permanently retire 15 of its older aircraft and accelerate retirement for 23 more aircraft (including some Airbus 300's and DC-10's).[21] Based on the current size of its Airbus 300 fleet and announced orders for Boeing 767 aircraft, it is assumed that the current Airbus flights will be replaced with 767's by 2027 with this pattern maintained through 2037.[22] It is also likely that FedEx's DC-10 fleet (at an average age of 39 years) will be replaced with MD-11's (or an equivalent aircraft size) by 2027.

The UPS wide body jet fleet is relatively newer than that of FedEx and there are no announced plans to replace the aircraft used at BDL (i.e., no firm orders or options). UPS currently has 68 Airbus 300 aircraft in service at an average age of 14 years (compared to 22 years for FedEx). The UPS Boeing 767 fleet is larger than FedEx's (59 vs. 43) and, while having a higher average age (13 years vs. 3 years), should be available for use throughout the forecast period. By 2027, it is expected that UPS will continue the same mix of wide body aircraft as in 2016, but will shift its Airbus operations to the Boeing 767 or similarly-sized replacement aircraft by 2037.

While UPS's Boeing 757 narrow body fleet average almost 25 years in age, it is likely that the current operations will be continued using similarly-sized replacement aircraft throughout the

[21] FedEx. (June 1, 2015). *FedEx Corp. Accelerates Aircraft Retirements [*News Release]. http://investors.fedex.com/news-and-events/investor-news/news-release-details/2015/FedEx-Corp-Accelerates-Aircraft-Retirements/default.aspx

[22] Since 2011, FedEx has retired 130 older aircraft (70 Boeing 727's, 41 Airbus 310's, 16 DC-10's and 3 Airbus 300's) while adding 105 aircraft (51 Boeing 757's, 44 Boeing 767's and 10 Boeing 777's). As of February 2017, FedEx operated 68 Airbus 300's and had orders to add 70 Boeing 767's (and options for 24 more). The new more efficient Boeing B-767 wide-body aircraft provide 19% more capacity than the Airbus 300 at reduced operating costs. Source: DIIO

forecast period (replacing retired aircraft with either converted passenger aircraft or a new design not yet available).

While the Cessna aircraft operated by FedEx are relatively old and may be replaced before 2037, the replacement type would likely be similarly sized.

Non-Integrated Freighter Fleet Mix

Operations of all-cargo aircraft by non-integrated all-cargo carriers is primarily Boeing 737-400 aircraft operated by Southern Air that accounted for 95% of the non-integrated traffic on freighters and 81% of operations in 2016. There were a total of 8minor ad hoc operations in 2016 using a mix of narrow body jets (Boeing 727), wide body jets (Antonov 124 and Boeing 767) and turboprop aircraft (Beech King Air). As with the traffic forecasts, it is assumed that the fleet mix for these operations would be constant throughout the forecast period. Based on high variability in fleet mix for the ad hoc flights, those operations are assigned to general aircraft categories rather than specific types.

Combined Fleet Mix Forecast

The fleet mix forecast in **Table 3-11** is based on the following assumptions:

- Integrators: The 2017 fleet mix will be the same as the 2016 distribution (based on equal traffic levels and no known changes to flight patterns). By 2027 and 2037, the split between aircraft size categories will remain constant but FedEx A-300 flights will be replaced with B-767 flights and FedEx's DC-10 flights replaced with MD-11 flights. UPS's wide body flights would use Airbus A300's in 2027 but be replaced by the Boeing 767's (or a similarly-size aircraft) by 2037.
- Other All-Cargo: The 2017 fleet mix (grouped into general aircraft categories for the minor ad hoc operations) will be the same as 2016 and maintained throughout the forecast period.

Table 3-11 – All-Cargo Fleet Mix (2017-2037)

Aircraft Type	2017	2027	2037
Narrow-body Jets			
Boeing 737-400	508	508	508
Boeing 757-200	2,240	2,606	2,985
All Other	2	2	2
	2,750	3,116	3,495
Wide-body Jets			
Airbus A300	1,708	570	0
Boeing 767-300	1,118	2,718	3,766
DC-10	596	0	0
MD-11	6	700	802
All Other	6	6	6
Subtotal - Jet	3,434	3,994	4,575
Turboprop			
Cessna	440	512	586
All Other	114	114	114
	554	626	700
Total - All Types	6,738	7,737	8,770

Source: Forecast Analysis

3.5 GENERAL AVIATION AND MILITARY FORECAST

General aviation (GA) includes all segments of the aviation industry except commercial air carriers/regional/commuter service, scheduled cargo, and military operations. General aviation represents the largest percentage of civil aircraft in the U.S. and accounts for most operations handled by towered and non-towered airports. Its activities include flight training, sightseeing, recreational, aerial photography, law enforcement, and medical flights, as well as business, corporate, and personal travel via air taxi charter operations. General aviation aircraft encompass a broad range of types, from single-engine piston aircraft to large corporate jets, as well as helicopters, gliders, and amateur-built aircraft.

Military aircraft and operations are simply defined as those owned and operated by the nation's military forces. Military aircraft are often included in the based aircraft and operations projections, but are not forecast in the same manner as general aviation activity since their number, location, and activity levels are not a function of anticipated market and economic conditions, but are rather a function of military decisions, national security priorities, and budget pressures that cannot be predicted over the course of the forecast period. Typically, military based aircraft and military operations, for forecasting purposes, remain static at baseline year levels through the forecast period.

General aviation and military operations are further categorized as either itinerant or local operations. Local operations are those performed by aircraft that remain in the local traffic pattern or within a 20-mile radius of the tower. Local operations are commonly associated with training activity and flight instruction, and include touch and go operations. Itinerant operations are arrivals or departures other than local operations, performed by either based or transient aircraft that do not remain in the airport traffic pattern or within a 20-nautical mile radius.

As shown in **Table 3-12**, the 2017 TAF represents a negative growth trend of -0.18 percent annual growth in GA operations at BDL. It is important to note that the Itinerant GA operations include the GA Air Taxi operations as a result of the previously mentioned split of Air Taxi & Commuter operations.

Table 3-12 – FAA TAF (condensed to GA only)

		Itinerant Operations			Local Operations			
Year	Air Taxi	GA Ops.	Military Ops.	Total	Civil Ops.	Military Ops.	Total	Total Ops.
2016	18,916	14,192	3,114	36,222	290	72	362	36,584
2017	17,254	14,290	2,953	34,497	285	49	334	34,831
2022	12,676	14,290	2,953	29,919	300	49	349	30,268
2027	13,630	14,290	2,953	30,873	315	49	364	31,237
2032	14,768	14,290	2,953	32,011	330	49	379	32,390
2037	15,903	14,290	2,953	33,146	345	49	394	33,540
2017-2037 AAGR	**-0.39%**	**0.00%**	**0.00%**	**-0.19%**	**0.91%**	**0.00%**	**0.79%**	**-0.18%**

Source: 2017 FAA Terminal Area Forecast, BDL Management, CHA 2017.
AAGR = Average annual growth rate

According to the FAA, the "Air Taxi & Commuter" category in FAA reported operations data includes both scheduled Air Carrier operations 60-seats or less (i.e., this will include all 50-seat regional jet operations) and business and charter jet operations (Part 135). As such, the Air Taxi & Commuter category in the 2017 FAA TAF includes both scheduled airlines and business/charter and general aviation operations. The following describes the difference between Air Carrier and Air Taxi & Commuter operations, as defined by the FAA.

- Air Carrier – Operations with aircraft designed to have seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds carrying passengers or cargo for hire or compensation. This includes US and foreign flagged carriers.
- Air Taxi & Commuter – Operations with aircraft designed to have a maximum seating capacity of 60 seats or less or a maximum payload capacity of 18,000 pounds or less carrying passengers or cargo for hire or compensation.

Therefore, to accurately gauge Commercial Air Carrier operations in comparison to GA operations when examining operations data, it is necessary to split GA Air Taxi operations from the commercial air carrier operations to account for the schedule air carrier operations using 50-seat regional jet aircraft.

This is accomplished by calculating the total scheduled commercial air carrier operations at BDL (actual scheduled Air Carrier operations for BDL were derived from Innovata Schedules) and applying the split to account for Air Carrier operations categorized under Air Taxi & Commuter operations, and reclassifying those operations as commercial airline operations. Eliminating the scheduled commercial operations from the Air Taxi and Commuter that are the main contributor to the decline and categorizes operations at the Airport by Air Carrier and GA, both categories then project growth throughout the forecast period. Table 3-13 below shows the comparison between the FAA and BDL reported data and provides an adjustment calculation example.

Table 3-13 – FAA TAF Vs. BDL Actual Total Airport Operations

Source	Year	Air Carrier	Air Taxi	Itinerant Operations			Local Operations			Total Ops.
				GA Ops.	Military Ops.	Total	Civil Ops.	Military Ops.	Total	
FAA	2016	58,258	18,916	14,192	3,114	94,480	290	72	362	94,842
BDL Actual	2016	63,278*	13,896	14,192	3,114	94,480	290	72	362	94,842

Source: 2017 FAA Terminal Area Forecast, BDL Management, CHA 2017.
*Actual BDL reported Air Carrier Operations

Adjustment calculation example:

FAA **58,258 AC + 18,916 AT = 77,174**

Adjusted **77,174 Total – 63,278 (actual AC) = 13,896***

Actual **63,278 AC and 13,896 AT**

*remaining AT that are not Scheduled Air Carrier operations

Table 3-14 shows actual a comparison between BDL reported GA operations only with the previously described split, and the FAA reported operations numbers for 2016. As shown in the table, there are 5,020 less Air Taxi operations. Based on schedule data and commercial aircraft operations counts, these operations were performed by scheduled aircraft carriers utilizing 50-seat regional jet aircraft, and therefore were counted in the Air Carrier category. It is important to note that all cargo operations are included within the GA Itinerant operations counts.

Table 3-14 – FAA TAF Vs. BDL Actual (GA, Cargo, and Military)

Source	Year	Air Taxi	Itinerant Operations			Local Operations			Total Ops.
			GA Ops.	Military Ops.	Total	Civil Ops.	Military Ops.	Total	
FAA	2016	18,916	14,192	3,114	36,222	290	72	362	36,584
BDL Actual	2016	13,896	14,192	3,114	31,202	290	72	362	31,564

Source: 2017 FAA Terminal Area Forecast, BDL Management, CHA 2017.

3.5.1 Potential GA Operations Forecasts

Similar to commercial operations forecasts, several methodologies exist that could be used to forecast GA operations. To determine the most plausible and reasonable scenario for BDL, it is necessary to compare and eliminate those forecasts that do not support the key factors and variables that comprise the specific operational direction of the Airport. After careful evaluation, the following forecast scenarios are considered not to be statistically reliable for application to the BDL GA operations.

Historical Growth Scenario

The Historical Growth Scenario is a forecasting approach in which the trend of past years' aviation activity is extrapolated over the forecast horizon (20 years). Over the last decade, BDL has experienced a sharp decline in GA activity, from 34,548 total ops in 2006 to 14,604 total ops in 2016. It is highly improbable that this waning of activity will continue at such a rate, and will likely initiate a static path or experience an increase at some point in the future. Because of this, the Historical Growth Scenario was considered unreliable and was not used for this forecasting effort.

Market Share Scenario

The Market Share Scenario is a forecast model that compares local aviation activity levels with regional, state, and national level trends. This methodology assumes that the activity of any one airport is regular and predictable in accordance with the average of airports nationally. Due to the fluctuating nature of GA traffic and the fact that this approach does not account for specific regional socioeconomic conditions (such as several alternative general aviation airports to serve light aircraft), the Market Share Scenario was not considered to be statistically reliable for the purposes of the BDL forecast.

3.5.2 Operations Per Based Aircraft

Operations per based aircraft (OPBA) forecasts involve a relatively straightforward forecasting methodology which assumes a total number of annual operations conducted is representative of the number of aircraft based at the Airport. This methodology is often used at airports where based aircraft is the predominant derivative of GA activity, such as BDL. As shown in the previous section, itinerant traffic makes up almost 99% of all GA activity at the airport. These operations are typically performed by jet and turbo-prop aircraft based at BDL flying charter and corporate aviation operations.

According to FAA *Order 5090.3C, Field Formulation of the National Plan of Integrated Airport Systems*, the methodology assumes airports with a reasonable level of operations per based aircraft to remain static, or increase with further explanation. Additionally, if the Airport does not have adequate operational data, the FAA provides guidance to adjust the operations as follows 250 OPBA for a typical GA airport, 350 OPBA for a busier GA airport with more itinerant traffic, and 450 OPBA for busy GA reliever airports. At BDL, the OPBA was 338 in 2016.

Based Aircraft Recommended Forecast

The first component of this methodology involved developing a forecast of based aircraft. To accomplish this task, annual fleet mix growth projections, provided in the *FAA Aerospace Forecasts, FY2017-2037*, were used to project the number of based aircraft throughout the forecast period. The methodology used to forecast based aircraft activity at the Airport assumes that BDL GA based aircraft will grow at the FAA projected national rates and maintain their respective share of fleet and operations throughout the forecast period. This methodology represents a relatively conservative approach to projecting this type of activity.

For based aircraft projections at BDL, each aircraft type was anticipated to grow at the national rates projected in the FAA Aerospace Forecasts, which are detailed in **Table 3-15**. Since each aircraft type is forecast independently based on specific growth rates unique to the aircraft type, a more logical fleet mix and total based aircraft count can be predicted with the FAA Aerospace Forecast than when using the TAF as a sole source forecast (the TAF forecasts an aggregate based aircraft number, not by specific type).

Table 3-15 – FAA Aerospace National GA Fleet Growth Rates

Period	Single Engine	Multi-Engine Piston	Turbo-Prop/Rotor	Jet
2013-2018 AAGR	-0.3%	-0.3%	2.1%	1.6%
2018-2023 AAGR	-0.3%	-0.3%	1.8%	1.9%
2023-2028 AAGR	-0.2%	-0.5%	1.6%	2.2%
2028-2033 AAGR	-0.7%	-0.6%	2.9%	2.9%
2013-2033 Total	**-0.4%**	**-0.5%**	**2.1%**	**2.1%**

Source: FAA Aerospace Forecast FY 2017-2037, CHA 2017.

AAGR = Average annual growth rate

Note: For the purposes of this projection, the Turbo-prop and Rotorcraft categories have been combined

Table 3-16 presents the market share based aircraft forecast in which the FAA Aerospace growth rates are applied to the most current BDL based aircraft fleet mix. Note that growth projections for military aircraft are not provided and remain static, consistent with operations.

Table 3-16 – FAA Aerospace National GA Fleet Growth Rates

Year	Single Engine	Multi-Engine Piston	Turbo-Prop/Rotor	Jet	Military	Total
2016	4	2	7	31	20	64
2017	4	2	7	31	20	65
2022	4	2	8	34	20	68
2027	4	2	9	38	20	72
2032	4	2	9	42	20	77
2037	4	2	11	49	20	85

Source: FAA Aerospace Forecast FY 2017-2037, Airport Master Record, CHA 2017.
AAGR = Average annual growth rate

Since the existing based aircraft fleet mix at BDL is comprised mostly of jet and turbo-prop/other (which are projected by FAA to grow at the fastest rate), this methodology yielded an increase from 64 to 85 aircraft by 2037.

General Aviation Operations Recommended Forecast

To supplement the guidance provided in Order 5090.3C, the second component of this methodology involved calculating the existing OPBA for BDL. The existing OPBA for BDL (345) was calculated using the BDL reported operations and carried forward as the OPBA baseline. **Table 3-17** depicts the results of the OPBA forecast for the forecast period. The OPBA Scenario was believed to be the most reasonable scenario for the BDL forecast. The projections in this model not only account for national growth conditions and trends within the aviation industry as a whole, but also reflect airport market and specific operations and anticipated demand. Therefore, for the purposes of this study, the OPBA forecast scenario is considered to be the recommended forecast for GA activity at BDL. As a result of the forecast, based aircraft and operations are projected to grow at 1.3% annually and 31.5% over the 20-year forecast period.

Table 3-17 – FAA Aerospace National GA Fleet Growth Rates

Year	Based Aircraft	Operations per Based Aircraft	Total GA Operations
2016	64	338	21,640
2017	65	338	21,852
2022	68	338	23,002
2027	72	338	24,380
2032	77	338	26,132
2037	85	338	28,735

Source: *FAA Aerospace Forecast FY 2017-2037*, Airport Master Record, CHA 2017.

3.6 RECOMMENDED FORECAST SUMMARY

The following tables present a summary of the preferred aviation activity forecasts for air carrier activity (operations and enplanements), GA activity (based aircraft and operations), and military activity as detailed in the previous sections. Additionally, direct comparisons to the BDL TAF are provided for evaluation purposes. The recommended forecasts are the preferred projections on which future planning for the Airport will be based. **Table 3-18** presents the complete summary of the preferred forecast for based aircraft, enplanements, and operations by type.

Table 3-18 – Recommended Forecast Summary

			Operations				
Year	**Based Aircraft**	**Enplanements**	**Air Carrier**	**GA**	**Cargo**	**Military**	**Total**
2016	64	3,025,166	63,278	21,640	6,738	3,186	94,842
2017	65	3,187,046	67,482	21,852	6,738	3,186	99,258
2018	65	3,276,184	69,104	22,068	6,836	3,186	101,193
2019	66	3,464,001	71,800	22,288	6,933	3,186	104,207
2020	67	3,595,967	73,339	22,511	7,031	3,186	106,067
2021	67	3,621,511	73,366	22,739	7,128	3,186	106,419
2022	68	3,640,759	73,366	23,002	7,226	3,186	106,780
2023	69	3,713,574	74,354	23,260	7,328	3,186	108,128
2024	70	3,785,988	75,479	23,523	7,430	3,186	109,619
2025	70	3,858,679	76,599	23,792	7,533	3,186	111,109
2026	71	3,931,609	77,713	24,065	7,635	3,186	112,599
2027	72	4,003,164	78,788	24,380	7,737	3,186	114,091
2028	73	4,073,619	79,832	24,702	7,837	3,186	115,557
2029	74	4,143,686	80,857	25,026	7,937	3,186	117,006
2030	75	4,212,471	81,847	25,357	8,037	3,186	118,427
2031	76	4,278,185	82,768	25,694	8,137	3,186	119,785
2032	77	4,341,075	83,625	26,132	8,237	3,186	121,180
2033	79	4,403,152	84,458	26,623	8,344	3,186	122,610
2034	80	4,464,796	85,274	27,128	8,450	3,186	124,038
2035	82	4,527,750	86,106	27,648	8,557	3,186	125,497
2036	83	4,591,591	86,946	28,183	8,663	3,186	126,979
2037	85	4,653,118	87,734	28,735	8,770	3,186	128,425
2017-2037 AAGR	**1.31%**	**1.91%**	**1.26%**	**1.31%**	**1.26%**	**0.00%**	**1.23%**
2017-2037 Growth	**31.50%**	**46.00%**	**30.01%**	**31.50%**	**30.16%**	**0.00%**	**29.38%**

Source: BDL Management, 2013 BDL TAF, *2013-2033 Aerospace Forecast*, CHA 2013.
AAGR = Average annual growth rate

Table 3-19 details the recommended air carrier enplanements and total operations (all activity types) forecast in comparison to the TAF forecast. At the end of the planning period, the recommended forecast predicts a level of enplanements 4.4 percent above the BDL TAF, and total Airport operations 1.8 percent above what is reported in the TAF. It is important to note that the projected enplanement is within 10 percent of the TAF in the first 5 years, and within 15 percent in 10 years as per the requirements set forth by the FAA in *AC150/5070-6B Airport Master Plans* for approval of Master Plan forecasts.

Table 3-19 – Recommended Forecast vs. FAA TAF

	Enplanements			Operations		
Year	BDL TAF	Recommended Forecast	Recommended Forecast vs. TAF	BDL TAF	Recommended Forecast	Recommended Forecast vs. TAF
2017	3,272,278	3,187,046	-2.60%	98,205	99,258	1.1%
2022	3,568,575	3,640,759	2.0%	104,451	106,780	2.2%
2027	3,846,956	4,003,164	4.1%	111,295	114,091	2.5%
2032	4,143,219	4,341,075	4.8%	118,543	121,180	2.2%
2037	4,457,618	4,653,118	4.4%	126,171	128,425	1.8%
2017-2037 AAGR	**1.48%**	**1.91%**		**1.20%**	**1.23%**	

Source: BDL Management, 2013 BDL TAF, *2013-2033 Aerospace Forecast*, CHA 2013.
AAGR = Average annual growth rate

3.7 PEAK ACTIVITY FORECAST

Commercial service airports experience peak periods of activity that will drive demand and facility requirements for differing areas of airport infrastructure. Peak commercial carrier operations help define the requirements for airside facilities (e.g., gates and aprons), while peak enplanements are used to determine terminal (e.g., ticketing and baggage claim) and landside (e.g., access roads and parking) facility needs. Total peak airport operations are used to evaluate runway capacity and airfield needs. Peak month, peak month-average day (PMAD), and peak hour calculations are the key elements in identifying the facilities needed to accommodate these above average levels of utilization (i.e., peak activity).

Since many of the airport's facility needs are related to the levels of activity during peak periods, forecasts were developed for peak month, average day and peak hour operations.

3.7.1 Peak Month – Average Day

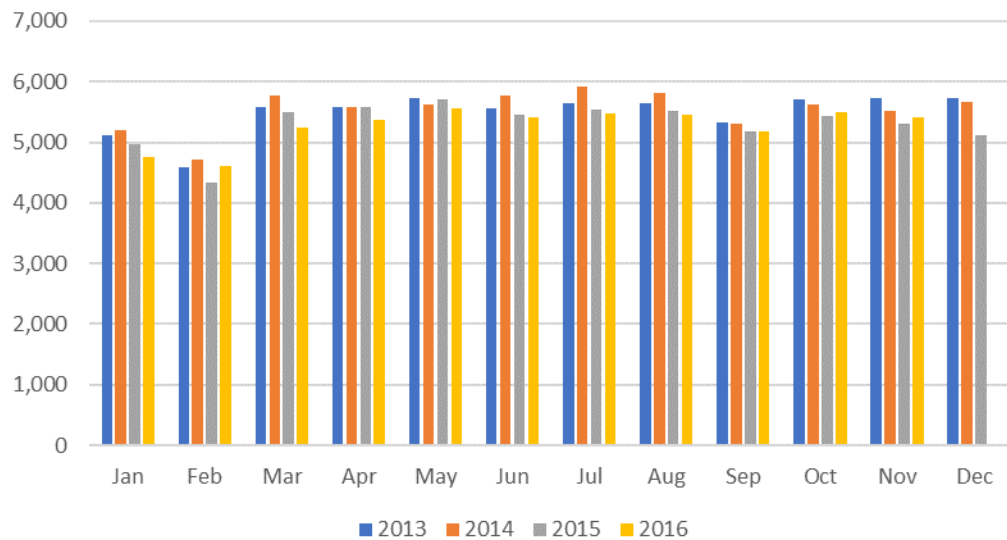
The peak month is defined as the calendar month of the year when the highest level of enplanements and aircraft operations typically occur. The peak month of passenger enplanements is not necessarily the same month as the peak month of operations. PMAD is simply the total operations, or total enplanements, divided by the number of days in the peak month. In order to provide the necessary metrics for the facility requirements analysis (i.e., demand/capacity analysis), PMAD was forecast for the following:

- Enplanements
- Commercial Carrier Operations
- Total Operations

3.7.2 Commercial Peak Activity

Airline activity at BDL is relatively stable throughout the year, with a typical winter lull in January and February. As shown in **Figure 3-23**, over the last four years, peak month activity occurred during the month of May, with the average operations exceeded the average calendar month by 4.6%. For the purposes of the forecast, peak month commercial operation activity is defined as 4.6 percent busier than the average month.

Figure 3-23 – Peak Month Commercial Operations

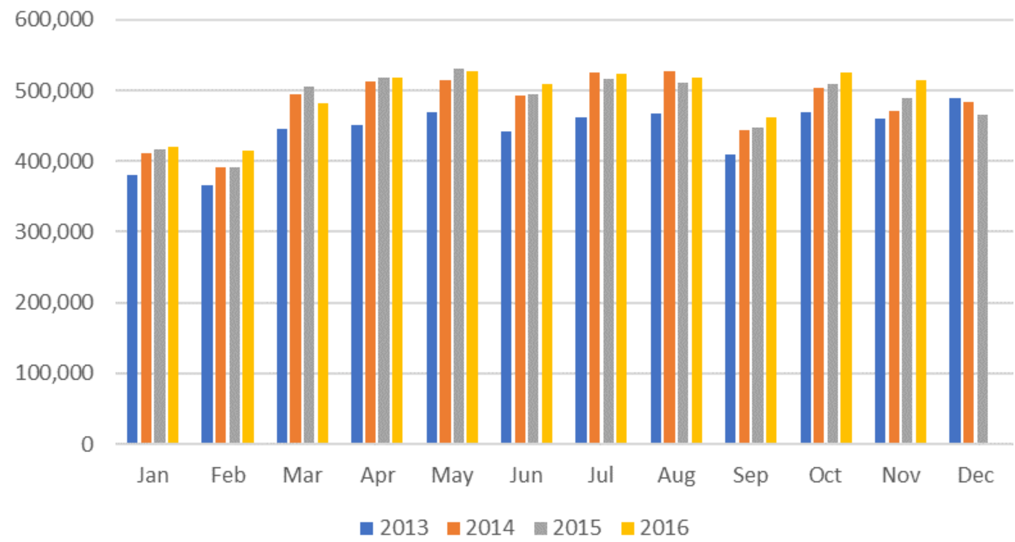


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Distribution by Month	7.7%	7.0%	8.5%	8.5%	8.7%	8.5%	8.7%	8.6%	8.1%	8.6%	8.5%	8.5%
Percent Busier than Average	-7.3%	-15.6%	2.2%	2.3%	4.6%	2.6%	4.4%	3.7%	-2.9%	2.9%	1.6%	1.9%

Source: U.S. DOT T-100 Report.

The peak commercial passenger month over the last four years has been consistent with peak operations in May. **Figure 3-24** below shows May passengers (i.e., enplanements and deplanements) are 7.6% higher than the average month, thus passengers have slightly greater seasonal peaking characteristics then operations. For the purposes of the forecast, peak month commercial passengers will be defined as 7.6% busier than the average month.

Figure 3-24 – Peak Month Commercial Passengers

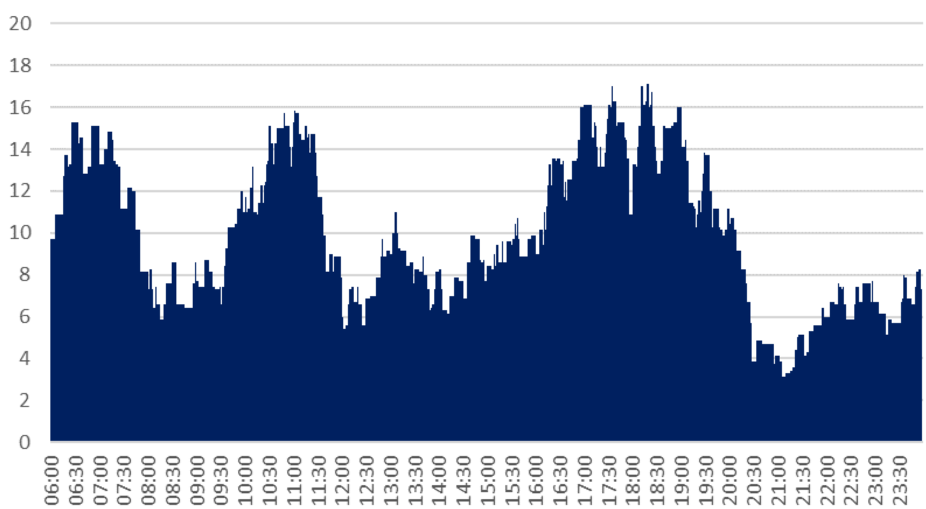


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Distribution by Month	7.2%	6.9%	8.5%	8.8%	9.0%	8.5%	8.9%	8.9%	7.7%	8.8%	8.5%	8.4%
Percent Busier than Average	-14.1%	-17.5%	1.6%	5.4%	7.6%	2.2%	6.9%	6.6%	-7.1%	5.8%	1.9%	1.0%

Source: U.S. DOT T-100 Report.

For the purposes of the forecast, average day commercial operation activity will be defined as an average day within the peak month of May. Based on an average daily schedule for a typical non-holiday week in May (May 15-21, 2017), on a 60-minute rolling basis the peak hour for operations is between 6:15pm and 6:20pm with 17.1 operations, or nearly 10% of the daily commercial operations, as shown in **Figure 3-25**.

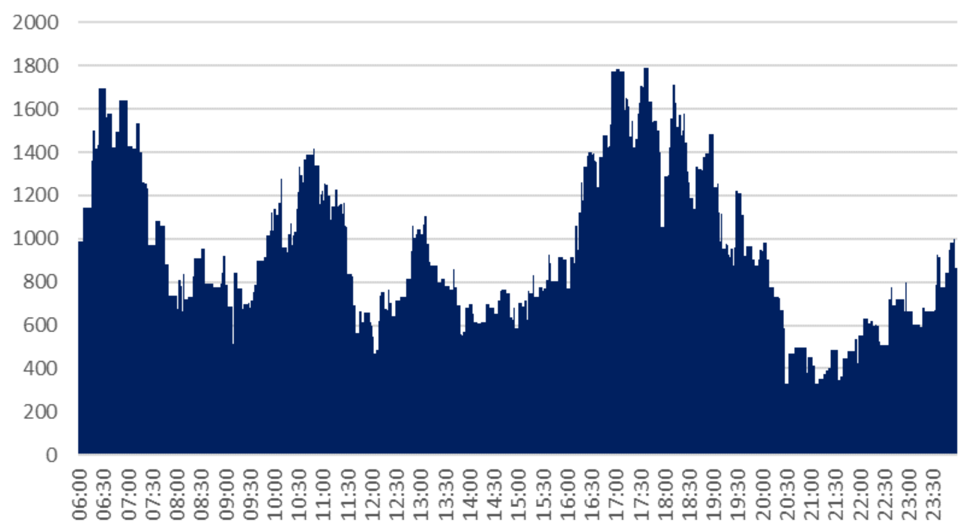
Figure 3-25 – Peak Hour Commercial Operations



Source: Innovata Schedule for average day May 15-21, 2017.

May 2016 load factor data was applied to a May 2017 schedule to compute passenger demand by time-of-day. For new services without load factor information, such as Aer Lingus and Spirit Airlines, estimated load factors were used. Peak passenger demand differs from the operation demand. On a 60-minute rolling basis, the peak hour passenger demand period is between 5:35pm and 5:40pm with over 1,780 passengers, or nearly 10% of the daily passengers. **Figure 3-26** below depicts PMAD peak hour passengers for the month of May at BDL.

Figure 3-26 – Peak Hour Passengers



Source: Innovata Schedule for May 15-21 2017, T-100 Report for May 2016.

Table 3-20 below presents the forecast of peaking characteristics for commercial operations and passengers at BDL. In the forecast, the peak hour average is held constant throughout the planning period

Table 3-20 – Peak Forecast of Commercial Operations and Passengers

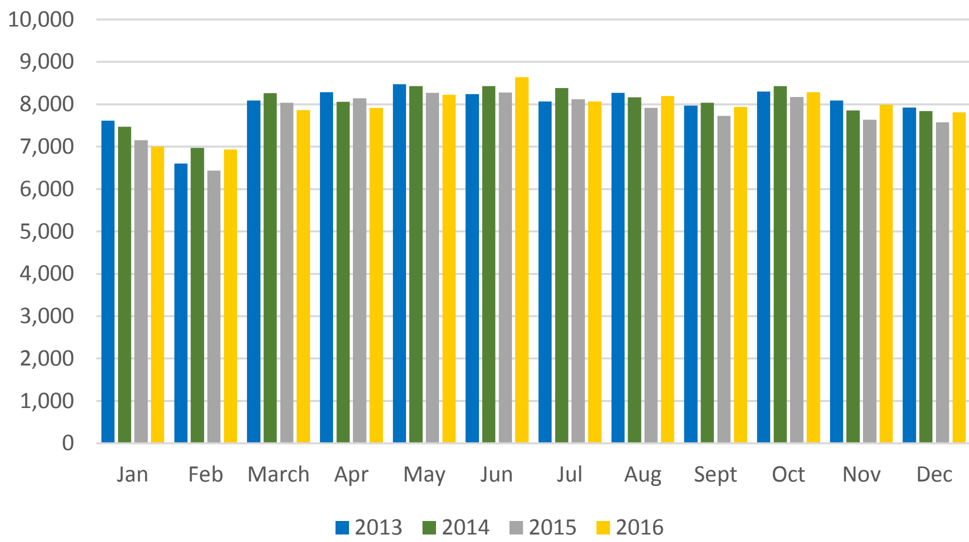
Year	Annual Operations	Peak Month Operations	Average Day Operations	Peak Hour Operations	Annual Passengers	Peak Month Passengers	Average Day Passengers	Peak Hour Passengers
2017	67,482	5,882	190	17.1	6,374,092	571,544	18,437	1,789
2022	73,366	6,395	206	18.6	7,281,518	652,909	21,062	2,044
2027	78,788	6,868	222	20.0	8,006,328	717,901	23,158	2,248
2032	83,625	7,289	235	21.2	8,682,150	778,499	25,113	2,437
2037	87,734	7,647	247	22.3	9,306,236	834,459	26,918	2,613

Source: Campbell-Hill Analysis.

3.7.3 Total Airport Peak Activity

Airline activity at BDL is relatively stable throughout the year, with a typical winter lull in January and February. As shown in **Figure 3-27**, over the last five years, peak month activity occurred during the month of May and June, with the average operations around 8.8%. For the purposes of the forecast, peak month airport operation activity is defined as 0.5%6 percent busier than the average month.

Figure 3-27 – Peak Hour Passengers



Source: BDL Reported Data, CHA, 2017

3.7.4 PMAD and Peak Hour Total Airport Operations

PMAD for all Airport operations (commercial carrier, GA, cargo, and military) are calculated in same manner as the previous PMAD analyses. The historic monthly operations for BDL, detailed in **Table 3-21**, yields May and June as the peak months with approximately 8.8 percent of total operations. June averaged 8,396 operations, equating to approximately 8.8 percent of the total average annual commercial operations over this timeframe. The forecast for BDL peak month and PMAD carrier operations, presented previously, uses a constant 8.8 percent ratio for the month through the forecast period. To compute PMAD, the peak month operations are divided by the number of days in the peak month to represent the peak average day for the forecast period.

The forecast for BDL peak month and PMAD total Airport operations, presented in **Table 3-22**, uses a constant 8.8 percent ratio for the month through the forecast period.

As discussed previously, the month of June averaged the greatest number of total Airport operations for 2012 through 2016. As shown in **Table 3-23**, using the established peak month, it was determined that peak hour total Airport operations (25) encompassed approximately nine percent of the PMAD total Airport operations in 2016. These percentages were then applied, respectively, to the projected PMAD total Airport operations to derive peak hour total airport and commercial carrier operations through 2037.

Table 3-21 – Historical Peak Month Average Day Total Airport Operations

	2013	2014	2015	2016	Average 2012-2016	Percent of Average Operations
Jan	7,615	7,470	7,152	6,999	7,309	7.7%
Feb	6,601	6,975	6,432	6,931	6,735	7.1%
Mar	8,091	8,263	8,035	7,860	8,062	8.5%
Apr	8,286	8,057	8,141	7,914	8,100	8.5%
May	8,471	8,427	8,272	8,221	8,348	8.8%
Jun	8,238	8,429	8,275	8,642	8,396	8.8%
Jul	8,067	8,387	8,121	8,064	8,160	8.6%
Aug	8,268	8,168	7,917	8,195	8,137	8.6%
Sept	7,966	8,038	7,730	7,940	7,919	8.3%
Oct	8,299	8,426	8,174	8,282	8,295	8.7%
Nov	8,092	7,857	7,639	7,987	7,894	8.3%
Dec	7,925	7,840	7,573	7,807	7,786	8.2%

Source: BDL Reported Data, CHA, 2017

Table 3-22 – Peak Forecast of Commercial Operations and Passengers

Year	Annual Airport Operations	Peak Month Percent	Peak Month Airport Operations	Peak Month Average Day
2016	94,842	8.8%	8,370	279
2017	99,258	8.8%	8,759	292
2022	106,780	8.8%	9,423	314
2027	114,091	8.8%	10,068	336
2032	121,180	8.8%	10,694	356
2037	128,425	8.8%	11,333	378

Source: BDL Reported Data, CHA, 2017

Table 3-23 – Peak Hour Forecast of Total Airport Operations

Year	Annual Airport Operations	PMAD	Peak Hour
2016	94,842	279	25
2017	99,258	292	26
2022	106,780	314	28
2027	114,091	336	30
2032	121,180	356	31
2037	128,425	378	33

Source: BDL Reported Data, CHA, 2017

4 FACILITY REQUIREMENTS

In order to ensure that Bradley International Airport (BDL) is capable of supporting the expected increase in passenger traffic, care must be taken to ensure that the recommendations of this Master Plan will adequately accommodate existing and anticipated activity levels. The purpose of this chapter is to identify the Airport's facility development needs over the 20-year planning horizon. Using the preferred aviation activity forecast presented in **Chapter 3** (approved by the FAA in March 2017), the airport facility needs were determined which will form the basis of the development concepts discussed in **Chapter 5**.

The airport demand, capacity, design standards, and the overall facility requirements at BDL were evaluated using guidance contained in several FAA publications, including:

- Advisory Circular 150/5060-5, *Airport Capacity and Delay*
- AC 150/5300-13A, *Airport Design*
- AC 150/5325-4B *Runway Length Requirements for Airport* Design
- AC 150/5360-13 *Planning and Design Guidelines for Airport Terminal Facilities*
- *Airport Cooperative Research Program Airport Passenger Terminal Planning and Design Manual*
- Federal Aviation Regulation (FAR) Part 77, *Objects Affecting Navigable Airspace*
- Order 5090.3C *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*

The following elements of the Airport are addressed in this assessment:

- Airfield Systems
- Passenger Terminal Building
- Surface Transportation & Parking Facilities
- General Aviation (GA) Facilities
- Airspace Protection

4.1 PLANNING FACTORS

Before the facility requirements for BDL could be determined, it was necessary to establish the Planning Activity Levels (PALs) based on the preferred forecasts, the design aircraft family, and the appropriate airport, runway, and taxiway classifications that are associated with FAA design standards. These parameters are discussed in the following subsections.

4.1.1 Planning Activity Levels (PALs)

Since aviation activity is highly susceptible to fluctuations in economic conditions and industry trends, identifying recommended facility improvements based solely on specific years can be a challenge. The timeline associated with the preferred forecast is representative of the anticipated timing of demand (in 5-year increments – 2022, 2027, 2032, and 2037). The actual timing of demand can vary. Therefore, Planning Activity Levels (PALs), rather than calendar years, were established to identify significant demand thresholds for facility enhancement projects. Disassociating the predetermined timeline from the recommended facility improvements provides CAA with the flexibility to advance or slow the rate of development in response to actualized demand. If the preferred forecast proves conservative (i.e. the high growth forecast scenarios is realized because of successful airport marketing and route development initiatives), some recommended improvements may be advanced in schedule. In contrast, if demand occurs at a rate that is slower than the preferred forecast predicts, the improvements should be deferred accordingly. As actual activity levels approach a PAL and trigger the need for a facility improvement, sufficient lead time for planning, design and construction must be also given to ensure that the facilities are available for the impending demand.

Table 4-1 identifies the PALs used for this study, which correspond with the preferred aviation activity forecast for the base year of 2017 and the planning horizon years 2022, 2027, 2032, and 2037. **Figure 4-1** presents a graphical representation of how the PALs for passengers were established, and relates them to the preferred and alternative forecast scenarios (discussed in **Chapter 3**). The graphic helps to depict the relative time range during which each PAL could be reached if one of these other forecast scenarios are actualized. For example, facilities capable of accommodating PAL 2 demands (i.e. ±4.0 million annual enplanements) could be needed as early as 2025, if the high-growth forecast scenario is experienced or as late as 2031 if the low-growth scenario is realized.

Table 4-1 – Planning Activity Levels (PALs)

Passenger Activity						
Activity		**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Annual		6,374,092	7,281,518	8,006,328	8,682,150	9,306,236
Peak Month		571,544	652,909	717,901	778,499	834,459
Average Day		18,437	21,062	23,158	25,113	26,918
Peak Hour		1,742	1,990	2,188	2,373	2,543
Operations						
Category	**Activity**	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Commercial Aviation	Annual	67,482	73,366	78,788	83,625	87,734
	Peak Month	5,882	6,395	6,868	7,289	7,647
	Average Day	190	206	222	235	247
	Peak Hour[1]	17.3	18.8	20.2	21.4	22.5
General Aviation	Annual	21,852	23,002	24,380	26,132	28,735
Military Aviation	Annual	3,186	3,186	3,186	3,186	3,186
Cargo Operations	Annual	6,738	7,226	7,737	8,237	8,770
TOTAL Operations	**Annual**	**99,258**	**106,780**	**114,091**	**121,180**	**128,425**
	Peak Month	8,370	8,759	9,423	10,068	10,694
	Average Day	292	314	336	356	378
	Peak Hour	26	28	30	31	33

Source: CHA, 2017.

[1] The Peak Hour was determined to be 5:35pm on weekdays.

Figure 4-1 – Enplanement Planning Activity Levels (PALs)

Source: CHA, 2017.

4.1.2 Aircraft Classification

The FAA has established aircraft classification systems that group aircraft types based on their performance and geometric characteristics. These classification systems (described below) are used to determine the appropriate airport design standards for specific runway, taxiway, taxilane, apron, or other facilities, as described in FAA AC 150/5300-13A *Airport Design*. The standard classifications are summarized in **Table 4-2**.

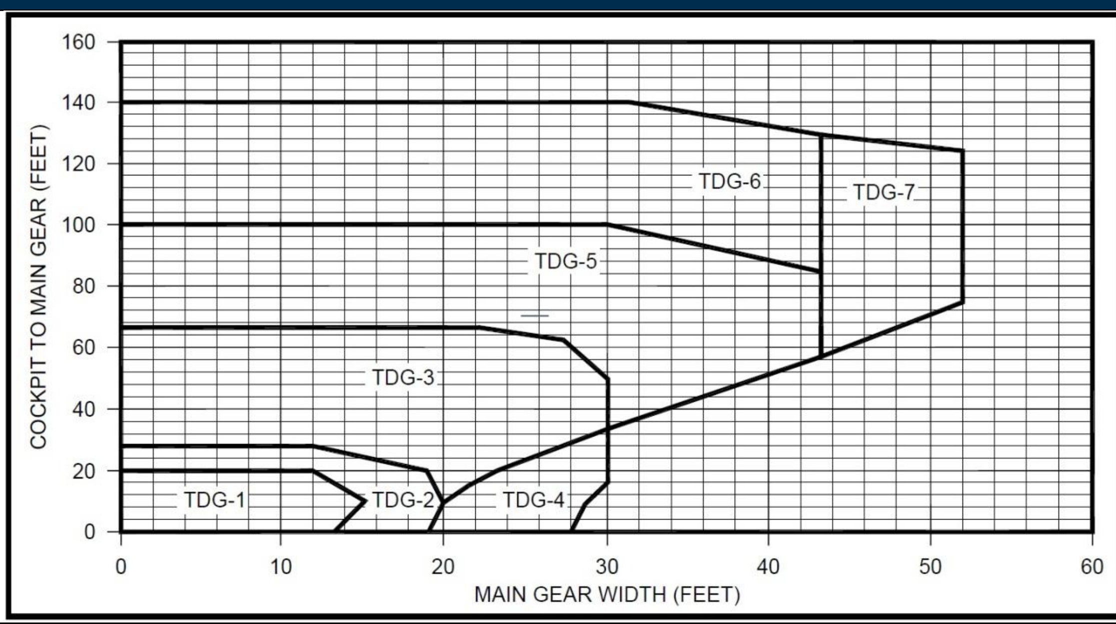
> ***Aircraft Approach Category (AAC)***: a grouping of aircraft based on a reference landing speed (V_{REF}), if specified, or if V_{REF} is not specified, 1.3 times stall speed (V_{SO}) at the maximum certificated landing weight. V_{REF}, V_{SO}, and the maximum certificated landing weight are those values as established for the aircraft by the certification authority of the country of registry.
>
> ***Airplane Design Group (ADG)***: a classification of aircraft based on wingspan and tail height. When the aircraft wingspan and tail height fall in different groups, the higher group is used.
>
> ***Taxiway Design Group (TDG)***: A classification of airplanes based on outer to outer Main Gear Width (MGW) and Cockpit to Main Gear (CMG) distance.

Table 4-2 – Aircraft Classification Criteria

Aircraft Approach Category (AAC)		
Approach Category	**Airspeed (knots)**	**Example Aircraft**
A	<91	Cessna 152, Beech Bonanza A36
B	91 ≤ 121	Pilatus PC 12, Beech Super King Air 350d
C	121 ≤ 141	Boeing 737,MD 80, A319
D	141 ≤ 166	Boeing 747, KC-135
E	166+	F-16, F-18, Boeing 787

Airplane Design Group (ADG)			
Design Group	**Tail Height (ft)**	**Wingspan (ft)**	**Example Aircraft**
I	<20	<49	Cessna 172, Cirrus SR-22
II	20-<30	49 ≤ 79	Cessna Citation II, Falcon 900, CRJ
III	30-<45	79 ≤ 118	Boeing 737, Airbus 320
IV	45-<60	118 ≤ 171	Boeing 757, Boeing 767, MD 11
V	60-<66	171 ≤ 214	Boeing 787, Boeing 777
VI	66-<80	214 ≤ 262	Airbus A380, C-5 Galaxy, AN-124

Taxiway Design Group (TDG)



Source: FAA AC 150/5300-13A *Airport Design*

The applicability of these classification systems to the FAA airport design standards for individual airport components (such as runways, taxiways, or aprons) is presented in **Table 4-3**.

Table 4-3 – Applicability of Aircraft Classifications

Aircraft Classification	Related Design Components
Aircraft Approach Speed (AAC)	Runway Safety Area (RSA), Runway Object Free Area (ROFA), Runway Protection Zone (RPZ), runway width, runway-to-taxiway separation, runway-to-fixed object
Airplane Design Group (ADG)	Runway, Taxiway, and apron Object Free Areas (OFAs), parking configuration, taxiway-to-taxiway separation, runway-to-taxiway separation
Taxiway Design Group (TDG)	Taxiway width, radius, fillet design, apron area, parking layout

Source: FAA AC 150/5300-13A *Airport Design*

4.1.3 Design Aircraft Family

The "design aircraft" or "design aircraft family" represent the most demanding aircraft or grouping of aircraft with similar characteristics (relative to AAC, ADG, TDG), that are currently using or are anticipated to use an airport on a regular basis. Upon review of the FAA's ETMSC data, OAG data, T100 and forecast fleet mix assumptions described in **Chapter 3**, the design aircraft family identified for BDL is presented in **Table 4-4**. This grouping represents the typical commercial aircraft and cargo aircraft anticipated to operate at BDL over the planning horizon. These aircraft generally have higher AAC, ADG, and TDG classifications than the other regularly scheduled commercial aircraft. While the study is not limited to planning for the design aircraft, they must still be considered when planning airfield and landside facilities as they may require specific facility design accommodations within their designated areas of operation. Note that the design aircraft is also commonly referred to as the "critical aircraft."

Table 4-4 – Design Aircraft Family

Aircraft	Total Operations in 2016	AAC	ADG	TDG	AAC: Approach Speed (knots)	ADG: Wingspan (ft)	ADG: Tail Height (ft)	TDG: CMG (ft)	TDG: MGW (ft)
Operated by Passenger Airlines									
Airbus A320	9,400	C	III	3	136	111.9	39.6	50.2	29.4
Airbus A321	1,300	C	III	3	142	111.9	39.7	64.2	29.4
Boeing 737-800	7,800	D	III	3	142	112.5	41.2	56.4	23.0
Boeing 757-200	3,200	C	IV	4	137	134.8	45.1	72.2	28.2
Projected:									
Boeing 787-800*		D	V	5	143	197.3	56.1	83.4	38.1
Cargo Operations									
Boeing 767-300ER	1,700	D	IV	5	140	156.2	52.9	79.7	35.4
Airbus A300	1,100	C	IV	5	137	147.1	55.0	75.0	36.1
DC10	600	D	IV	5	145	155.3	58.4	93.4	41.2
MD-11	10	D	IV	6	153	170.5	58.8	101.7	41.3
Infrequent Operations									
Boeing 777-200	2	C	V	5	136	199.8	61.5	94.8	42.3
Airbus A340-600	4	D	V	6	153	208.2	58.8	122.6	41.4

Source: CHA, 2017
*Boeing 787-800 projected to be operated Air to European destinations by 2027

4.1.4 Airport & Runway Classification

The FAA classifies airports and runways based on their current and planned operational capabilities. These classifications (described below), along with the aircraft classifications defined previously, are used to determine the appropriate FAA standards (as per AC 150/5300-13A) for airfield facilities.

Airport Reference Code (ARC)

ARC is an airport designation that represents the AAC and ADG of the aircraft that the airfield is intended to accommodate on a regular[23] basis. The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely on the airport. The Airport's previous 2005 Airport Layout Plan (ALP) identified the Boeing 767-300ER as the critical aircraft. Due to increasing airframe size due to fleet mix transition and the projected international operations of the Boeing 787-800 Dreamliner by 2027, the future classification of BDL will increase to D-V over the planning horizon.

[23] According to FAA AC 150/5325-4B *Runway Length Requirements for Airport Design*, the terminology of "regular use" and "substantial use" is defined as 500 annual itinerant operations by an individual airplane or grouping of airplanes.

4.2 AIRFIELD CAPACITY REQUIREMENTS

Airfield capacity refers to the maximum number of aircraft operations (takeoffs or landings) an airfield can accommodate in a specified amount of time. An assessment of the airfield's current and future capacity was performed using common methods described in FAA AC 150/5060-5 *Airport Capacity and Delay*. This evaluation helps to determine any capacity-related improvements or expansions that may be needed in order to support flight activity levels. The estimated capacity of the airfield at BDL can be expressed in the following three measurements:

Hourly Capacity: the maximum number of aircraft operations an airfield can safely accommodate under continuous demand in a one-hour period. This expression calculates for Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) conditions, and is used to identify any peak-period constraints on a given day.

Annual Service Volume (ASV): the maximum number of aircraft operations an airfield can accommodate in a one-year period without excessive delay. This calculation is typically used in long-range planning and referenced for capacity-related improvement project approval.

Aircraft Delay: the average number of minutes an aircraft experiences delay on the airfield and total hours of delay incurred over a one-year period.

4.2.1 Capacity Calculation Factors

To calculate these three measurements of capacity and delay, several key factors and assumptions specific to BDL were defined. Consistent with the guidance provided in AC 150/5060-5, these include:

Aircraft Fleet Mix Index – a ratio of the various classes of aircraft serving an airport

Runway-Use Configuration – the number and orientation of the active runways

Percentage of Aircraft Arrivals – the ratio of landing operations to total operations

"Touch and Go" Factor – the ratio of landings with an immediate takeoff to total operations

Location of Exit Taxiways – the number of taxiways available to an aircraft within a given distance from the arrival end of a runway

Meteorological Conditions – the percentages of times an airfield experiences VFR, IFR, and Poor Visibility Conditions (PVC) conditions

Aircraft Fleet Mix Index

Due to the varying performance features, the types of aircraft operating at an airport can have significant impact on an airfield's capacity. The FAA dictates that the heavier the aircraft operating at an airfield, the greater spacing in-flight path is needed between aircraft to avoid wake turbulence. The airport's fleet mix index is determined by the size of typical aircraft and the frequency of their operations. To identify the aircraft mix index (a ratio of the various classes of aircraft serving an airport), AC 150/5060-5 *Airport Capacity and Delay* has established four categories in classifying an aircraft by its maximum certificated takeoff weight (MTOW), as depicted in **Table 4-5**.

Table 4-5 – Aircraft Capacity Classifications

Aircraft Class	MTOW (lbs)	Number of Engines	Wake Turbulence
A	<12,500	Single	Small (S)
B		Multi	
C	12,500 – 300,000	Multi	Large (L)
D	>300,000	Multi	Heavy (H)

Source: AC 150/5060-5 *Airport Capacity and Delay*, CHA, 2017.

The aircraft mix index is calculated using the formula *%(C + 3D)*, the letters corresponding with the aircraft class. This product falls into one of the FAA-established mix index ranges for use in capacity calculations listed below:

• 0 to 20 • 21 to 50 • 51 to 80 • 81 to 120 • 121 to 180

The current facilities at the Airport can accommodate all four aircraft classes. The following operations percentages for aircraft categories C and D were gathered from a review of base year operations:

- Class C = 75.53 percent of the Airport's operations
- Class D = 1.95 percent of the Airport's operations

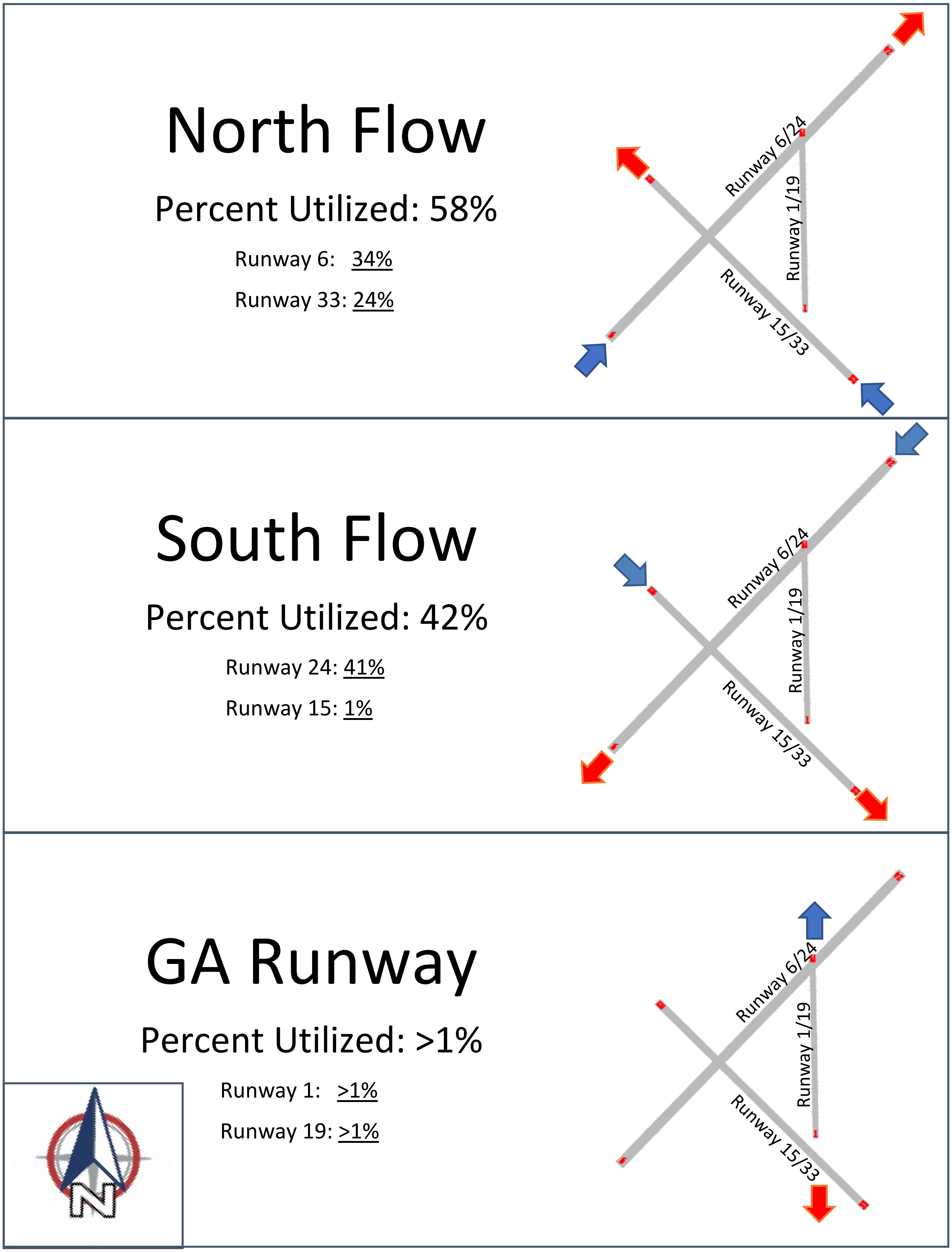
As such, the base year aircraft mix index is 81.38 (75.53 + 3[1.95] = 81.38). While the actual mix index for the Airport is subject to variations given changes in air traffic operations, the likelihood of the Airport's mix index to grow beyond the fourth mix index grouping of 81-120 over the planning period is low. Based on the fleet mix changes described in Chapter 2 for commercial, cargo, and general aviation operations, the aircraft fleet mix index is anticipated to increase lightly from 81.38 in 2016 to 82.8 in 2037.

Runway Use Configuration

The principle determinants of an airfield's layout or configuration are the number and orientation of runways. The efficiency and functionality of the runways used in conjunction with the taxiways and aprons during the various levels of aviation activity directly affects an airport's operational capacity.

If an airfield layout consists of more than one runway, those runways can be termed as either "independent" or "dependent" of each other. An independent runway is one that is not operationally affected by the other runways during normal operations (e.g. parallel runways). A dependent runway is one that is configured in such a way that aircraft must wait for operations to complete on another runway before resuming (e.g. intersecting runways). Due to this wait time, airfields with dependent runway systems are inherently limited compared to independent runways. The intersecting runways at BDL are thus dependent. **Figure 4-2** portrays the runway configuration and utilization at BDL.

Figure 4-2 – Runway Configuration and Utilization



Runway 6-24 has a northeast/southwest orientation, while Runway 15-33 has a northwest/southeast orientation and serve as the main runways for all airport operations. In addition to the two longer runways, Runway 1/19 which serves as the general aviation runway has a north/south orientation. Because the Airport primarily utilizes the four-main runway ends for takeoff and landing (arrival and departure) operations, the usage rates of each runway (6, 24, 15, and 33) were evaluated. These conclusions were established considering the combined VFR and IFR conditions, and are expressed in **Table 4-6**.

Table 4-6 – Runway Usage

Runway End	Runway End Utilization	Runway Utilization
6	34%	75%
24	41%	
15	1%	25%
33	24%	
1	>1%	>1%
19	>1%	

Source: BDL ATCT, CHA, 2017.

Percentage of Aircraft Arrivals

Arriving aircraft usually contribute more to delay than departing aircraft. This percentage is the ratio of landing operations to total operations at an airport during a specified period, and is generally assumed to be equal to the percentage of departing operations. Therefore, a factor of 50 percent will be used for the capacity calculations for the Airport.

Percentage of Touch-and-Go Operations

Because a touch-and-go (T&G) is representative of two operations (i.e. a landing and takeoff performed consecutively during local flight training operations), an airfield with a higher percentage of T&Gs typically has a greater airfield capacity than one with a higher percentage of air carrier operations.

Operational statistics provided by the BDL Air Traffic Control Tower (ATCT) identified very little local or T&G operations (less than 1 per day) at BDL. With the assumption that these operations are T&Gs and that local operations will not experience a significant growth over the planning horizon, a percentage range of less than one percent is used in the capacity calculations. Based on FAA figures, this percentage equates to a T&G factor of 1.0.

Location of Exit Taxiways

The location and number of exit taxiways affect the capacity of an airport's runway system because they directly relate to an aircraft's runway occupancy time. Runway capacities are highest when they are complimented with full-length, parallel taxiways, ample runway entrance and exit taxiways, and no active runway crossings. These components reduce the amount of time an aircraft remains on the runway. FAA AC 150/5060-5 identifies the criteria for determining taxiway exit factors based on the mix index and the distance the taxiway exits are from the runway threshold and other taxiway connections. As the Airport's existing mix index range was calculated to be 81 to 120 over the planning period, only exit taxiways that are between 5,000 and 7,000 feet from the threshold and spaced at least 750 feet apart contribute to the taxiway exit factors. By combining the mix index, percent of aircraft arrivals, and the number of exit taxiways within the specified range, a taxiway exit factor can be calculated as 0.83 VFR / 1.0 IFR, respectively.

Meteorological Conditions

Meteorological conditions at and around an airport also have significant impacts on the capacity of an airfield. Previously described runway use percentages are a result of prevailing winds dictating which runway an aircraft should use for takeoff and landing operations.

Three measures of cloud ceiling and visibility are recognized by the FAA and used to calculate capacity. These include:

> **Visual Flight Rules (VFR)** – Cloud ceiling is greater than 1,000 feet above ground level (AGL) and visibility is at least three statute miles.
>
> **Instrument Flight Rules (IFR)** – Cloud ceiling is at least 500 feet AGL but less than 1,000 feet AGL and/or the visibility is at least one statute mile but less than three statute miles.
>
> **Poor Visibility conditions (PVC)** – Cloud ceiling is less than 500 feet AGL and/or the visibility is less than one statute mile.

BDL experiences VFR conditions 76.8% percent of the time, IFR conditions 15.4% percent of the time, and PVC conditions 7.8% percent of the time. These are approximate percentages derived from the historical data from the Airport's ASOS.

Summary of Capacity Calculation Factors

Table 4-7 summarizes these parameters calculated for BDL, which were used to define the hourly capacity (in VFR and IFR conditions), the ASV, and average delay for the Airport. It is important to note, due to the very limited utilization of Runway 1-19 (less than one percent of airport operations), Runway 1-19 was not included in the capacity parameter calculations.

Table 4-7 – Calculated Capacity Parameters

Factor	2016
Aircraft Fleet Mix Index	81
Runway-Use Configuration	Dual-Intersecting
Percentage of Aircraft Arrivals	50%
Touch and Go Factor (VFR / IFR)	1.02 / 1.0
Taxiway Exit Factor (VFR / IFR)	.96 / 1.0
Meteorological Conditions (VFR / IFR)	77% / 23%

Source: FAA AC 150/5060-5 *Airport Capacity and Delay*, CHA, 2017.

4.2.2 Hourly Capacity

Hourly capacity for the airfield is a measurement of the maximum number of aircraft operations (VFR and IFR) that an airfield can support in an hour based on runway configuration. Using graphs provided in AC 150/5060-5, VFR and IFR hourly capacity *bases* were established by applying the given VFR and IFR operational capacities for the runway use configuration, the aircraft mix index, and percentage of aircraft arrivals. Once the hourly capacity *bases* are identified, they are multiplied by the touch-and-go factors and taxiway exit factors to determine the hourly capacities. This equation is expressed as:

$$\text{Hourly Capacity} = C^* \times T \times E$$

C = Hourly Capacity Base*
T = Touch-and-Go Factor
E = Taxiway Exit Factor

Table 4-8 shows the results of the hourly capacity for 2016 and for PALs 1 through 4. Note that as the mix index increases from 81 (2016) to 83 (2037), the operational capacities decrease.

Table 4-8 – Calculation of Hourly Capacity

Factors	2017 VFR / IFR	2022 VFR / IFR	2027 VFR / IFR	2032 VFR / IFR	2037 VFR / IFR
Hourly Capacity Base	109 / 58	107 / 58	107 / 58	106 / 59	106 / 59
Touch-and-Go Factor	1.02 / 1.0	1.02 / 1.0	1.02 / 1.0	1.02 / 1.0	1.02 / 1.0
Taxiway Exit Factor	.83 / .97	.83 / .97	.83 / .97	.83 / .97	.83 / .97
Calculated Hourly Capacity	**92 / 56**	**91 / 56**	**91 / 56**	**90 / 57**	**90 / 57**

Source: FAA AC 150/5060-5 *Airport Capacity and Delay (VFR: Figure 3-8; IFE Figure 3-44)*
CHA, 2017.

4.2.3 Annual Service Volume

Annual Service Volume (ASV) is an expression of the total number of aircraft operations that an airfield can support annually. The formula for estimating an airport's ASV is based on the ratio of annual operations to average daily operations during the peak month, multiplied by the ratio of average daily operations to average peak hour operations during the peak month. The product of these values is then multiplied by the *weighted* hourly capacity to determine the ASV.

Weighted hourly capacity accounts for the varying operating conditions at the airport, which are applied to the hourly capacity determined in the previous section. The formula for weighted hourly capacity is expressed as:

$$C_w = \frac{(C_{n1} \times W_{n1} \times P_{n1}) + (C_{n2} \times W_{n2} \times P_{n2})}{((W_{n1} \times P_{n1}) + (W_{n2} \times P_{n2}))}$$

C_w = *Airfield weighted hourly capacity*

$_n$ = *Number of runway-use configurations. Due to the operational limitations of the intersecting runways, the airfield operates as a single runway with two configurations: VFR and IFR.*

C = Hourly Capacity of each configuration. ***VFR= 92 / IFR = 56***

W = FAA ASV weighting factor, based on mix index & percentage and hourly capacity. ***VFR = 1 / IFR = 1***

P = Percent of time the Airport operates in each configuration.

For BDL, this applies as VFR and IFR conditions.
VFR = 77% / IFR = 23%

Applying the 2016 BDL data to this equation yields the following:

$$C_w = \frac{(92 \times 1 \times .77) + (56 \times 1 \times .23)}{((5 \times .77) + (1 \times .23))}$$

$$\mathbf{C_w = 83.72}$$

The ASV formula accounts for a variety of conditions that occur at an airport, including low- and high-volume activity periods, and is expressed as:

$$ASV = C_w \times D \times H$$

C_w = Weighted Hourly Capacity.
D = Daily Demand Ratio (ratio of annual operations to average daily operations during peak month).
H = Hourly Demand Ratio (ratio of average daily operations to average peak hour operations during peak month)

Table 4-9 identifies the daily and hourly demand ratios for 2016 through 2036.

Table 4-9 – Demand Ratios

Factor	2017	2022	2027	2032	2037
Annual Operations	**99,258**	**106,780**	**114,091**	**121,180**	**128,425**
Av. Daily Operations (in Peak Month)	292	314	336	356	378
Av. Peak Hour (in Peak Month)	26	28	30	31	33
Daily Demand Ratio (D)	**339.9**	**340.1**	**339.6**	**340.4**	**339.7**
Hourly Demand Ratio (H)	**11.2**	**11.2**	**11.2**	**11.5**	**11.5**

Source: FAA AC 150/5060-5 *Airport Capacity and Delay*
CHA, 2017.

The ASV equation for 2016 is therefore:

$$ASV = 83.7 \times 339.9 \times 11.2$$

$$\mathbf{ASV = 318{,}635}$$

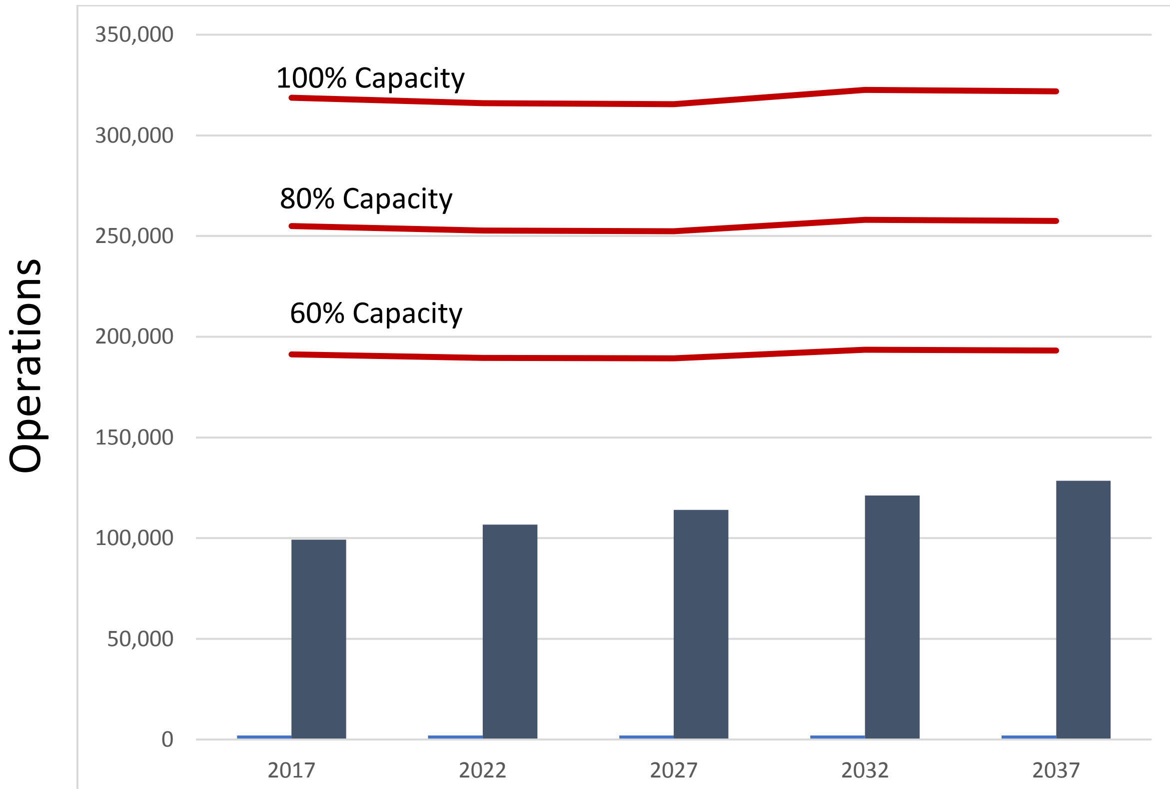
If the annual operations exceed the ASV, the airport is likely to see significant delays. However, at BDL it is determined that annual capacity of approximately 320,000 operations, is well above the PAL 4 operations of annual approximately 128,000. It should be understood, however, that an airport can still experience delays before capacity is reached. As stated in the FAA Order 5090.3C *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*, an airport is eligible to secure funding for capacity-enhancing projects once it has reached 60 percent of its annual capacity. This allows an airport to make necessary improvements and avoid delays before they are anticipated to occur. To better understand BDL's current and projected operational capacity levels, base year and PAL 1 through 4 demands are compared to their respective annual service volumes in **Table 4-10**. The capacity levels are depicted in **Figure 4-3**.

Table 4-10 – Annual Service Volume

Factor	2017	2022	2027	2032	2037
Annual Operations	99,258	106,780	114,091	121,180	128,425
Annual Service Volume	318,712	315,967	315,502	322,602	321,939
Capacity Level	**31.1%**	**33.8%**	**36.2%**	**37.6%**	**39.9%**

Source: FAA AC 150/5060-5 *Airport Capacity and Delay*
CHA, 2017.

Figure 4-3 – Projected Demand



Source: CHA, 2017.

4.2.4 Airfield Capacity Conclusion

Based on the airfield capacity calculations and discussions with airport staff and ATCT, airfield capacity should not be an issue at BDL through PAL 4. Neither the forecast annual activity or peak hour activity will approach 60 percent of capacity.

However, that is not to say that the Airport will not experience delays during inclement weather conditions or briefly during periods of peak activity. The efficiency of the Airport should be continuously monitored to appropriately determine any changes or improvements the airfield may need in order to maintain a high level of customer service and reduce the potential for delay.

4.3 RUNWAY FACILITY REQUIREMENTS

Airfield improvements are planned and developed according to the established ARC, ADG, and TDG for an airport, and the associated design criteria are applied when planning upgrades or improvements for a runway or taxiway. According to the FAA AC 150/5300-13A, an airport's ARC is determined by the critical aircraft (aircraft with the longest wingspan, highest tail, and fastest approach speeds) that makes "substantial use" of the airport or a specific runway. FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems* (NPIAS), defines "substantial use" as 500 or more annual itinerant aircraft operations or commercial service use (an operation is either an arrival or departure). As stated in Section 4.1.4, BDL has an existing ARC of D-IV and based on future projections of aircraft fleet mix transitions, is forecast to become a D-V airport by PAL 2.

4.3.1 Airfield Configuration

The general configuration of the airfield, including the number of runways along with their location/orientation, should allow the airport to meet anticipated air traffic demands and maximize wind coverage and operational utility for all types of aircraft. As stated in **Chapter 2**, it is an FAA recommendation that the runway system at an airport be oriented to provide at least 95 percent wind coverage. This means that 95 percent of the time in a given year, the crosswind coverage at an airport is within acceptable limits for the types of aircraft operating on the runways. The current intersecting runway configuration at BDL provides wind coverage greater than the FAA recommended 95 percent for the design aircraft, and all flight conditions with the exception of A-I and B-I aircraft during IFR conditions.

Air traffic records indicate limited use of A-I and B-I aircraft at BDL. Furthermore, the 2010 *General Aviation and Part 135 Activity Survey* indicates that these smaller aircraft do not fly as often during IFR weather conditions. As such, it is concluded that no changes to the runway configuration are recommended during the planning horizon to accommodate wind conditions.

4.3.2 Runway Designations

Due to the changes in the earth's magnetic declination over time, the compass heading of a runway and its associated end number can change. The current magnetic heading of the runways ends at BDL are as follows:

- Runway 6 is 058 °, Runway 24 is 238 °
- Runway 15 is 148 °, Runway 33 is 328 °
- Runway 1 is 013 °, and Runway 19 is 193 °

Currently, no changes in orientation are needed; however, since magnetic declination changes slowly over time (estimated to be changing by 0.03 degrees annually according to the National Oceanic and Atmospheric Administration Magnetic Field Calculator) the runway numbers may need to be reevaluated by the year 2050 – at which time the magnetic declination may have changed by one full degree.

4.3.3 Runway Design Standards

This master planning effort identifies all FAA design and safety standards related to the airfield facilities so that the airport may work to achieve compliance. The standards include dimensions, separation distances, protection zones, clearance requirements, etc., and vary according to the design aircraft. The FAA design and safety standards related to runways (as defined in AC 150/5300-13A *Airport Design*) are described below.

Runway Width – Runway width requirements are based on the critical aircraft associated with each runway. For ARC C-IV and D-V, the required runway width is 150 feet. Currently, Runways 6-24 is 200’ wide and 15-3315-33 is 150 feet wide, thereby meeting or exceeding this design requirement. Runway 1-19, with an ARC of B-II, has a requirement of 75 feet. Runway 1-19 is 100 feet in width, meeting the design requirement.

Runway Shoulders - Shoulders provide resistance to blast erosion and accommodate the passage of maintenance and emergency equipment and the occasional passage of an airplane veering from the runway. The FAA recommends paved shoulders for runways accommodating Group III aircraft and higher. FAA AC 150/5300-13A indicates the required shoulder width to be 25 feet on either side of a Group IV runway and 35 feet on either side of a Group V runway. Runways 6-24 and 15-33 are equipped with 25-foot-wide paved shoulders, Runway 1-19 is equipped with 18-foot-wide paved shoulders. Runway 15-33 is ARC C-IV; therefore the 25-foot shoulders are adequate per FAA. Additionally, Runway 6-24 has an existing reference code of ARC D-IV and is therefore in compliance with FAA design standards. However, the future activity projections identify Group-V aircraft as the future design aircraft, therefore to meet the runway shoulder width requirements for Group V runways, additional shoulder pavement should be added to Runway 6-24 to bring each shoulder’s width to the required 35 feet[24].

Runway Safety Area (RSA) – The RSA is a rectangular area bordering a runway that is intended to reduce the risk of damage to aircraft in the event of an undershoot, overrun, or excursion from the runway. The RSA is required to be cleared and graded such that it is void of potentially hazardous ruts, depressions, or other surface variations. Additionally, the RSA must be drained by grading or storm sewers to prevent water accumulation, and support snow removal and firefighting equipment, and be free of objects except those required because of their function.

The RSA for a Group IV or V runway is required to be 500 feet wide and extend 1,000 feet beyond the runway end. The longitudinal grade from the end of the runway should be between 0.0 percent to -3.0 percent for the first 200 feet and no more than -5.0 percent for the remaining 800 feet of the RSA. Transverse grades should be -1.5 percent to -3.0 percent away from the runway shoulder edge and beyond the runway ends.

For the most part, the RSAs associated with each of BDL’s runways meet the length and width requirements of Group IV/V runways. However, portions of the northeast and southeast sides of Runway 33 do not meet the transverse grading requirement per FAA (existing is 1.0% to 4.5%). Therefore, it is recommended these areas be graded to meet FAA design criteria.

[24] As Runway 6-24 has a 200’ width, which is greater than required, the FAA may allow a ‘modification to FAA design standards’ and determine that 25’ paved shoulders are adequate.

Runway Object Free Area (ROFA) – The ROFA is a rectangular area bordering a runway intended to provide enhanced safety for aircraft operations by ensuring the area remains clear of parked aircraft or other equipment not required to support air navigation or the ground maneuvering of aircraft. The ROFA design standard for Group IV and Group V runways is 800 feet wide, centered about the runway centerline, and extends 1,000 feet beyond each runway end. At present, all BDL runways adhere to the prescribed ROFA geometry and are free of potentially hazardous objects non-essential to air navigation or aircraft ground movements.

Runway Object Free Zone (ROFZ) – The ROFZ is a volume of airspace centered above the runway that is required to be clear of all objects, except for frangible navigational aids that need to be in the ROFZ because of their function. The ROFZ provides clearance protection for aircraft landing or taking off from the runway. The ROFZ is the airspace above a surface whose elevation at any point is the same as the elevation of the nearest point on the runway centerline. The ROFZ extends 200 feet beyond each end of the runway, and its width is based on visibility minimums and aircraft size. The ROFZ width for Runways 6-24 and 15-33 is 400 feet.

The inner-approach OFZ is a volume of airspace and centered on the approach area that applies only to runway ends equipped with approach lighting systems. At BDL, the inner-approach OFZ applies to Runway ends 6, 24, and 33. The inner-approach OFZ begins 200 feet from the runway threshold at the same elevation as the runway threshold and extends 200 feet beyond the last unit in the approach lighting system. It has the same width as the Runway OFZ and rises at a slope of 50:1 away from the runway end.

The inner-transitional OFZ is a volume of airspace along the sides of the ROFZ and inner-approach OFZ. It applies only to runways with lower than ¾-mile approach visibility minimums; at BDL only Runway ends 6 and 24 meet this criterion. At present, all BDL runways adhere to the prescribed OFZ geometry and are free of objects not fixed by their function.

Runway Protection Zone (RPZ) – The RPZ is a trapezoidal area located 200 feet beyond the runway end and centered on the extended runway centerline. The RPZ is primarily a land use control that is meant to enhance the protection of people and property near the airport through airport control. Such control includes clearing of RPZ areas of incompatible objects and activities. The RPZs are BDL are discussed in further detail in **Section 4.3.6**.

Runway Blast Pads - Similar to runway shoulders, blast pads are intended to provide erosion protection at the runway end. Conformance to FAA design criteria requires that 200’ wide x 200’ length blast pads be placed symmetrically at the end of each Group IV runway. Additionally, Group V standards require blast pads dimensions to be 220’ x 400’. At present, except for Runway 33, all BDL Group IV runways meet or exceed the design standards for Group IV runways. The blast pad prior to the Runway 33 approach end is approximately 95’ in length, thereby not meeting the 200’ requirement. This blast pad should be extended 105’ feet to address its nonconformity to the standard. Additionally, the Runway 6 end blast pad is currently 220’ x 235’ which meets Group IV requirements. However, based on the forecast activity at BDL and the increase to Group V will require additional length to meet the new standards. Therefore, the blast pad should ultimately be extended to the full 400’ length to meet the requirements.

Building Restriction Line (BRL) – Though not a specific FAA design standard, the BRL is a reference line which provides generalized guidance on building location and height restrictions. The BRL is typically established with consideration to OFAs and RPZs as well airspace protection by identifying areas of allowable building heights such and 35 feet above ground level. It should be noted that site-specific terrain considerations (i.e. grade/elevation changes) may allow buildings taller than indicated by the generalized BRL to be developed within the limits of the BRL. These height restrictions are based on FAR Part 77 standards that will be described in more detail in **Section** Error! Reference source not found. and are evaluated for each specific site development plan.

Table 4-11 identifies the existing conditions at BDL and the geometric requirements of the above standards relative to ARC C-IV through D-V. Please see **Appendix** A for a detail report of the existing airfield design standard review.

Use of Runway 1-19

In its present condition, Runway 1-19 is maintained at 4,268 feet in length and 100 feet in width. This north-south oriented runway serves as the Airport's general aviation runway. The previous master plan included an ultimate recommendation to close the runway. As such, this study reviewed the need for Runway 1-19 as presented below. The study efforts included interviews with key airport tenants, including the two fixed base operators, Bombardier, FedEx, UPS, as well as BDL operations and air traffic control personnel. These interviews address the following runway considerations:

Activity: As discussed in **Chapter 2,** the activity forecast for BDL is showing a trend reflecting a decline in small general aviation traffic, such as single and twin-engine propeller-driven aircraft. Runways 1-19 is maintained primarily for this type of activity. Based on the interviews, there is already very little use of this runway in the present period, and no tenant expressed a need or interest in retaining the runway.

Constraints: Due to constrains on the south end of the runway, there are published restrictions on takeoff and landing procedures for Runway 1-19. Presently, Runway 1 is restricted only to allow departures, while Runway 19 is restricted to allow only landings. This is largely a result of the terminal area developments immediately south of the runway. Consequently, this leaves 1-19 as a one-way runway. Additionally, the runway does not enable independent use due to its intersection with Runway 6-24, preventing simultaneous runway operations. In addition, the Runway 19 end is part of Hotspot 1, defined by the FAA as a location of concern for runway incursions, as depicted in **Figure 4-8.**

Airfield Capacity: The capacity analysis in **Section 4.2.1** determined that Runway 15-33 and Runway 6-24 adequately serve the airfield capacity needs and forecast activity levels throughout the planning period. Thus, a third runway is not needed to accommodate future operational levels at BDL.

As such, based on discussions with airport users, activity, constraints (safety), and capacity discussion above, it is recommended that Runway 1-19 no longer be maintained at BDL. The Airport should permanently close it as soon as deemed practical.

Figure 4-4 depicts these standards as they currently exist at BDL (ARC D-IV). As supported by **Table 4-11** and, BDL's runways are compliant with all FAA design standards for C-IV through D-IV aircraft (and approach visibility minimums not lower than ½-mile), with the exception of Runway 15-33 shoulder widths and grading. Upgrades and improvements will be necessary to comply with ARC D-V by PAL 2.

Table 4-11 – FAA Runway Design Standards

<table>
<tr><th rowspan="2">Design Standard</th><th colspan="3">Existing Conditions</th><th colspan="3">Runway Design Code (RDC)
(w/visibility minimums ≥ ½-mile)</th></tr>
<tr><th>6-24
D-V < ¼ mi.</th><th>15-33
C-IV ¾ mi.</th><th>1-19
B-II 3 mi.</th><th>B-II</th><th>C/D-IV</th><th>C/D-V</th></tr>
<tr><td>Runway Width</td><td>200’</td><td>150’</td><td>100’</td><td>75’</td><td colspan="2">150’</td></tr>
<tr><td>RSA Width</td><td>500’</td><td>500’</td><td>300’</td><td>300’</td><td colspan="2">500’</td></tr>
<tr><td>RSA Length Past RW End</td><td>1,000’</td><td>1,000’</td><td>600’</td><td>600’</td><td colspan="2">1,000’</td></tr>
<tr><td>ROFA Width</td><td>800’</td><td>800’</td><td>800’</td><td>800’</td><td colspan="2">800’</td></tr>
<tr><td>ROFA Length Past RW End</td><td>1,000’</td><td>1,000’</td><td>600’</td><td>600’</td><td colspan="2">1,000’</td></tr>
<tr><td>Runway OFZ Width</td><td>400’</td><td>400’</td><td>300’</td><td>300’</td><td colspan="2">400’</td></tr>
<tr><th colspan="7">Separation Between:</th></tr>
<tr><td>Runway Centerline to Parallel Taxiway Centerline</td><td>400’</td><td>400’</td><td>240’</td><td>240’</td><td colspan="2">400’</td></tr>
<tr><td>Runway Centerline to Edge of Aircraft Parking</td><td>500’</td><td>500’</td><td>400’</td><td>400’</td><td colspan="2">500’</td></tr>
<tr><td>Runway Centerline to Hold line</td><td>280’</td><td>250’</td><td>250’</td><td>250’</td><td>250’</td><td>280’</td></tr>
<tr><th colspan="7">Runway Protection Zone (RPZ):</th></tr>
<tr><td>Length</td><td>2,500’</td><td>1,700’</td><td>1,000’</td><td>1,000’</td><td colspan="2">2,500 feet</td></tr>
<tr><td>Inner Width</td><td>1,000’</td><td>1,000’</td><td>500’</td><td>500’</td><td colspan="2">1,000’</td></tr>
<tr><td>Outer Width</td><td>1,750’</td><td>1,510’</td><td>700’</td><td>700’</td><td colspan="2">1,750 feet</td></tr>
</table>

Source: FAA AC 150/5300-13A *Airport Design*

Appendix A provide a detailed review if the existing airfield and FAA Design Standards.

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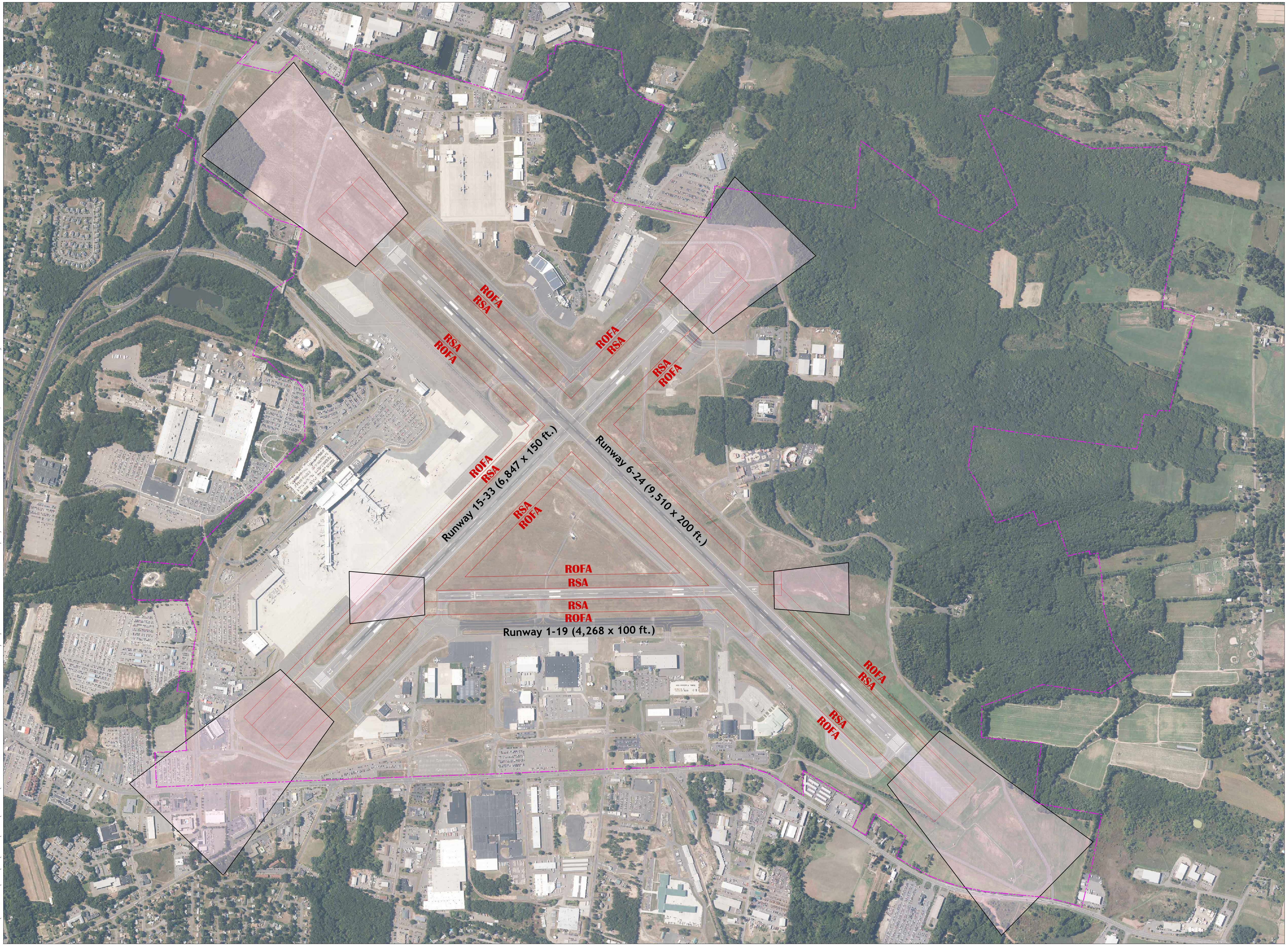

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LEGEND

- ROFA — Runway Object Free Area (ROFA)
- RSA — Runway Safety Area (RSA)
- Property Line
- Runway Protection Zone (RPZ)

Figure 4-4
Design Standards

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4.3.4 Runway Length

To ensure that BDL can support existing and anticipated aircraft and airline operational demands, a detailed runway length analysis was performed based on specific aircraft performance characteristics as documented in the manufacturer's Aircraft Planning Manuals (APMs). Inadequate runway length can limit the operational capability of an airport, including the aircraft that can operate and the destinations that the airport serves. Runway lengths can place restrictions on the allowable takeoff weight of the aircraft, which then reduces the amount of fuel, passengers, or cargo that can be carried. Per the guidance provided in AC 150/5325-4B *Runway Length Requirements for Airport Design*, the following factors were used in the runway length calculations for BDL:

Aircraft Specifics

- **Model and Engine Type –** the aircraft version and engine type. The most common and demanding aircraft specific to BDL were used.
- **Payload** – represents the carrying capacity of the aircraft, including passengers, baggage, and cargo. For this analysis, 90% was chosen as the payload for planning purposes.
- **Estimated Takeoff Weight** – the estimated weight at takeoff, which includes the payload and the fuel required to reach the intended destination (with reserve fuel). The estimated takeoff weight varies by aircraft, payload, and destination.
- **Estimated Landing Weight** – the estimated weight at landing. For this analysis, maximum landing weight (MLW) was used to determine runway landing requirements.

Airport Specifics

- **Temperature** – the atmospheric temperature at the airport. Warmer air requires longer runway lengths because the air is less dense, therefore generating less lift on the aircraft. The average temperature of the hottest month at BDL (72°F) was used in the calculations.
- **Elevation** – the elevation above sea level at the airport. As elevation increases, air density decreases, making takeoffs longer and landings faster. The elevation at BDL is established at 173 feet MSL.
- **Runway Gradient –** the average slope of the runway, expressed as a percentage. The runway gradients at BDL are not significant enough to impact runway length requirements.
- **Stage Length (flight distance) –** the length in nautical miles (nm) to the intended destination. The stage length determines the amount of fuel an aircraft will require on takeoff to complete its flight, thus impacting runway length requirements.

Existing Aircraft and Destinations

Currently, the longest stage length at BDL is ±2,740 nautical miles to Edinburgh, Scotland (operated by Norwegian Airlines). The runway length requirements for the design aircraft family (passenger airline aircraft only) to this destination were calculated and are presented in **Table 4-12**. These length requirements at BDL can be accommodated by 6-24 (9,510 feet) and most of the length requirements by Runway 15-33 (6,847 feet). Therefore, the runway system at BDL is considered adequate to accommodate the current traffic. Required landing length was also evaluated, but is not shown as the takeoff lengths proved to be more demanding.

Table 4-12 – Existing Takeoff (TO) Length Requirements

Aircraft Model	Payload	Stage Length (nm)	Estimated Takeoff Weight (lb)	Takeoff Length Req. (ft)
Airbus A320	90%	2,740 (Edinburgh)	160,000	5,750
Airbus A321			200,000	7,000
Boeing 737-900			170,000	9,500
Boeing 787-9			470,000	7,500
Boeing 767-300			330,000	8,000
Boeing 757-200			250,000	7,750
Airbus 300-600			355,000	8,000

Source: AC 150/5325-4B, *Runway Length Requirements for Airport* Design, CHA, 2017.
Note: Runway lengths are calculated at 15° Celsius (59° F – Standard Day) at Sea level.

Potential Future Markets

To position the Airport to meet future demands, it is important to consider the markets that BDL may ultimately serve. Several domestic and international markets were chosen for analysis based on existing airline destinations and market development initiatives by the Authority. Out of the markets listed below, several likely airports/destinations were identified and the longest stage length was used for the runway length analysis.

- ***South Central US***: 1,320 NM
- ***Southeast US:*** 1,120 NM
- ***West Coast US***: 2,280 NM
- ***Caribbean***: 1,450 NM
- ***Eastern Europe***: 2,750 NM
- ***Western Europe***: 3,250 NM

Figure 4-5 depicts the maximum ranges of the design aircraft family when departing from BDL (based on existing runway lengths). Based on FAA guidance, this graphic will focus on the design aircraft family that was calculated with a 90% aircraft payload. As shown, with variants of the B737 through the B787, the runway length at BDL is adequate to accommodate all stage lengths, except for scenarios in which the stage length exceeds the range of the aircraft, despite the runway length. The analysis proved that Runway 6-24 is long enough to accommodate European service if operated by the B757-200, B767-300ER, or the B787-800. **Table 4-13** presents the results of this analysis based on an estimated travel distance (stage length) in nautical miles, to different regions of the world. Based on the activity forecasts and current market trends, including airline routes and international connections, additional runway length is not warranted beyond the existing 9,510' length. However, to support the long-term potential of the Airport, CAA should continue working with surrounding jurisdictions and land owners to promote compatible land use and preserve sufficient area for a possible runway extension should it become warranted in the future.

Table 4-13 – Potential Future Destinations

Runway Lengths at 90% Payload - Dry								
Aircraft	Northwest *2,281 nm*		Southwest *2,196 nm*		Eastern Europe *2,750 nm*		Western Europe *3,250 nm*	
	Takeoff	Landing	Takeoff	Landing	Takeoff	Landing	Takeoff	Landing
A320	5,000	3,250	5,000	3,250	5,750	3,250	Exceeds Range	Exceeds Range
A321	6,750	4,750	6,750	4,750	7,000	4,750	Exceeds Range	Exceeds Range
B737-800	6,000	6,250	6,000	6,250	6,250	5,500	6,750	6,750
B787-9	7,000	5,500	7,000	5,500	7,500	5,500	7,750	5,500
B767-300	7,500	4,750	7,500	4,750	8,000	4,750	8,250	4,750
B757-200	7,250	4,000	7,000	4,000	8,500	4,000	Exceeds Range	Exceeds Range
A300-600	6,750	4,250	6,750	4,250	7,750	4,250	7,750	4,250

Note: All distances are Nautical Miles (NM)

Crosswind Runway

As the secondary or crosswind runway at BDL, Runway 15-33 does not provide adequate length to fully serve in this role. It is noted that a second commercial runway is not an FAA requirement; however, there is a public benefit for commercial hub airports to have a second runway that can accommodate most airport operations. At BDL, regular airfield maintenance and snow removal activities on Runway 6-24, periodic high wind conditions from the northwest, and operational flexibility and convenience are all common reasons why the secondary runway is an asset to BDL airport users.

Based on the overall runway length evaluation above, a runway length of approximately 7,500 feet is a reasonable goal for BDL to provide a secondary runway, and would be adequate for the majority of airline operations. This length aligns with a common planning guideline for the crosswind runway length to be 80% of the main runway's length at the airport. Using this guideline, a similar length of 7,600' should be considered for BDL. Again, this length not a facility requirement, but is provided herein as a master plan consideration or goal.

4.3.5 Runway Protection Zone (RPZ)

The RPZ's function is to enhance the protection of people and property on the ground, by restricting land uses that would result in the congregation of people. Preventing these types of uses is best achieved through the airport sponsor's fee-simple ownership of the land within the RPZs. Based on the dimensions identified in **Table 4-11**, the RPZs for all runways are located primarily within airport property, except for Runway 33 (refer to **Figure 2-1**). The RPZ for Runway 33 extends beyond airport property. It is recommended that the Airport consider acquisition in this area if the affected parcels become available. While it is recommended that these parcels be purchased in whole, partial acquisitions may be sufficient in some areas.

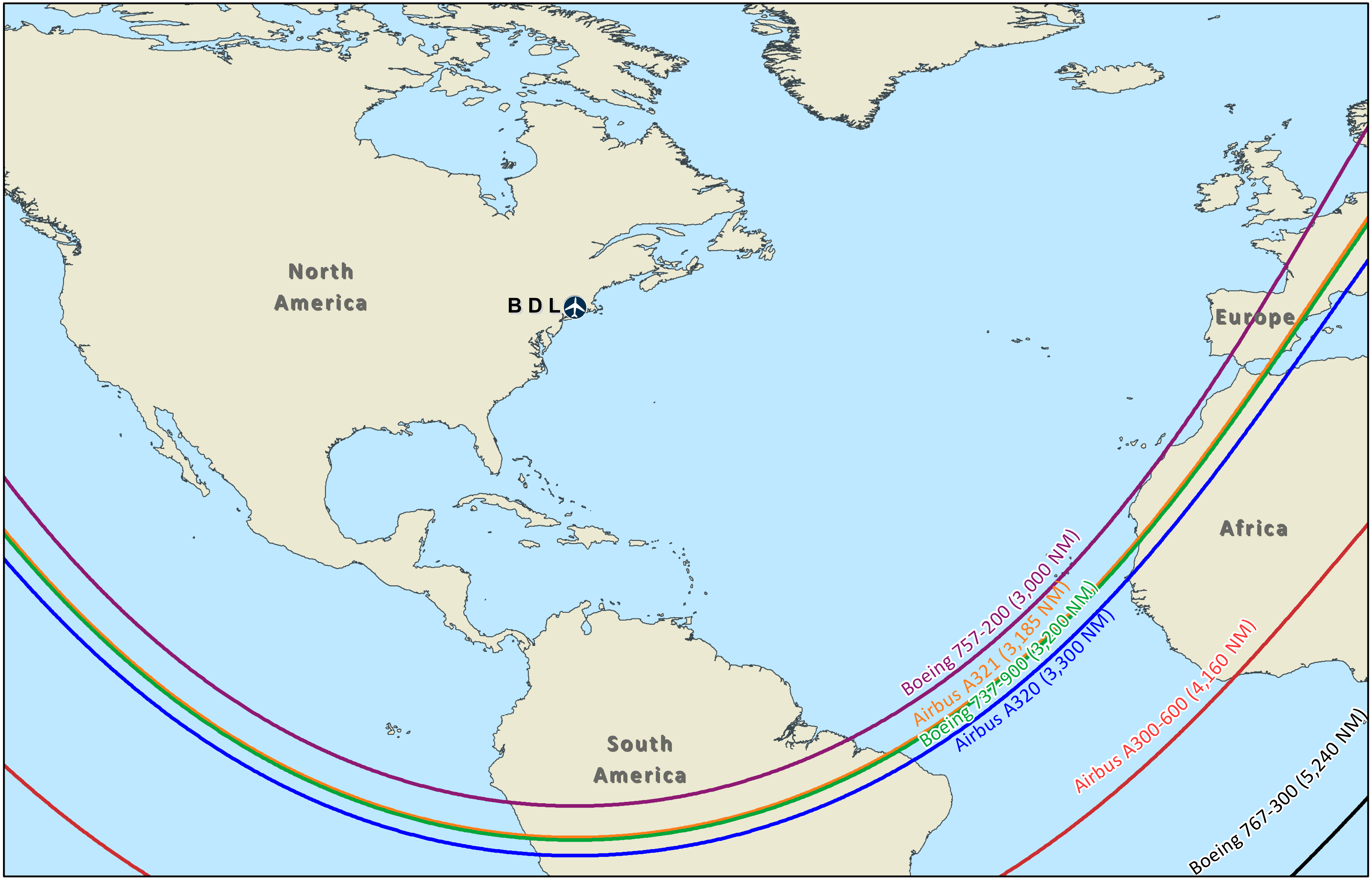

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Figure 4-5
Aircraft Ranges from BDL
(9,510 ft. Runway)

It should be mentioned that the Airport owns avigation easements over some of property parcels located off the Runway 6 and Runway 24 ends. Typically, avigation easements restrict vertical construction by giving the Airport the rights of the airspace above a specified height. Although land use restrictions are sometimes worked into these agreements, they typically only restrict uses that could disrupt aircraft flight procedures – such as uses that emit electromagnetic signals that could interfere with navigation instruments, or uses that are considered bird-attractants. It is recommended that the Airport consider avigation easements over some off-Airport properties.

4.3.6 Instrument Approach NAVAIDS and Procedures

Instrument approach capability is predicated on the type of instrument approach navigational aids (or NAVAIDs) available at an airport and the approach procedure minimums established by the FAA. As the Inventory chapter indicated, three of BDL's four primary runway ends are equipped with a minimum of CAT-I Instrument Landing System (ILS), which provides precision approach capabilities with a 200-foot ceiling and ¾-statute mile visibility minimum for CAT-I and 100-foot ceilings and less than ¼-statute mile visibility for CAT-II/III– the best possible for ILS approaches. RNAV (GPS) approaches are also available to the 06, 24, 15, and 33 runway ends. **Table 4-14** summarizes the available instrument approach procedures at BDL.

The approach capability at BDL is considered to be suitable for an Airport of its size, and there has been no explicit demand for additional facilities. However, as a part of this Master Plan Update, the feasibility of upgrading one of the MALSF systems to MALS-R was evaluated.

Table 4-14 – Instrument Approach Procedures

Runway End	Approach Type	Approach Method	Minimums – Ceiling (AGL) / Visibility
Runway 6	Precision	ILS (CAT - II/III)	100' / <¼ mile
	Non-Precision	RNAV (GPS/RNP)	200' / ½ mile
Runway 24	Precision	ILS (CAT - I/II	100' / <¼ mile
	Non-Precision	RNAV (GPS)	200' / ½ mile
Runway 33	Precision	ILS (CAT-I)	200' / ¾ mile
	Non-Precision	RNAV (GPS)	200' / 3/4 mile
Runway 15	Non-Precision	RNAV (GPS)	300' / ¾ mile
Runway 1	Visual	Visual	1,000'/ 3 mile
Runway 19	Visual	Visual	1,000'/ 3 mile

Source: BDL Instrument Approach Procedure Charts, accessed August 2015

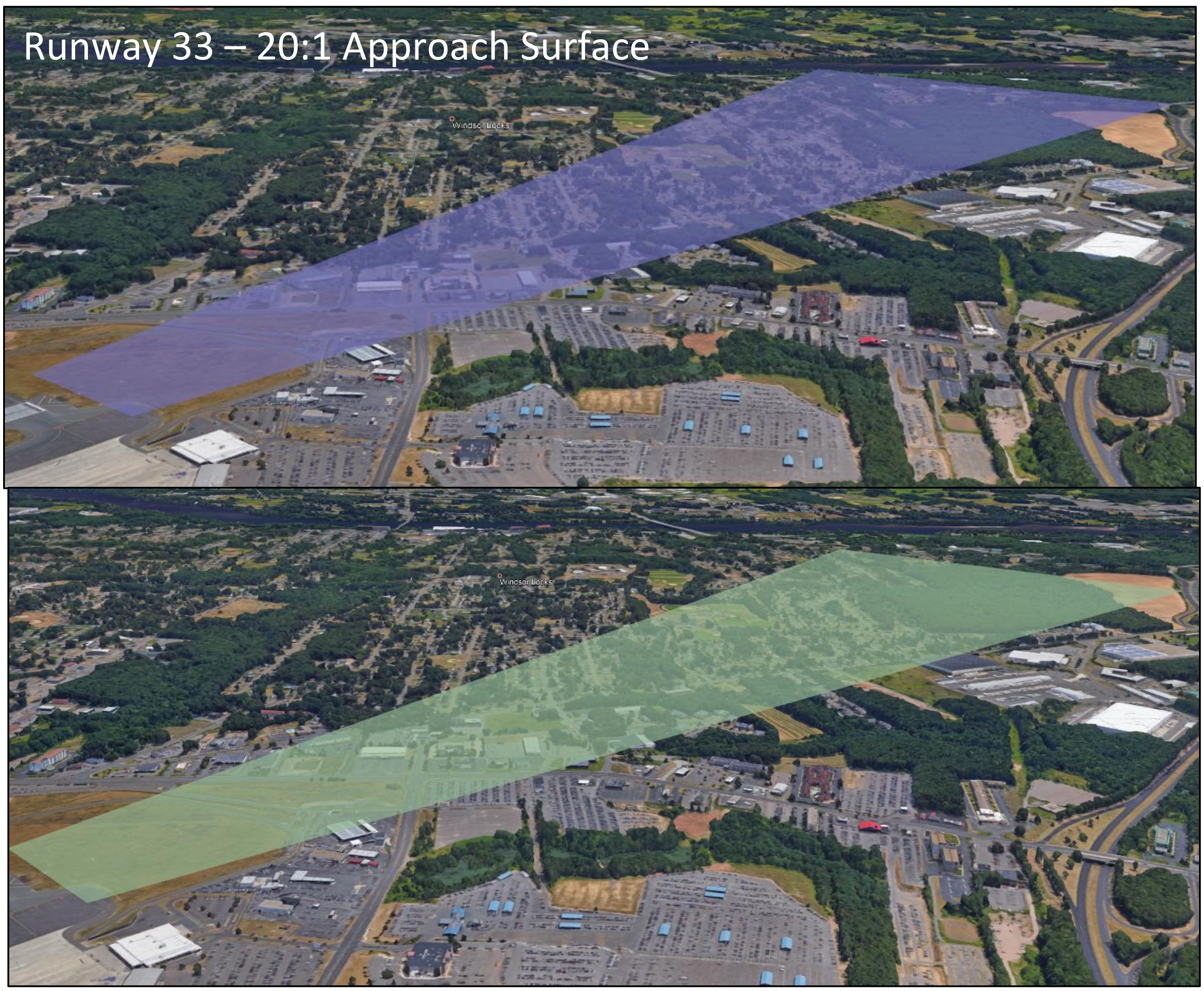
4.3.7 ILS Upgrade Potential

The feasibility of upgrading one of the Medium Intensity Approach Lighting Systems (MALS) on Runway 33 at BDL was evaluated using the guidance provided in FAA AC 150/5300-13A, and FAA Order 6750.16D *Siting Criteria for Instrument Landing Systems.* Currently, Runway 33 has a MALSF system, which consists of a 1,400-ft. approach lighting system with sequenced flashers. This provides ILS approach visibility minimum's to be 200' ceiling and ¾ mile visibility. Upgrading the approach lighting system to a MALSR may benefit the Airport by lowering the approach visibility minimums to 200' and ½ mile visibility, which allows the Airport to accommodate a greater percentage of landings in poor weather conditions. The upgrade from the MALSF to the MALSR system requires an additional five sequenced flashers that extend beyond the existing

MALSF system, totaling 2,400’ beyond the Runway 33 end. As the sequence flashers (or Runway Alignment Indicator Lights – RAIL) would extend beyond the airport property, this facility requirement requires further evaluation.

In addition to the additional property necessary to accommodate the additional lighting system for the MALSR, there may be additional impacts based on the new criteria for approach and threshold siting surfaces (TSS). The current TSS begins at ground level and extends outward from the centerline of the runway at a 20:1 slope. As the Airport upgrades the approach system, this slop lowers to a 34:1 thus potentially having an impact to the approach surface that was previously adequate based on the grade of the 20:1 slope. The following figure depicts the slope differential based on the existing and future approach systems. As shown in the **Figure 4-6**, based on primary evaluation, both the 20:1 (existing) and 34:1 (future) approach surfaces do not have no shown obstructions, however further evaluation will be completed in **Chapter 5**.

Figure 4-6 – Approach Surface Impacts



4.3.8 Taxiway Facility Goals

The overall goal of airfield planning and design is to enhance efficiency and the margin of safety for operational activities. Through discussions with the airport operations and air traffic control and review of current FAA guidance, the following specific goals were identified for the taxiway system at BDL.

Accommodate all existing and projected users. The existing and forecasted fleet mix, for all commercial, cargo, and general aviation, should be considered when evaluating the taxiway system.

Reduce runway crossings. The opportunity for runway incursions can be reduced by minimizing the number of runway crossings on primary runways.

Reduce risk of pilot confusion. Complexity of the taxiway system can lead to pilot confusion, which can lead to human error and the increased potential for runway incursions. Reducing the risk for pilot confusion includes:

- reducing the number of taxiways intersecting at a single location
- increasing the pilot's situational awareness (through proper signage and marking)
- avoiding wide expanses of pavement
- removing "hot spots"
- increasing visibility.

Allow for expandability of all Airport facilities. The taxiway system should be designed with the long-term expansion of other aviation facilities in mind. The ability to provide efficient airside access to developable parcels of the airport.

Adhere to all FAA design standards (based on ADG and TDG). Taxiways should be developed to the appropriate FAA standards associated with the ADG and TDG of the design aircraft.

4.3.9 Taxiway Design Standards

Similar to runways, taxiways are subject to FAA design requirements such as pavement width, edge safety margins, shoulder width, and safety and object free area dimensions. The FAA standards in relation to taxiways (as defined in AC 150/5300-13 *Airport Design*) are described below.

Taxiway Width – The physical width of the taxiway pavement.

Taxiway Edge Safety Margin – The minimum acceptable distance between the outside of the airplane wheels and the pavement edge.

Taxiway Shoulder Width – Taxiway shoulders provide stabilized or paved surfaces to reduce the possibility of blast erosion and engine ingestion problems associated with jet engines which overhang the edge of the taxiway pavement.

Taxiway/Taxilane Safety Area (TSA) – The TSA is located on the taxiway centerline and shall be cleared and graded, properly drained, and capable, under dry conditions, of supporting snow removal equipment, ARFF equipment, and the occasional passage of aircraft without causing structural damage to the aircraft.

Taxiway/Taxilane Object Free Area (TOFA) – The TOFA is centered on the taxiway centerline and prohibits service vehicle roads, parked airplanes, and above ground objects, except for objects that need to be located in the TOFA for air navigation or aircraft ground maneuvering purposes.

Taxiway Separation Standards – Separation standards between the taxiways and other airport facilities are established to ensure operational safety of the airport.

With consideration of BDL's previously described design aircraft family, **Table 4-15** identifies the geometric requirements for ADG-III, IV, and V, and **Table 4-16** identifies the requirements for TDG-3, 4, 5, and 6. Based on the existing taxiway configuration and its infrastructure, there are several areas on the airfield considered to be non-standard conditions, **Figure 4-7** depicts the current taxiway configuration and areas that will require attention.

Table 4-15 – Taxiway Design Standards based on Airplane Design Group (ADG)

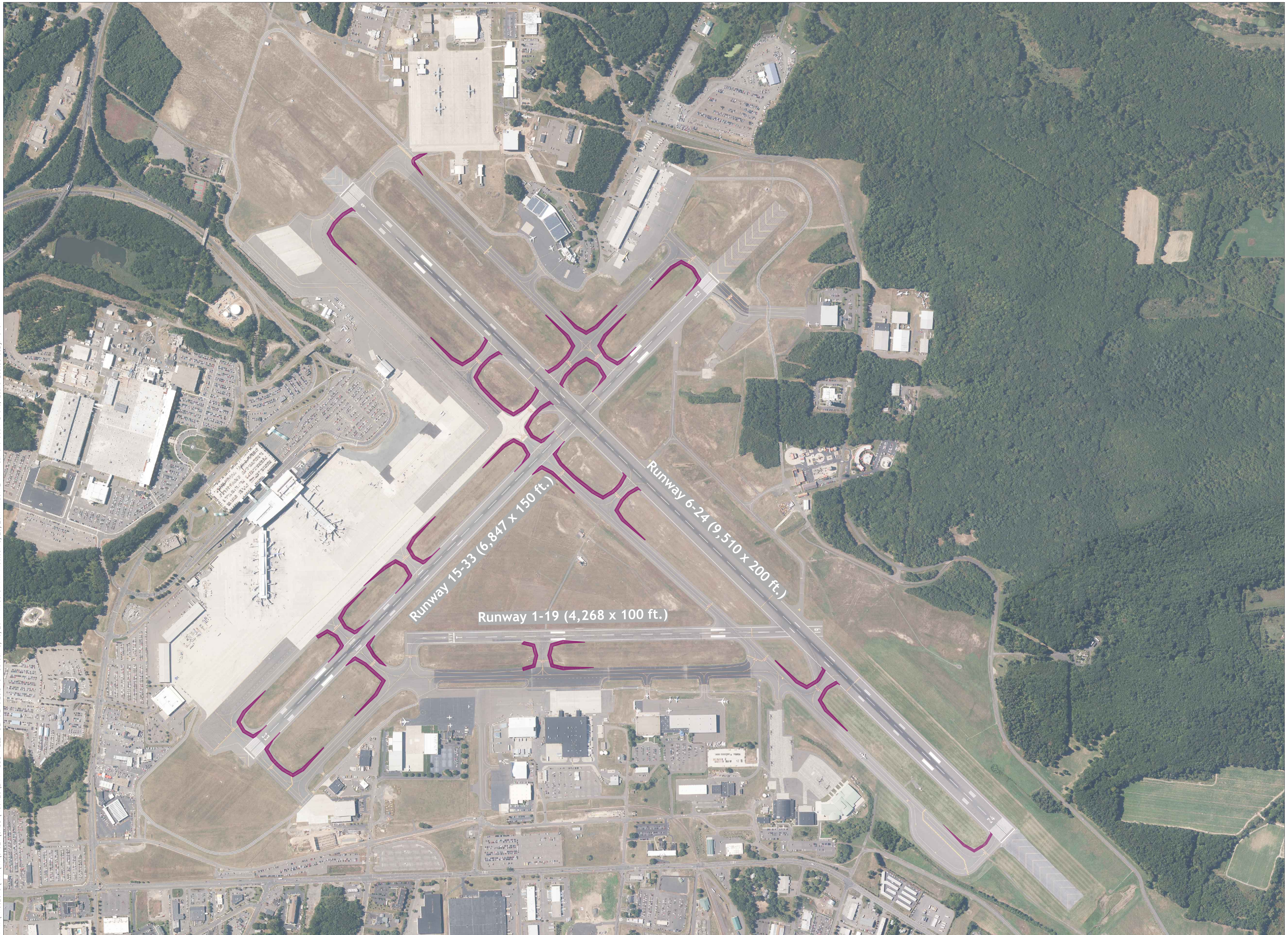
Design Standard	ADG		
	III	IV	V
Protection Standards			
Taxiway Safety Area (TSA) Width	118 feet	171 feet	214 feet
Taxiway Object Free Area (TOFA) Width	186 feet	259 feet	320 feet
Wingtip Clearance	34 feet	44 feet	53 feet
Paved Taxiway Shoulders	Recommended	Required	
Separation Standards			
Taxiway Centerline to Parallel Taxiway	152 feet	215 feet	267 feet
Taxiway Centerline to Fixed or Moveable Object	93 feet	129.5 feet	160 feet

Source: FAA AC 150/5300-13A *Airport Design*

Table 4-16 – Taxiway Design Standards based on Taxiway Design Group (TDG)

Design Standard	TDG			
	3	4	5	6
Protection Standards				
Taxiway Width	50 feet		75 feet	
Taxiway Edge Safety Margin	10 feet		15 feet	
Taxiway Shoulder Width	20 feet		25 feet	35 feet

Source: FAA AC 150/5300-13A *Airport Design*



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Fillet Deficiencies

Figure 4-7

Fillet Deficiencies

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4.3.10 Taxiway Deficiencies and Recommendations

While the existing taxiway system is generally adequate and manageable for current airfield activities, there are some issues and design standard deficiencies that should be improved. Most notably, in several locations the taxiway fillet geometry that is non-standard according to the revised FAA design criteria. To maximize long term aeronautical use of airport property, for both commercial and general aviation operators, additional taxiways or modifications to the current configuration would also be beneficial. **Figure 4-8** depicts taxiway fillets that are non-standard based on the new airfield geometry per FAA requirements. **Table 4-17** addresses the various taxiway concerns and requirements.

Appendix A provide a detailed review if the existing airfield and FAA Design Standards.

Table 4-17 – ADG/TDG General Upgrade Requirements

Upgrade	Impacts
ADG-IV or V	• Paved shoulders required • TSA / TOFA widths impacted • Taxiway centerline to fixed or moveable object distance impacted • Distance to hold lines increased
TDG-4	• Paved shoulders required if ADG is IV or higher
TDG-5	• Paved shoulders required if ADG is IV or higher • Taxiway Edge Safety Margin increased

Source: AC 150/5300-13A *Airport Design*

Hot Spots and High Energy Intersections

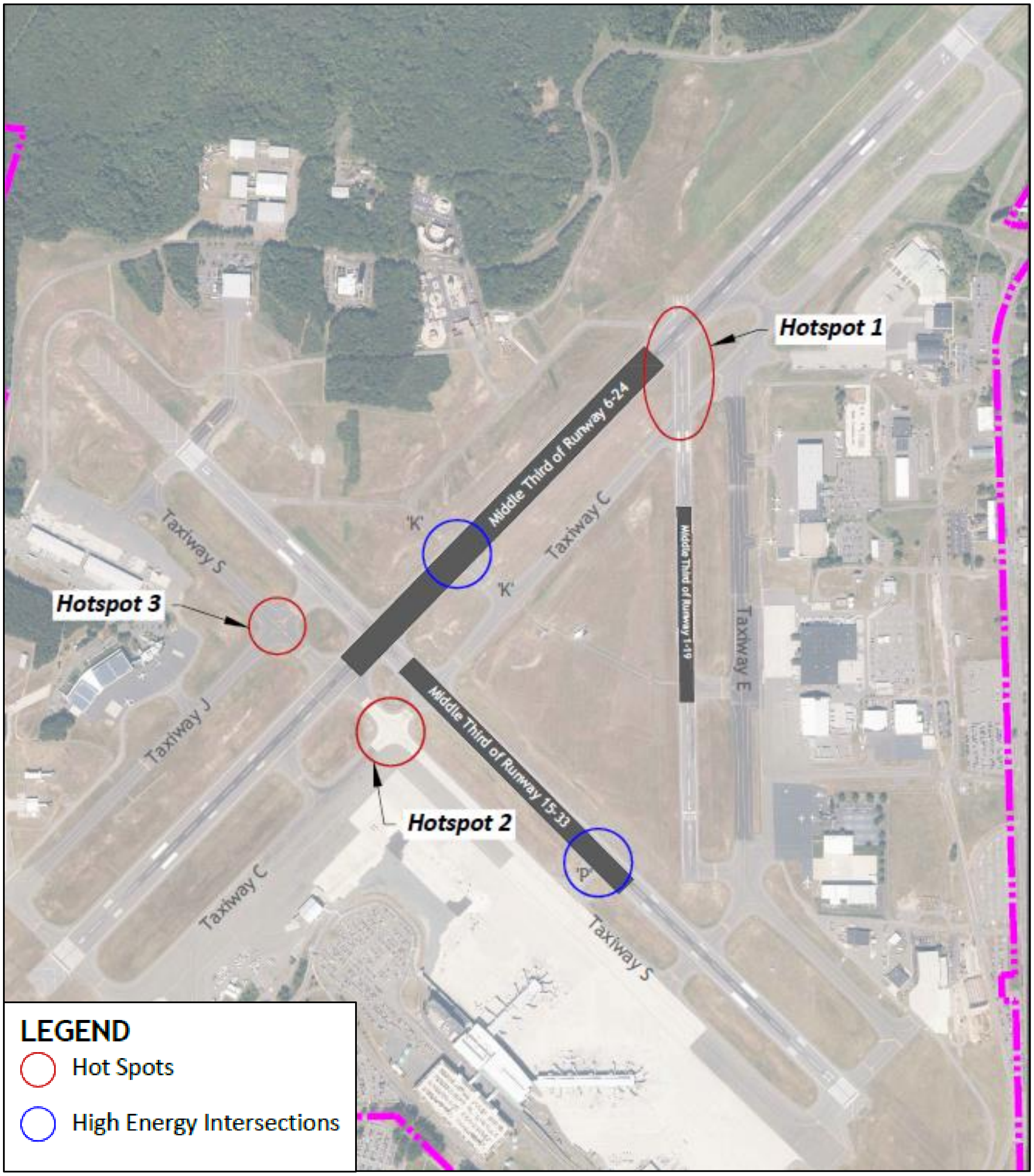
Taxiway "hot spots" are intersections or locations on the airfield that are considered complex or confusing and may have non-standard conditions and/or increase the potential for runway incursion. Because heightened attention by pilots and service vehicle drivers is necessary in these areas, the FAA has initiated a program to identify and document known hot spots on published FAA Airport Diagrams.

"High energy" intersections are those in the middle third of the runways. This is the portion of the runway where the pilot is thought to have the least maneuverability to avoid an incident or collision.

The FAA has identified three hot spots at BDL, which are depicted in **Figure 4-7** and described in the following paragraphs. Additionally, Taxiways K and P are in the middle third of Runway 6-24 and 15-33. To the extent practicable, taxiway geometry should be improved to remove or mitigate these hot spots and high energy intersections when feasible.

Hot Spot 1 is the intersections of Taxiway C and E, in proximity to Runway 1-19. This area is of significant concern due to the number of intersections involving both runways and taxiways and its proximity to Runway 1-19. While well marked, this location may be confusing, particularly by transient pilots, which could lead to aircraft entering a taxiway or runway prematurely. Additionally, aircraft holding short at these positions become obstacles for the other aircraft transiting the area. The closure of Runway 1-19 and reconfiguration of existing taxiways should be considered to eliminate Hot Spot 1 and improve taxiway circulation and apron access.

Figure 4-8 – Taxiway "Hot Spots" and High-Energy Intersections



Source: CHA, 2017.

Hot Spot 2 is the intersection of Taxiway S and C, in proximity to Runway 6-24. Taxiing aircraft have the potential to enter a runway inadvertently. Aircraft exiting the runway may also be delayed by aircraft on the taxiways.

Hot Spot 3 is the intersection of Taxiways J and S, in proximity to Runway 15-33. Similar to Hot Spot 2, with taxiing aircraft having the potential to enter a runway inadvertently. Aircraft exiting the runway may also be delayed by aircraft on the taxiways. Both locations have hold short lines on Taxiway J and S being nearly co-located, potentially causing confusion to pilots attempting to cross the runways. While FAA ground and air traffic control can manage the traffic flow in this area, improving access and circulation on the west side, is strongly encouraged. Specifically, a full parallel taxiway on the west side of Runway 15-33 (i.e., extension of Taxiway T) will reduce congestion, runway crossings, and improve traffic flow.

Two "high energy" taxiway intersections are located at BDL, and include Taxiway K, with Runway 6-24 and Taxiway P, with Runway 15-33. Due to their locations on the airport, these taxiways are not used as runway entrances or runway crossing. As such, the potential concern for runway incursions and incidents is very low. As such, no changes are recommended for these taxiways do to their high energy locations within the middle third of a runway.

Full Length Parallel Taxiways

The FAA requires a full-length parallel taxiway be coupled with precision instrument runways that provide approach minimums of less than 1-mile visibility and a decision height of less than 250 feet (both runways at BDL support ½ mile visibility and 200-foot decision height). Both runways at BDL have full parallel taxiways – Taxiways C and S. While these taxiways provide access to all runway ends, they are all on the south and west side of the airfield and result in some aircraft following circuitous routes, crossing active runways, and navigating around the commercial apron. This is often the case for aircraft beginning or ending operations from the air cargo, military, and general aviation areas. Developing all or portions of north and east side parallel taxiways to both runways will increase efficiency and reduce the potential of airfield incursions. FAA air traffic control staff have expressed a desire for, and acknowledged the operational benefits of, improved taxiway facilities. The ability to improve operational efficiency and reduce runway crossings through the development of improved parallel taxiways will be examined in **Chapter 5**.

Exit Taxiways

Exit taxiways are those connectors used by aircraft exiting the runway and should provide free flow to the adjacent parallel taxiway or at least to a point where the aircraft is completely clear of the hold line. There are three basic types of exit taxiways as described below:

> **Right Angle** – These are configured 90-degrees perpendicular to the runway and depending on longitudinal location can be used by aircraft in either direction. FAA guidance recommend right angled exits, which typically provide adequate traffic flow for airfields when peak hour activity is less than 30 operations. As identified in **Chapter 3** or **Table 4-1**, peak hour commercial operations are anticipated to reach 30 at PAL 2, and total airport operations will exceed 30 in the peak hour between PAL 2 and PAL 3. Right angled exits are also most commonly used at runway ends, serving both as an exit and entrance taxiway, and at runway crossing points as they provide taxiing pilots with the best view of runway in both directions.
>
> **Acute Angle** – Due to site constraints, engineering concerns or desired traffic flow, an exit taxiway orientation of less than 90-degrees may sometimes be preferred. These are

typically configured between 30 and 45-degrees from the runway centerline and may be unidirectional in nature (i.e. exit only).

High-Speed – These exit taxiways are intended to enhance capacity by allowing aircraft to exit the runway onto a parallel taxiway at a relatively high rate of speed. The exit angle is typically 30-degrees.

In each operating direction, there are multiple runway exits available for aircraft landing at BDL. The majority of these exits are right-angled; however, Taxiway H does provide an angled exit. There are currently no high-speed exits. Based on airport capacity and existing available exit taxiways, no additional exit taxiways are recommended for BDL.

Bypass Capability and Holding Bays

Providing bypass capability at runway ends allows aircraft that have received clearance to move into the takeoff position to go around those that may be awaiting departure clearance or performing pre-flight runups. This can be accomplished by either bypass taxiways or holding bays. Due to the nature of their separated location, bypass taxiways work best for segregating the mix of large and small aircraft at the departure runway, as the smaller aircraft may not require the full runway length. Alternatively, holding bays provide a designated standing space for aircraft clear of the taxiway path to the runway end, thereby improving overall circulation and efficiency.

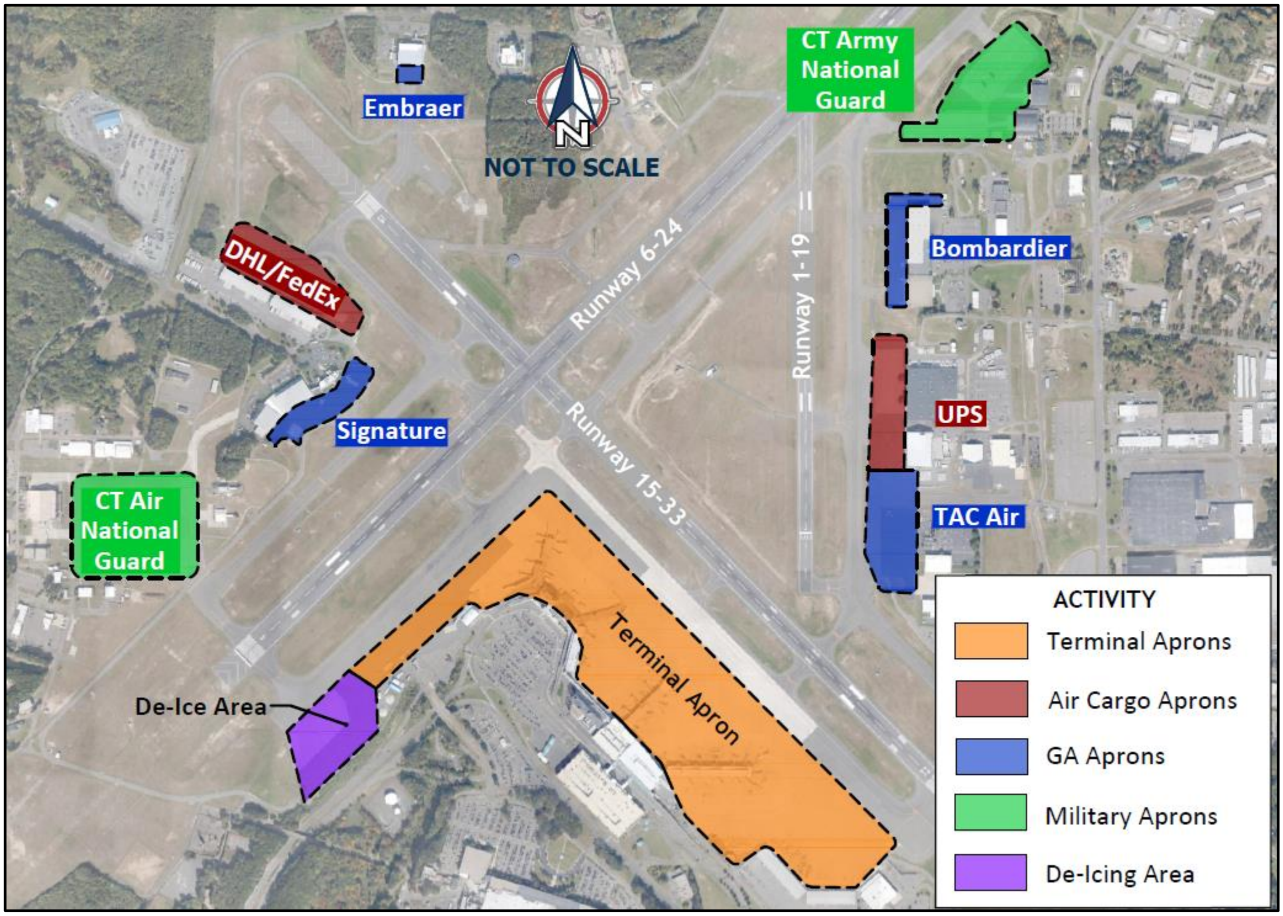
At BDL, ATC personnel have expressed a desire for operational efficiency improvements on the airfield due to the fleet mix of faster commercial service jets and slower general aviation aircraft, and the distance between the tower and the runway ends during poor visibility conditions. The FAA recommends developing holding bays when peak hour activity reaches a level of 30 operations per hour which, as stated previously, could be reached between PAL 2 and PAL 3. The ability to develop holding bays at BDL is limited due to surrounding land constraints and existing infrastructure. Currently, there is a holding bay on the Runway 6 end. With the development of general aviation facilities focused on the east side of the airfield, along with associated taxiway infrastructure, the interaction between large and small (i.e. commercial and GA) aircraft will be minimized and operational safety on the more utilized runway ends will be improved during bad weather situations where visibility across the airfield is limited.

Based on the runway utilization presented in **Table 4-6** it is recommended that the airport consider the development of holding bays for the Runway 6 and 33 ends. Due to the low utilization and proximity to the tower, a holding bay on the Runway 15 is not recommended.

4.4 APRONS

Aircraft parking aprons are intended to accommodate a variety of functions, including the loading and unloading of passengers or cargo, the refueling, servicing, maintenance, and parking of aircraft, and any movements of aircraft, vehicles, and pedestrian’s necessary for such purposes. As depicted in **Figure 4-9**, there are ten distinct apron areas at BDL that serve various functions. This section begins is with discussion of a new FAA design standard for aircraft parking aprons, followed by an evaluation of the apron facility requirements for the passenger terminal, remain overnight (RON) airline aircraft, general aviation aircraft, and deicing activities.

Figure 4-9 – Apron Areas



Source: CHA, 2017.

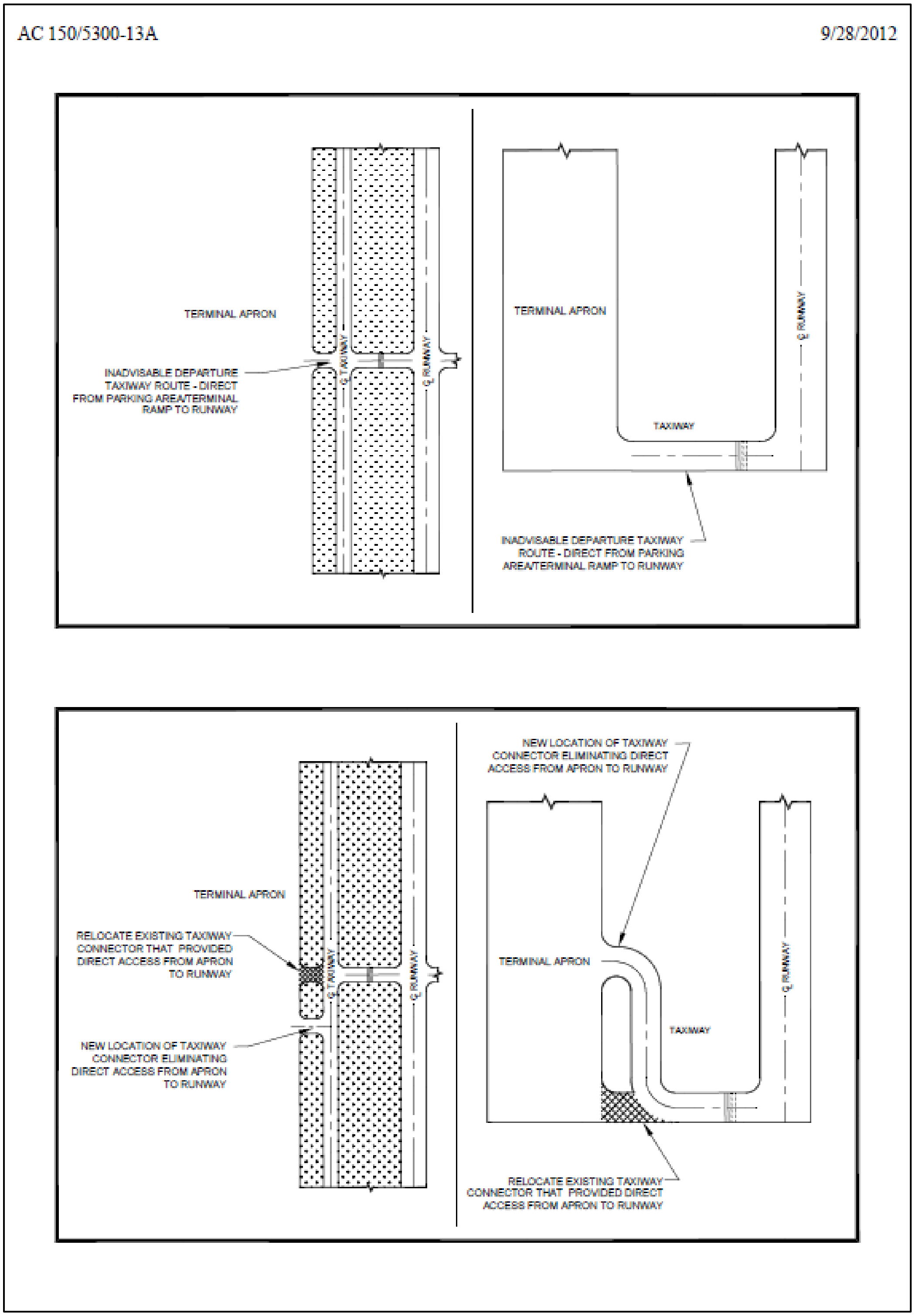
4.4.1 Direct Runway Access

Per FAA AC 150/5300-13A, Airport Design, direct access from an apron to a runway is non-standard. The standard requires a turn prior to runway access; this concept is referred to as "Indirect Access", which states:

> "*Indirect Access. Do not design taxiways to lead directly from an apron to a runway without requiring a turn. Such configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway but instead accidentally enters a runway.*"

For example, the FAA considers it a safety concern if an aircraft can taxi directly from the terminal apron to a runway, either to cross or depart, without first performing a 90-degree turn. **Figure 4-10** depicts the indirect access figures provided in FAA AC 150/5300-13A.

Figure 4-10 – Indirect Access



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

The Indirect Access design standard set forth by FAA in AC 150/5300-13A, Airport Design, was added in the 2012. As such, new apron and taxiway design or reconstruction is now required to comply with this design standard as a condition of new design, or mitigation of existing non-standard conditions.

At BDL, there are four existing aprons constructed prior to 2012 that have direct access from the apron to runway ends or runway crossings.

- Terminal apron has five taxiway connectors directly to a runway, including Taxiways C, E, P, S and V.
- National Guard apron has direct access to the Runway 6 end via Taxiway R
- FedEx apron has direct access to the Runway 15 end via Taxiway U
- TAC Air southeast apron provides direct access to the Runway 33 end via Taxiway L

Figure 4-11 depicts each direct access point on the airfield.

Per FAA, these non-standard conditions are not considered to be a high priority for mitigation as the BDL has a fulltime ATCT. However, when pavement reconstruction or rehabilitation is necessary for the associated taxiways, mitigation to correct non-standard conditions is required. For example, in 2018, the Airport is reconstructing a portion of Taxiway C and R. Currently, there are three non-standard direct aprons to runway access points along these Taxiways. As such, the Airport is implementing appropriate changes as part of the reconstruction project to mitigate the non-standard conditions. As more taxiway reconstruction and rehabilitation projects occur, addressing these non-standard access locations will be necessary. It is recommended that the Airport including these projects in the Airport Capital Improvement Plan (ACIP).

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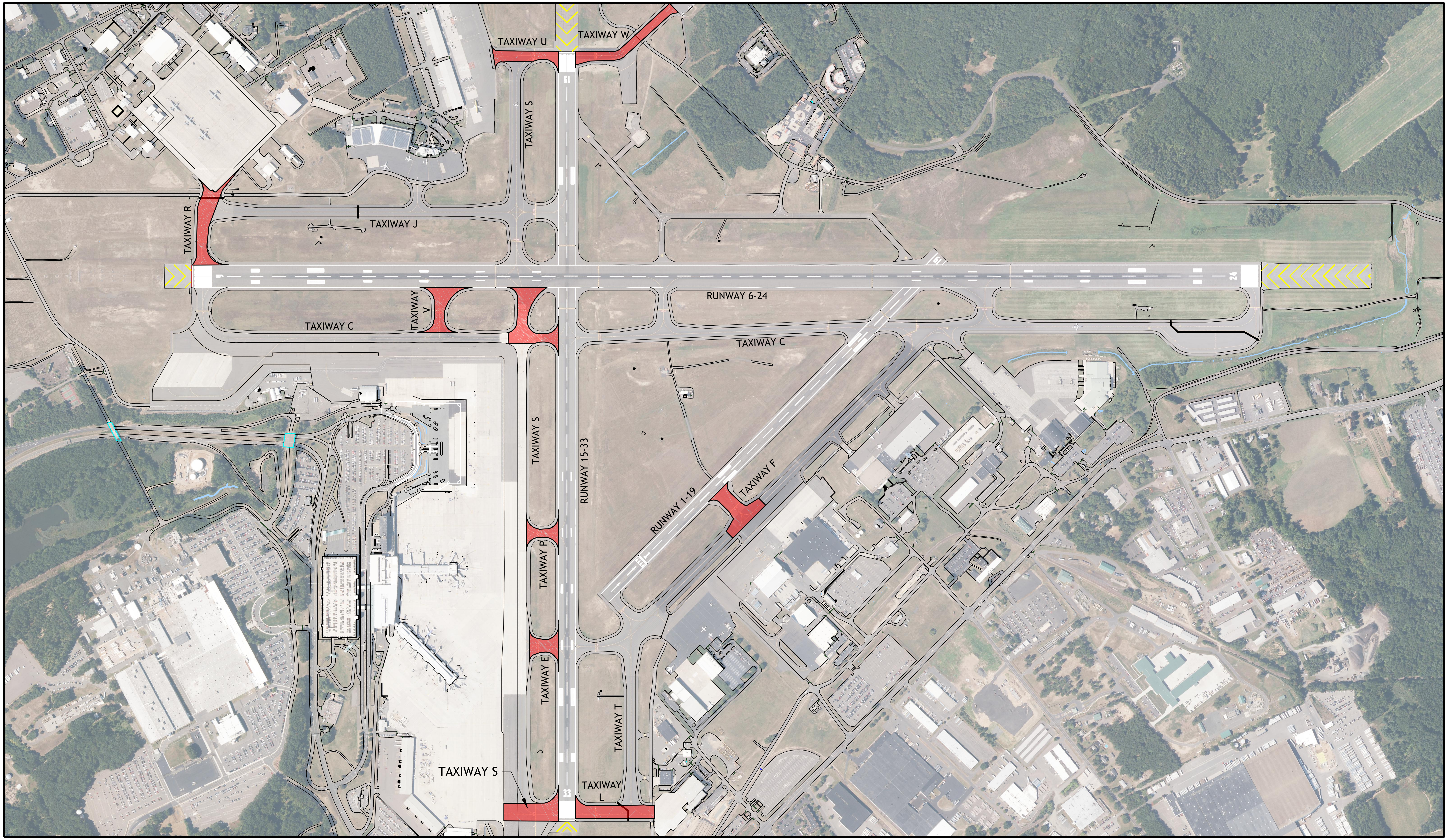

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Direct Runway Access from Apron

Figure 4-11
Existing Direct Runway Access

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4.4.2 Terminal Apron

The terminal apron is comprised of the facilities used for commercial aircraft gate parking as well as airline support and servicing operations. **Figure 4-12** depicts the existing terminal apron and gate configuration. The terminal apron and its facilities must be able to accommodate the current and future fleet mix of commercial aircraft. Currently, most commercial aircraft operating on the terminal apron consist of Group III aircraft (with the less than daily Group II and Group IV operation). Although most gates can accommodate up to Group III aircraft and two gates can accommodate Group IV, the clearance requirements for all Group III and IV aircraft is equal. The following outlines the fleet mix accommodations of the terminal gates.

- All gates include passenger boarding bridges (PBB) capable of supporting up to Group III aircraft with the exceptions of Gate 1 and 27.
- Gates 2 and 23 can accommodate up to Group IV.
- Gate 1 is a multi-use gate for Group II passenger aircraft and can be accessed via passenger boarding bridge (PBB) or lower level boarding (stairs).
- Due to the configuration of Gates 21 through 23, all three gates are multi-use gates to accommodate aircraft of varying wingspans.

These configurations impact adjacent gates as larger aircraft in use impact the maximum size the adjacent gates can accommodate. For example, if an aircraft (Group III) with a wingspan 100+ feet (i.e., MD88 is 107ft.), Gate 23 must utilize the center or right lead-in lines to accommodate aircraft of a similar size to be used simultaneously. As the fleet mix transitions to larger airframes (see Chapter 3 Forecasts) gate space, layout, and accommodations must be revised. Issues related to the development and operation of the terminal apron are addressed in the following subsections.

In addition to the Terminal and Concourses, the terminal apron also houses the Airport's fueling infrastructure (adjacent to the south of the terminal building), RON parking positions (north apron), the south cargo apron (which includes two belly cargo buildings), all Ground Storage Equipment (GSE) storage (at the terminal building and on the south cargo apron), and terminal access locations.

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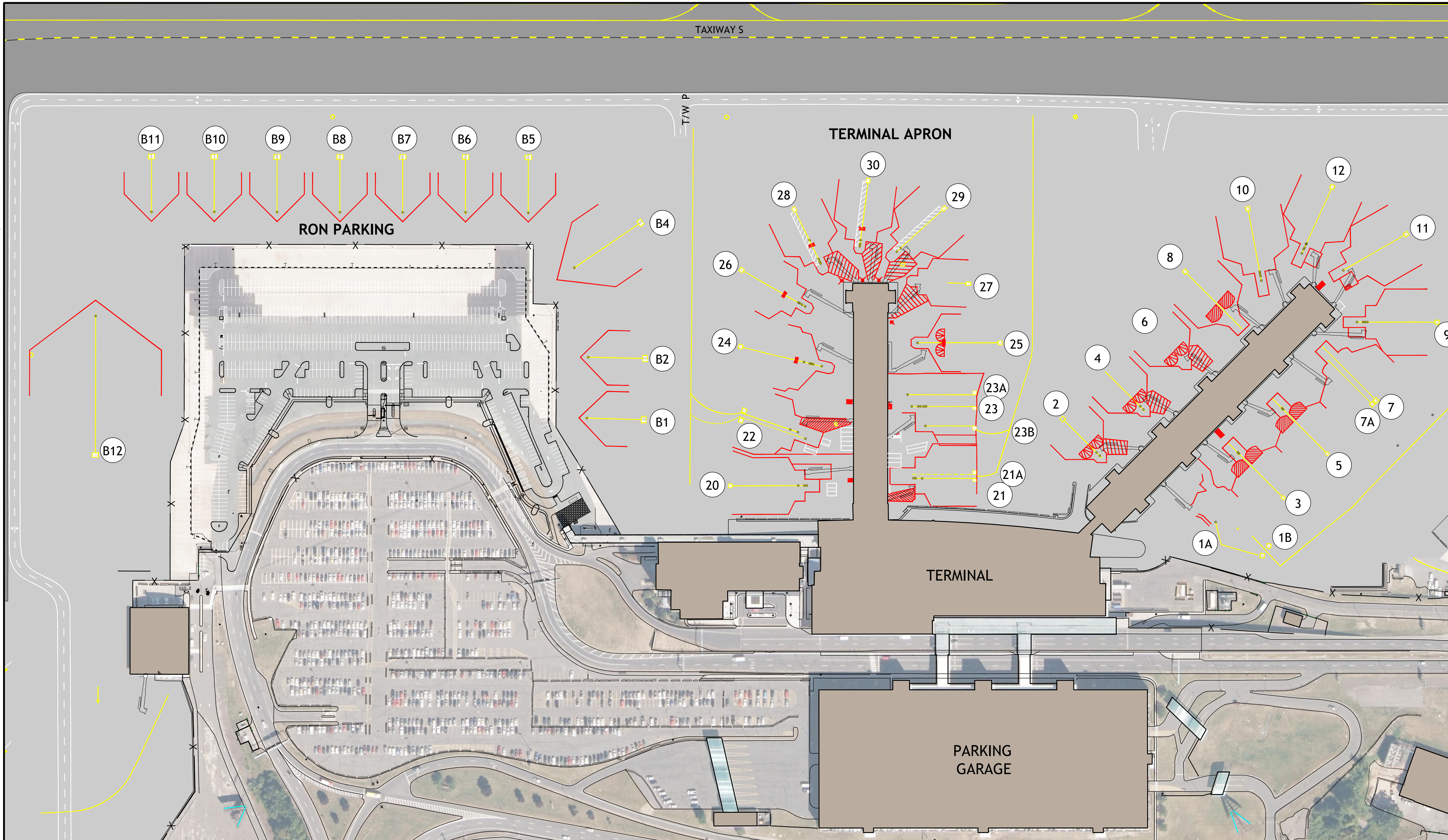

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Figure 4-12

Existing Terminal Apron Area

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GSE Equipment Storage

At BDL, the airlines at BDL own and operate the ground service equipment (GSE), including a variety of aircraft tugs, cabin service vehicles, deicers, ground power units (GPUs), belt-loaders, and waste disposal vehicles. This equipment is stored outside where space is available and on the south cargo apron adjacent to the belly cargo buildings. A storage shelter to protect from harsh weather conditions will increase the service life of the equipment. The airlines have expressed a desire to have a dedicated storage facility to protect critical equipment from the elements. Review of the airlines' GSE inventory indicates that significant storage space would be required to house all airline GSE equipment indoors. Further evaluation is necessary to determine the amount of space required to house GSE equipment.

4.4.3 Remain Overnight (RON) Parking

The north end of the terminal apron is currently reserved for remain-overnight (RON) aircraft and deicing operations (when necessary). This area was previously the apron associated with the Murphy terminal building that is now demolished. There are currently 11 designated and striped RON parking locations at BDL that surround the former terminal apron. These positions include two spots that accommodate regional jets or smaller, seven positions that accommodate Group III narrowbody jets, one Group IV position and one Group V or VI. In addition to the RON parking positions, commercial aircraft typically park overnight at the terminal gates as a first option until all gates are occupied.

At BDL, it is common for cargo aircraft as large as a Boeing 767 and an Antonov 124 to overnight at the Airport, in addition to regular airline aircraft from small RJs to the 757-200. As such, in addition to the 23 terminal gates, all 11 RON designated parking locations are utilized on a consistent basis.

According to Airport operations personnel, all designated RON positions not located at the terminal gates are utilized on a nightly basis and are at capacity. As such, based on the commercial operations forecast presented in Chapter 3, it can be assumed that as airline traffic increases throughout the planning horizon (1.3% AAGR), airlines will require increased segregated space for overnight parking. Therefore, based on the current number of RON positions (34), the Airport will need to consider an additional 10-12 RON position within the forecast period. For these reasons, it is a recommendation that additional RON parking positions be provided for PAL 1, that should accommodate aircraft as large as ADG-IV.

4.4.4 General Aviation Aprons

GA activity at BDL represents approximately 23 percent of total annual airport operations and include all types of private, corporate, and business aircraft flights. GA aircraft are primarily accommodated by the two Fixed Based Operators (FB0), Signature Flight Support and TAC Air. However, activity is also associated with the two local Maintenance, Repair, and Overhaul (MRO) facilities, Bombardier and Embraer, as well as by a few corporate facilities at BDL.

For the purpose of this analysis, a peak month-average day (PMAD) methodology was used to gauge the approximate number of GA aircraft parked on the FBO aprons during an average day of the peak month. The following is a description of the PMAD aircraft parking metric shown in **Table 4-18**.

GA Itinerant Operations – According to the BDL activity data for 2016 (described in **Section 3**), itinerant GA operations accounted for approximately 98 percent of total GA operations.

GA Peak Month Itinerant Operations – According to 2016 data obtained from the Air Traffic Control Tower at BDL, the month of June experienced the greatest number of GA itinerant operations (approximately 11 percent).

GA PMAD Operations – The GA peak month itinerant operations were divided by the number of days in June (30).

GA Itinerant Arrivals – The number of PMAD operations was reduced by half to derive the approximate number of GA itinerant arrivals requiring parking.

GA Itinerant Aircraft Parked on the Apron – According to the FBOs, GA itinerant arrivals typically remain parked on the apron for an extended period during the day. Therefore, parking space should be provided for the number of aircraft anticipated to use the apron during an average day of the peak month. For the purposes of this evaluation, it was assumed 80 percent of itinerant GA operations utilize the FBO aprons and therefore will be used in the subsequent analysis for apron space.

Table 4-18 – GA Itinerant Aircraft Parked on the Apron

	2017	PAL 1	PAL 2	PAL 3	PAL 4
GA Operations	21,852	23,002	24,380	26,132	28,735
GA Transient Operations	21,559	22,693	24,054	25,782	28,350
GA Peak Month Transient Operations	2,374	2,499	2,649	2,839	3,122
GA PMAD Transient Operations	79	83	88	95	104
GA Transient Arrivals	40	42	44	47	52
GA Transient Aircraft Parked on the Apron	32	33	35	38	42

Source: CHA, 2017.

Between the two FBO facilities there is approximately 52,000 SY of usable apron space currently available for GA itinerant aircraft parking.

- **Signature Flight Support** has an approximately 22,000 square yard (SY) apron on the west side of the airfield. Some of this total apron area is used for movement purposes, thus reducing the available parking space on the Signature Apron. For the purposes of this study, approximately 5,000 SY was considered to be movement area and thus reducing the total available apron parking area to 17,000 SY.
- **TAC Air** maintains an apron located at the east side of the Airport, that is approximately 45,000 SY. Similar to the Signature Flight Support apron, the TAC Air apron has both tie downs and parking positions on the apron. However, there is significantly more movement area on the TAC Air apron. For the purposes of this study, it was assumed that there is roughly 10,000 SY of movement area along the taxilanes on the TAC Air apron thus reducing their total available ramp parking space to 35,000 SY Additionally, it was assumed TAC Air does not park itinerant based aircraft along the taxiway lines.

In 2016, itinerant operations were comprised of approximately 9% single/multi engine piston aircraft, 11% turboprop, and 49% business jet (approximately 30% of the other operations are comprised of helicopters, military, and other aircraft). Applying these percentages to the number of GA itinerant aircraft parked on the apron at peak periods produced the number of each type of aircraft that will need space for parking. General planning assumptions and professional experience were used to determine the following apron space requirements for the different aircraft types:

- Single/Multi-Engine Piston = 400 square yards per aircraft
- Turboprop = 800 square yards per aircraft
- Business Jet = 1,600 square yards per aircraft

Table 4-19 shows the apron space needed to support the existing and future demand.

Table 4-19 – Based Aircraft and Itinerant Apron Space Requirement

Aircraft Type	2017	PAL 1	PAL 2	PAL 3	PAL 4
Single/Multi-Engine Piston	5 1,912 SY	5 2,189 SY	5 2,147 SY	5 2,105 SY	5 1,914 SY
Turboprop	6 4,573 SY	6 5,071 SY	7 5,622 SY	8 6,234 SY	9 6,912 SY
Business Jet	25 40,527 SY	28 45,044 SY	31 50,064 SY	35 55,643 SY	39 61,844 SY
Total Space Required	**47,013 SY**	**52,303 SY**	**57,833 SY**	**63,982 SY**	**70,670 SY**
Total Existing Apron Space	**52,000 SY**	**52,000 SY**	**52,000 SY**	**52,000 SY**	**52,000 SY**
Space Deficit	**4,987 SY**	**(-303 SY)**	**(-5,833 SY)**	**(-11,982 SY)**	**(-18,670 SY)**

Source: CHA 2017.

In addition to the GA aprons utilized by the FBO tenants, this study also identified apron requirements for the two the MROs (Embraer and Bombardier) and two major air cargo operators (UPS and FedEx) through interviews. Although their needs are not included not included in the GA itinerant apron requirements, they must be included in the overall study. The apron areas and requirements for cargo and MRO aprons are listed below.

- **Bombardier** has an apron for their service facility that is approximately 21,000 SY. This 21,000SY accommodates both parked aircraft and on taxilane along the building. The taxilane uses roughly one third of the total apron space for movement purposes. As such, approximately 14,000SY of pavement exists for aircraft parking. The existing apron capacity is exceeded by current activity. Bombardier representatives expressed demand for twice the apron area as currently available.
- **Embraer** has a small service apron of approximately 3,000 SY. The apron is rarely used for aircraft parking, and no additional demand was identified. Nevertheless, the long-range plan should enable apron expansion if needed in the future.
- **FedEx** - The apron on the west side of the airfield, located near the Runway 15 threshold, is approximately 55,000 SY. This apron is used primarily by DHL and FedEx and is owned and operated by Aviation Facilities Company, Inc. (AFCO). The three existing cargo aircraft positions are adequate; however, operations would benefit from additional space between parked aircraft

and the cargo processing building, and for aircraft manoeuvring on the airport (particularly for push back). Expansion to approximately 70,000 SY should be considered.

- **UPS** - The UPS apron on the east side of airfield, east of Runway 1-19, is approximately 36,000 SY. UPS expressed a potential need to provide an additional cargo loading bay in the future, as well as the potential to accommodate larger aircraft (up to a Boeing 747 on occasion). There is also the need to demolish the storage building (former hangar) on the south side of the UPS leased area. As such, an ultimate cargo apron of approximately 50,000 SY is included for planning purposes.

Expansion concepts to address all apron needs are discussed in in the following chapter.

4.4.5 Deicing Aprons

In 2017, CAA began an effort to evaluate the deicing procedures at BDL and identify requirements to accommodate current and future activity. As explained in **Chapter 2**, the aircraft deicing apron at BDL is located north of the passenger terminal building at the Runway 6 end and has three aircraft bays. This deicing facility was originally designed to accommodate up to Group III aircraft when all three bays are occupied. For larger aircraft, based on wingspan and clearance requirements, two bays are necessary to (adjacent bay left empty while in use) are accommodate the wider wingspan. The circulation around the north deicing pad has been known to cause congestion issues on the apron as the deicing apron operates at capacity when deicing procedures are necessary. In addition, to commercial airline operations being accommodated on the deicing pad, air cargo and general aviation activity also use the facility.

Based on capacity and throughput issues during peak periods, and the transition from smaller Group II aircraft to larger Group IV and V aircraft, it is recommendation that the Airport expand the existing deicing apron or consider additional locations for future operations. Based on interviews with BDL operations personnel, the existing facility would benefit from two additional positions to accommodate busy periods without aircraft queues. Based on the activity forecasts, additional two positions would then be warranted during the planning period for a total of seven deicing positions. The size of the position need to accommodate the forecast fleet mix of group III, IV, and V aircraft.

4.4.6 Airfield Lighting

Runways 6-24 and 15-33 at BDL are equipped with high-intensity runway edge lights (HIRL), threshold lights, and approach or runway end lights (see Chapter 2, Inventory for further details). Runway 6-24 also has Centerline and Touchdown Zone Lights. All four runway ends are equipped with a 4-box Precision Approach Path Indicator (PAPI). Taxiways are lighted by medium-intensity taxiway lights (MITL) along the edge of the taxiways. All runway and taxiway lighting systems are considered to be in fair to good condition, are consistent with approach runway requirements, and aside from routine maintenance, should be adequate throughout the planning horizon.

4.5 PASSENGER TERMINAL FACILITY BUILDING

With the forecasts developed for Task 4, the peak hours for 2017, 2022, 2027, 2032, and 2037 can be used to create spatial requirements for the various terminal components. The following sections address different program areas and how they might evolve over the 20-year planning period at 5-year interval horizons. The following narrative is intended to be an overview; **Appendix B** provides a more detailed analysis of these programmatic requirements.

The program provides an IATA Level of Service (LOS) of "Optimum" as defined by Airport Development Reference Manual (ADRM) 10th Edition 5th Release unless otherwise noted.

Figure 4-13 – LoS Guidelines for Airport Terminal Facilities

LoS Guidelines		SPACE GUIDELINES [sqm/PAX]			MAXIMUM WAITING TIME GUIDELINES Economy Class [minutes]			MAXIMUM WAITING TIME GUIDELINES Business Class / First Class / Fast Track [minutes]			OTHER GUIDELINES & REMARKS		
	LoS Parameter:	Over-Design	Optimum	Sub-Optimum	Over-Design	Optimum	Sub-Optimum	Over-Design	Optimum	Sub-Optimum	Over-Design	Optimum	Sub-Optimum
Public Departure Hall		> 2.3	2.0 - 2.3	< 2.0	n/a			n/a			Optimum proportion of seated occupants:	15 - 20%*	
Check-In	Self-Service Kiosk (Boarding Pass / Bag Tagging)	> 1.8	1.3 - 1.8	< 1.3	< 1	1 - 2	> 2	< 1	1 - 2	> 2			
Check-In	Bag Drop Desk (queue width 1.4 - 1.6m)	> 1.8	1.3 - 1.8	< 1.3	< 1	1 - 5	> 5	< 1	1 - 3	> 3			
Check-In	Check-in Desk (queue width: 1.4 - 1.6m)	> 1.8	1.3 - 1.8	< 1.3	< 10	10 - 20	> 20	< 3 < 1	Business Class 3 - 5 First Class 1 - 3	> 5 > 3			
Security Control (queue width: 1.2m)		> 1.2	1.0 - 1.2	< 1.0	< 5	5 - 10	> 10	< 1	Fast Track 1 - 3	> 3			
Emigration Control (Outbound Passport Control) (queue width: 1.2m)		> 1.2	1.0 - 1.2	< 1.0	< 5	5 - 10	> 10	< 1	Fast Track 1 - 3	> 3			
Gate Holdrooms / Departure Lounges	Seating	> 1.7	1.5 - 1.7	< 1.5	n/a			n/a			Optimum proportion of seated occupants:	50 - 70%*	
Gate Holdrooms / Departure Lounges	Standing	> 1.2	1.0 - 1.2	< 1.0	n/a			n/a			Maximum Occupancy Rate: < 60%	60 - 70%	> 70%
Immigration Control (Inbound Passport Control) (queue width: 1.2m)		> 1.2	1.0 - 1.2	< 1.0	< 5	5 - 10	> 10	< 1	Fast Track 1 - 5	> 5			
Baggage Reclaim	Narrow Body Aircraft	> 1.7	1.5 - 1.7	< 1.5	< 0	0 / 15	> 15	< 0	0 / 15	> 15	The first waiting time value relates to "first passenger to first bag". The second waiting time value relates to "last bag on belt" (counting from the first bag delivery).**		
Baggage Reclaim	Wide Body Aircraft	> 1.7	1.5 - 1.7	< 1.5	< 0	0 / 25	> 25						
Customs Control		> 1.8	1.3 - 1.8	< 1.3	< 1	1 - 5	> 5	< 1	1 - 5	> 5	Waiting times refer to a procedure when 100% of the passengers are being checked by Customs		
Public Arrival Hall		> 2.3	2.0 - 2.3	< 2.0	n/a			n/a			Optimum proportion of seated occupants:	15 - 20%*	

Source: IATA Airport Development Reference Manual 10th Edition 5th Release, 2017

4.5.1 Gate Demand

Gate demand is projected by first determining each airline's current gate utilization (from 2015 historical data where known):

Table 4-20 – 2015 Gate Utilization

	2015 Enplanements	2015 Gates	Enplanements by Gate
United	282,365	3	94,100
American	753,762	4	188,400
Southwest	827,147	3	275,700
Air Canada	22,120	1	22,100
JetBlue	424,457	1	424,500
Delta	654,065	4	163,500

To provide a conservative projection, it is assumed that airlines will continue to operate preferential gates. Common-Use gates may bring down demand by allowing gates to be utilized by multiple airlines. The gate utilization factor may now be applied to the forecast enplanements by airlines. **Table 4-21** below illustrates the annual enplanements by airline for the forecast horizons

Table 4-21 – Annual Enplanements by Airline

	2017	2022	2027	2032	2037
United	362,314	402,385	442,439	479,786	514,274
American	829,578	921,040	1,012,721	1,098,206	1,177,147
Southwest	844,359	891,661	980,418	1,063,176	1,139,599
Air Canada	36,139	37,514	41,249	44,730	47,946
jetBlue	436,683	486,839	535,299	580,484	622,210
Delta	646,178	708,604	779,139	844,907	905,640
International Airline		33,784	37,147	40,282	43,178
Aer Lingus	30,034	53,851	59,211	64,209	68,825
West Coast Airline		51,610	56,747	61,537	65,961
Ultra-Low Cost Airline		51,570	56,703	61,489	65,909
One Jet	1,762	1,902	2,091	2,267	2,430

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Southwest	844,359	891,661	980,418	1,063,176	1,139,599
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Each airline's annual enplanements can then be divided by its current gate utilization to generate gate demand. Assumptions to be used in generating full gate demand are:

- United and Air Canada are assumed to share gates as members of Star Alliance
- International airlines are each assumed to have one dedicated gate at each horizon
- Low-cost carriers and ULCC are assumed to use one common-use gate

The generated gate demand is illustrated in the following table:

Table 4-22 – Gate Demand by Airline

	2017	2022	2027	2032	2037
United *(includes Air Canada)*	5	5	6	6	6
American	5	5	6	6	7
Southwest	4	4	4	4	5
Air Canada *(included with United)*	---	---	---	---	---
jetBlue	2	2	2	2	2
Delta	4	5	5	6	6
International Airlines		1	1	1	1
Aer Lingus	1	1	1	1	1
Shared Gate	1	1	1	1	1
Total Gates	***22***	***24***	***26***	***27***	***29***

	2017	2022	2027	2032	2037
United *(includes Air Canada)*	5	5	6	6	6
American	5	5	6	6	7
Southwest	4	4	4	4	5
Air Canada *(included with United)*	---	---	---	---	---
jetBlue	2	2	2	2	2
Delta	4	5	5	6	6
International Airlines		1	1	1	1
Aer Lingus	1	1	1	1	1
Shared Gate	1	1	1	1	1
Total Gates	***22***	***24***	***26***	***27***	***29***

Gate Demand in 2022, 2027, 2032, and 2037 may be lowered by one if a dedicated gate is assumed to be common-use and utilized by other airlines when not occupied. Gate gauge is determined by utilizing the aircraft group identified in the Peak Month Departures of the forecast. This number is divided by 31 to approximate Peak Month Average Daily Departures for the ADG group for each planning horizon.

Table 4-23 – Peak Month Average Daily Widebody Departures

	2017	2022	2027	2032	2037
ADG IV	1	2	2	2	2
ADG V	0	1	2	2	2

To provide a conservative estimate, it is assumed that the widebody aircraft are at the gates simultaneously. The remaining gates at each horizon are assumed to be ADG III. Assumed gate demand is listed below in **Table 4-24**:

Table 4-24 – Gate Demand by ADG

	2017	2022	2027	2032	2037
ADG III	21	21	22	23	25
ADG IV	1	2	2	2	2
ADG V	0	1	2	2	2

Projected gate demand and peak hours can now be used to generate functional requirements for the terminal building.

4.5.2 Check-in Hall

The programmatic analysis is based upon a common use approach (in lieu of preferential) with airlines sharing desks and kiosks. This allows the terminal to maximize its processing potential and achieve a greater efficiency.

Departures Public Concourse

Located between the terminal entries and the start of the ticketing queues, the size of this area is determined by taking the linear footage of the terminal processor (including linear footage of counters, bag drops, and security) and multiplying it by a nominal 35-foot depth of circulation.

Departures Meeter/Greeter Area

This area is calculated by first determining its occupancy. It is assumed that every fifth passenger will have one meeter and greeter, spending 20 minutes within the terminal. The peak hour occupancy is multiplied by 23sf per IATA LOS standards.

Table 4-25 – Meeter/Greeter Occupancy

	2017	2022	2027	2032	2037
Meeters and Greeters and Passengers	220	252	276	300	320

Check-in Processors

The analysis for the Check-In processors assumes a mix of full service agent positions (where passengers complete their entire transaction with an agent), bag drops (where passengers drop bags after checking-in online or at a kiosk), self-service kiosks, curbside, and an estimate for the number of passengers who complete check-in offsite (i.e. at home, via mobile device, etc.) The assumptions are shown in **Table 4-26** below.

Table 4-26 – Check-In Utilization

	2017	2022	2027	2032	2037
% of PAX utilizing Full Service	14%	14%	10%	10%	10%
% of PAX utilizing Bag Drops	45%	45%	48%	48%	48%
% of PAX utilizing Self-Service Kiosks	11%	11%	12%	12%	12%
% of PAX utilizing Remote	20%	20%	20%	20%	20%
% of PAX utilizing Curbside	10%	10%	10%	10%	10%

Full Service Check-In

Full Service positions are computed in accordance with IATA ADRM equations, utilizing the Peak 30-Minute from the forecast. The following assumptions are utilized in resulting processor and area demands:

- All Passengers assumed to be economy
- Process time: 149 seconds
- Maximum Queuing Time: 15 minutes (midpoint of IATA range for "Optimum" LOS)
- Check-in Processor Depth: 20 feet (includes cross circulation in front of queue, transaction position, counter depth, operations area from desk to back wall)
- Check-In processor width: 6.5 feet (includes circulation space between desks and one bag scale shared between two Check-In desks)
- Area per queuing passengers: 16.68sf (midpoint of IATA range for "Optimum" LOS)

Using the Peak 30-Minute and assumptions listed above, the overall demand for Full Service Positions are computed per IATA ADRM v10 equations. The results are listed in **Table 4-27**.

Table 4-27 – Full Service Check-In Demand

	2017	2022	2027	2032	2037
Counter Positions	10	11	9	10	11
Bag Scales	5	6	5	5	6
Maximum Passengers in Queue	63	72	57	62	66
Counter Area	1,271sf	1,400sf	1,152sf	1,271sf	1,400sf
Queue Area	1,055sf	1,206sf	958sf	1,045sf	1,109sf
Total Area	***2,326sf***	***2,606sf***	***2,110sf***	***2,316sf***	***2,509sf***

Bag Drop

Bag drop positions are assumed spatially comparable to the Full-Service counters, with every two transaction zones sharing a bag drop position. Future deployment of self-drop induction points may result in a space savings but for this study maintaining equivalent dimensions between Full Service and Bag Drop protects short term flexibility without compromising future reconfiguration potential. Again, the Peak 30-Minute is used alongside the following assumptions to generate both processor and area demands:

- All Passengers assumed to be economy
- Process time: 44 seconds
- Maximum Queuing Time: 3 minutes (midpoint of IATA range for "Optimum" LOS)
- Check-in Processor Depth: 20 feet (maintains module of Full-Service)
- Check-In processor width: 6.5 feet (maintains module of Full-Service)
- Area per queuing passengers: 16.68sf (midpoint of IATA range for "Optimum" LOS)

Using the Peak 30-Minute and assumptions listed above, the overall demand for Bag Drop Positions are computed per IATA ADRM v10 equations. The results are listed in **Table 4-28**.

Table 4-28 – Bag Drop Check-In Demand

	2017	2022	2027	2032	2037
Bag Drop Positions	16	18	21	22	24
Bag Scales	8	9	11	11	12
Maximum Passengers in Queue	67	76	90	97	104
Bag Drop Area	2,035sf	2,293sf	2,670sf	2,799sf	3,057sf
Queue Area	1,120sf	1,271sf	1,507sf	1,626sf	1,744sf
Total Area	***3,155sf***	***3,564sf***	***4,177sf***	***4,425sf***	***4,801sf***

Self Service Kiosks

Self Service Kiosk demand is determined by adding the percentage of passengers utilizing E-ticket transactions (not checking bags) to those using Bag Drop. This generates total kiosk demand by combining passengers utilizing kiosks for e-transactions only with those who utilize them as the first step in dropping bags. The resultant percentage and the Peak 30-Minute along with the following assumptions are used to identify processor demand.

- Process time: 147 seconds
- Maximum Queuing Time: 1.5 minutes (midpoint of IATA range for "Optimum" LOS)
- Individual kiosk area: 3.9sf
- Adjustment factor for layout variations: 300%
- Circulation area: 35%
- Area per queuing passengers: 16.68sf (midpoint of IATA range for "Optimum" LOS)

Using the Peak 30-Minute and assumptions listed above, the overall demand for Self Service Kiosks is computed using IATA ADRM v10 equations. The results are listed in **Table 4-29**.

Table 4-29 – Self-Service Check-In Demand

	2017	2022	2027	2032	2037
Kiosk Positions	66	76	90	97	103
Maximum Passengers in Queue	83	95	112	121	130
Kiosk Processing Area	1,045sf	1,195sf	1,421sf	1,529sf	1,626sf
Queue Area	1,873sf	2,143sf	2,530sf	2,735sf	2,939sf
Total Area	***2,918sf***	***3,338sf***	***3,951sf***	***4,264sf***	***4,565sf***

Airline Ticket Support Offices (ATO)

Area allocations for airline ticket offices assume that these offices run continuously behind the row of Full-Service Counters and Bag Drops positions, at a 29.5ft depth. While assumed to be located behind the Check-In hall, some airports provide these spaces in other locations throughout the terminal.

Restrooms

Restroom calculations assume 60% of men and 40% of women occupants will use the facilities at one time. Fixture counts are determined and then applied a sf/fixture factor to determine overall required square footage for restrooms. Provisions for janitor's closets, companion care, and circulation are included as well. These areas are for facility master planning efforts and compliance with local plumbing standards should be verified as part of any future terminal work.

Check-In Hall Customer Services

This area uses an industry standard sf/pax ratio of 1sf per 10 peak hour departing passengers.

Departures Public Concourse Operations and Support

Support spaces adjacent to the Departures Hall are typically 2.5% of overall terminal operations space (per benchmarking past projects).

Table 4-30 –Check-In Hall Summary

	2017	2022	2027	2032	2037
Public Concourse	21,035sf	23,415sf	26,320sf	28,070sf	30,555sf
Meeter/Greeter Area	5,091sf	5,831sf	6,387sf	6,942sf	7,405sf
Full-Service Positions	2,326sf	2,606sf	2,110sf	2,316sf	2,509sf
Bag Drop Positions	3,155sf	3,564sf	4,177sf	4,425sf	4,801sf
Self Service Kiosks	2,918sf	3,338sf	3,951sf	4,264sf	4,565sf
Airline Ticket Offices	5,039sf	5,620sf	5,813sf	6,201sf	6,783sf
Check-In Restrooms	1,165sf	1,288sf	1,330sf	1,401sf	1,444sf
Meeter/Greeter Restrooms	355sf	355sf	355sf	355sf	355sf
Customer Services	200sf	200sf	300sf	300sf	300sf
Public Concourse Ops and Support	700sf	800sf	900sf	1,000sf	1,000sf
Total Area	***41,984sf***	***47,017sf***	***51,643sf***	***55,274sf***	***59,717sf***

4.5.3 Security Screening Checkpoint

Security Screen requirements use IATA ADRM equations. All domestic and international traffic are assumed to share the same lanes; thus, the Simultaneous Peak 30-Minute is the basis for generating demand. Processor and area requirements are computed in accordance with IATA ADRM equations. The following assumptions create the processor and resultant area demands:

- Passengers assumed to be PreCheck: 40%
- Process time (standard lane): 150 PAX/Lane/Hour
- Process time (PreCheck lane): 250 PAX/Lane/Hour
- Maximum Queuing Time (standard lane): 10 minutes (high point of IATA range for "Optimum" LOS used)
- Maximum Queuing Time (PreCheck lane): 5 minutes (low point of IATA range for "Optimum" LOS used)
- Security Lane Depth: 100 feet
- Security Lane width: 15 feet
- Area per queuing passengers: 11.84sf (midpoint of IATA range for "Optimum" LOS)

- Recompose Zone after security: 25ft deep along length of checkpoint

The number of screening lanes is established by taking the Peak-30 Minute throughput created by the Full-Service Check-In counters, Bag Drops, Self-Service Kiosks, and adding to that those bypassing check-in altogether and proceeding directly to the checkpoint. Standard Lanes and PreCheck Lanes and their respective queues are computed separately using their individually assumed processing rates and queueing times. Support spaces are estimated by applying metrics derived from benchmarking comparable projects, establishing a minimum square footage and then increasing this area for every lane over six. The sum of the standard and PreCheck results create a single checkpoint requirement as illustrated in **Table 4-31**.

Table 4-31 – Departures Passenger Processing Summary

	2017	2022	2027	2032	2037
Security Lanes	14	15	17	18	20
Maximum Passengers in Queue	317	357	400	427	462
Screening Area	20,667sf	22,142sf	25,091sf	26,566sf	29,515sf
Queue Area	3,757sf	4,231sf	4,737sf	5,060sf	5,479sf
Recompose Area	5,167sf	5,544sf	6,276sf	6,642sf	7,385sf
Operations and Support	754sf	808sf	915sf	969sf	1,077sf
Total Area	***30,345sf***	***32,725sf***	***37,019sf***	***39,237sf***	***43,456sf***

4.5.4 Departures Concourse (Holdroms and Lounges)

The assumptions which create anticipated occupancy for the gate/holdrooms and supporting functions are indicated below:

Table 4-32 – Departures Concourse Occupancy

	Method	2017	2022	2027	2032	2037
Load Factors (LF)	From May 2017 Aviation Activity Forecast	85.7%	88.3%	88.5%	88.5%	88.5%
Passengers in Airline Lounges	Percentage of Peak Hour Domestic and International PAX assumed to be flying in first/business class and in airline lounges	10%	10%	10%	10%	10%
Passengers in each ADG V Holdroom	PAX number per gate has been determined by taking the typical seat count for a ADG V aircraft (350 pax) and applying the Load Factor and then reducing by the number of PAX in Airline Lounges	270 pax/gate	279 pax/gate	279 pax/gate	279 pax/gate	279 pax/gate
Passengers in each ADG IV Holdroom	PAX number per gate has been determined by taking the typical seat count for a ADG IV aircraft (265 pax) and applying the Load Factor and then reducing by the number of PAX in Airline Lounges	206 pax/gate	211 pax/gate	212 pax/gate	212 pax/gate	212 pax/gate
Passengers in each ADG III Holdroom	PAX number per gate has been determined by taking the typical seat count for a ADG III aircraft (180 pax) and applying the LF and reducing by the number of PAX in Airline Lounges	140 pax/gate	144 pax/gate	144 pax/gate	144 pax/gate	144 pax/gate

Holdrooms

An 80% seating ratio is assumed for each gate with the remainder of passengers standing at the gates. A typical gate area for each aircraft position is determined by combining: podium area for agents, a typical enplaning corridor dimension; area for wheelchair staging, and a passenger area calculation which multiplies LOS space criteria by the occupancy numbers for each holdroom. Assumptions which informed these calculations are as follows:

- Number of seats provided: 80% of passengers in each holdroom
- Agents per ADG III gate: 2
- Agents per ADG IV and V gate: 4
- Area per seat: 17.22sf (midpoint of IATA range for “Optimum” LOS)
- Area per standing passengers: 11.84sf (midpoint of IATA range for “Optimum” LOS)

Restrooms

Restroom calculations assume that 85% of domestic arriving, departing, and transferring peak hour passengers use concourse restrooms as well as 85% of international departing peak hour passengers. An occupancy number adjustment of 1.5 is applied to these peak hour numbers. The male/female breakdown is assumed to be 60% male/ 40% female. Fixture counts are determined and then have applied a sf/fixture factor to determine overall required square footage for restrooms. Provisions for janitor's closets, companion care, and circulation are included as well. These are for facility masterplan efforts and compliance with local plumbing standards should be verified as part of any future terminal work.

Airline Club Lounges

Airline Club occupancy is determined by applying the load factors listed in **Table 4-32** to the Domestic and International Non-Simultaneous Peak Hour Passengers. The Domestic and International occupancy load is then multiplied by an estimated standard area per passenger (50sf per pax) to calculate the total international and domestic club needs.

4.5.5 Concourse Customer Services

This area uses an industry standard sf/pax ratio of 1sf per four peak hour departing passengers.

Departures Concourse Operations and Support

From previous projects, support spaces located along the Departures Concourse are typically 3.0% of overall terminal operations space.

Concourse Circulation

Concourse Circulation is determined by establishing a typical linear footage for each contact gate position, calculated by adding the wingspan to a standard clearance dimension and multiplying it by the total number of aircraft. This overall linear dimension is then multiplied by a concourse width of approximately 15ft (which assumes a double-loaded concourse as it is half of the overall typical concourse circulation width of 30ft).

Table 4-33 –Departures Concourse Summary

	2017	2022	2027	2032	2037
Domestic Holdroom Area	56,421sf	60,708sf	63,599sf	66,490sf	72,272sf
Domestic Holdroom seats	*2,239*	*2,436*	*2,552*	*2,668*	*2,900*
International Holdroom Area	5,620sf	11,701sf	17,237sf	17,237sf	17,237sf
International Holdroom Seats	*150*	*379*	*530*	*530*	*530*
Domestic Restrooms	3,729sf	4,065sf	4,510sf	4,818sf	5,205sf
International Restrooms	355sf	355sf	355sf	355sf	355sf
Airline Lounges	9,010sf	10,855sf	11,935sf	12,940sf	13,875sf
Customer Services	600sf	600sf	700sf	700sf	700sf
Concourse Ops and Support	900sf	1,000sf	1,100sf	1,100sf	1,200sf
Concourse Circulation	47,655sf	54,150sf	59,850sf	61,980sf	66,240sf
Total Area	***124,290sf***	***143,435sf***	***159,286sf***	***165,619sf***	***177,084sf***

4.5.6 Concessions

Based on previous experience, concessions typically range between 8% and 20% of total usable terminal area. For BDL, a factor of 15% will be used to generate facility requirements. Further assumptions are as follows: 15% of concessions are landside, 85% of concessions are airside, and storage is assumed to be an additional 20% of the sum of landside and airside concessions.

Table 4-34 – Concessions Demand

	2017	2022	2027	2032	2037
Landside Concessions	8,740sf	10,212sf	11,104sf	11,550sf	12,504sf
Airside Concessions	49,526sf	57,865sf	62,920sf	65,448sf	70,858sf
Concessions Storage	11,653sf	13,615sf	14,805sf	15,400sf	16,672sf
Total Area	***69,919sf***	***81,692sf***	***88,829sf***	***92,398sf***	***100,034sf***

4.5.7 Baggage Conveyance and Screening Systems

The baggage system is made up of the following constituent elements: outbound screening, baggage makeup, and inbound baggage. The system demand and individual areas are programmed using standard processing rates and benchmarked areas from comparable projects. The following assumptions are used to analyzing the baggage system:

- Checked bags per domestic passenger: 1.2
- Checked bags per international passenger: 1.5

Baggage Screening (Departures)

The number of EDS units required is determined by taking the Simultaneous Peak Hour Domestic Departing and Simultaneous Peak Hour International Departing, multiplying each by their respective bags per passenger ratio, and then taking their sum to determine total peak hour EDS demand. The resultant number of bags is then divided by a standard EDS processing rate of 650 bags/hour to determine the number of devices required for Level 1 screening. A benchmark ratio of 600sf / per EDS unit is utilized to determine ETD area.

Table 4-35 – Baggage Screening Demand

	2017	2022	2027	2032	2037
Baggage Screening Units	4	4	4	5	5
Screening Area	10,000sf	10,000sf	10,000sf	12,000sf	12,000sf
ETD Screening Area	2,400sf	2,400sf	2,400sf	3,000sf	3,000sf
Total Area	***12,400sf***	***12,400sf***	***12,400sf***	***15,500sf***	***15,500sf***

Baggage Make-Up (Departures)

Baggage Make-Up assumes three gates share a single 100ft by 20ft carousel makeup device. Circulation is computed by providing offload and bypass lanes on either side of the device and a two-way tug road running perpendicular to the devices on each end.

Table 4-36 – Baggage Make-Up Demand

	2017	2022	2027	2032	2037
Make-Up Devices	8	9	10	10	11
Device Area	16,000sf	18,000sf	20,000sf	20,000sf	22,000sf
Baggage Train Circulation	42,888sf	48,096sf	53,304sf	53,304sf	58,512sf
Total Area	***58,888sf***	***66,096sf***	***73,304sf***	***73,304sf***	***80,512sf***

Inbound Baggage (Arrivals)

Inbound Baggage is based upon the estimated number of claim devices (discussed below in Section 1.7 Arrivals Baggage Claim Hall). Each claim device is assumed to have two 65ft feeds, each capable of accommodating a single ADG III aircraft. This number of induction feeds is multiplied by their 65ft length and a width (including belt area, work area, and offload area). A single bypass lane is estimated between each pair of feeds.

Table 4-37 – Inbound Baggage Demand

	2017	2022	2027	2032	2037
Domestic Inbound belts	8	8	8	8	10
Domestic Device Frontage	520ft	520ft	520ft	520ft	650ft
Domestic Inbound Baggage Handling Area	10,725sf	10,725sf	10,725sf	10,725sf	13,260sf
International Inbound belts*	0*	2	2	2	2
International Device Frontage	0ft*	130ft	130ft	130ft	130ft
International Inbound Baggage Handling Area	0sf*	3,120sf	3,120sf	3,120sf	3,120sf
Total Area	***10,725sf***	***13,845sf***	***13,845sf***	***13,845sf***	***16,380sf***

**no International demand during Simultaneous Peak Hour*

Table 4-38 – Baggage Processing Summary

	2017	2022	2027	2032	2037
Baggage Screening	12,400sf	12,400sf	12,400sf	15,500sf	15,500sf
Baggage Make-Up	58,888sf	66,096sf	73,304sf	73,304sf	80,512sf
Inbound Baggage	10,725sf	13,845sf	13,845sf	13,845sf	16,380sf
Total Area	***82,013sf***	***92,341sf***	***99,549sf***	***102,649sf***	***112,392sf***

4.5.8 International Arrivals Processing

The international arrivals facility is sized per the forecast demand and US Customs and Border Protection Airport Technical Design Standards. More than half of the international arrivals at BDL are forecast to be PreClear and will arrive as domestic flights without the need for CBP processing. This leads to a smaller processing demand than would be typically necessary for a comparably-sized airport. Assumptions made are as follows below:

- Area of a Primary Processor: 1560sf (includes queue, processing booth, post circulation)
- Percentage of Passengers diverted to Secondary Screening: 10%
- Internal circulation factor applied: 35%
- Sterile Arrivals Corridor width: 15ft

Primary Inspection

To determine the area and processor requirements for the CBP Primary Processing and Inspection, the international non-PreClear Peak is divided by a processing rate of 100 pax/hour/doublebooth (or pair of universal podiums). This number is then multiplied by the per booth area unit of 1560sf (which accounts for processing area, queue, and cross circulation after processing).

Table 4-39 – Primary Processing

	2017	2022	2027	2032	2037
# of Doublebooths (or pair of universal podiums)	2	3	3	3	3
Counter Area	260sf	390sf	390sf	390sf	390sf
Primary Queue Area	2,600sf	3,900sf	3,900sf	3,900sf	3,900sf
Cross Circulation	260sf	390sf	390sf	390sf	390sf
Total Area	***3,120sf***	***4,680sf***	***4,680sf***	***4,680sf***	***4,680sf***

Secondary Screening

Secondary Processing is determined by CBP space requirements for the corresponding number of passengers processed per hour. Where necessary, variables are estimated by benchmarking previous projects. Queue size is determined by IATA v10 calculations for Customs Facilities with an assumed 10% of the International Arrivals Peak being selected for screening and a max queue time of three (3) minutes.

Table 4-40 – Secondary Screening

	2017	2022	2027	2032	2037
Exam Podiums	2	2	2	2	2
X-Ray Positions	1	1	1	1	1
Processing Area	1,676sf	1,676sf	1,676sf	1,676sf	1,676sf
Queue	293sf	293sf	309sf	309sf	309sf
Red Channel	830sf	830sf	830sf	830sf	830sf
Green Channel	448sf	448sf	448sf	448sf	448sf
Blue Channel	448sf	448sf	448sf	448sf	448sf
Total Area	***3,695sf***	***3,695sf***	***3,711sf***	***3,711sf***	***3,711sf***

Operations and Support

Support and Administration areas are determined by CBP space requirements for the corresponding number of passengers processed per hour. When necessary, variables are estimated by benchmarks. An additional 35% internal circulation factor is applied to net area requirements to generate a gross facility size.

Table 4-41 – Operations and Support

	2017	2022	2027	2032	2037
FIS Operations and Support	17,285sf	17,803sf	17,515sf	17,569sf	17,677sf

Sterile Arrivals Corridor

Arrivals sterile circulation is determined by establishing a typical linear footage for each international contact gate position, calculated by adding the wingspan to a standard clearance dimension and multiplying it by the total number of aircraft. This overall linear dimension is then multiplied by a concourse width of approximately 15ft.

Table 4-42 – Sterile Arrivals Corridor

	2017	2022	2027	2032	2037
ADG III Gates (International)	2	0	0	0	0
ADG IV Gates (International)	0	2	2	2	2
ADG V Gates (International)	0	1	2	2	2
Sterile Arrivals Corridor	4,867sf	10,285sf	14,033sf	14,033sf	14,033sf

Restrooms

Restroom calculations assume 60% of men and 40% of women occupants will use the facilities at one time. Fixture counts are determined and then have applied a sf/fixture factor to determine overall required square footage for restrooms. Provisions for janitor's closets, companion care, and circulation are included as well. These are for facility masterplan efforts and compliance with local plumbing standards should be verified as part of any future terminal work.

Table 4-43 – International Arrivals Processing Summary

	2017	2022	2027	2032	2037
Primary Processing	3,120sf	4,680sf	4,680sf	4,680sf	4,680sf
Secondary Screening	3,695sf	3,695sf	3,711sf	3,711sf	3,711sf
Operations and Support	17,285sf	17,803sf	17,515sf	17,569sf	17,677sf
Sterile Arrivals Corridor	4,867sf	10,285sf	14,033sf	14,033sf	14,033sf
Restrooms	355sf	398sf	398sf	398sf	398sf
Total Area	***30,072sf***	***37,610sf***	***41,087sf***	***41,141sf***	***41,249sf***

4.5.9 Arrivals Baggage Claim Hall

Baggage Claim facilities assume individual claim devices will swing between international and domestic use. Swing facilities utilize partitions containing access points between international and domestic claim devices which allow devices within to be utilized for either domestic or international baggage claim (by opening or closing the access points). Such an arrangement seeks to maximize efficient use while minimizing area requirements by ensuring that the claim requirements are based upon the simultaneous maximum total number of arriving passengers (rather than the individual international and domestic peaks which often occur at different times of the day and could result in a dedicated international hall sitting vacant and unused for much of the day). Thus, baggage claim hall requirements are sized utilizing the Simultaneous Peak Hour. Further assumptions utilized in developing the claim hall are as follows:

- Percentage of Domestic Passengers claiming bags: 70%
- Percentage of Domestic Passengers at claim at one time: 67%
- Rows of Domestic Passengers at claim: 1.5
- Standard Domestic Claim size: 1,600sf (accommodates a narrowbody aircraft)
- Percentage of International Passengers claiming bags: 85%
- Percentage of International Passengers at claim at one time: 67%
- Rows of International Passengers at claim: 1.0
- Standard International Claim size: 2,400sf (accommodates a widebody aircraft or two narrowbody aircraft)
- Average claim frontage per passenger: 2ft

Domestic Claim Hall

Domestic claim devices are sized by first determining the claim length required to accommodate the expected occupancy of the claim hall. The Simultaneous Peak Hour Domestic Arriving Passenger count is adjusted by the percentage of passengers claiming bags and how many of them are at claim at one time. This number is multiplied by the assumed frontage per passenger with the final length considering passengers will form one and a half rows around the device. This length required is divided by the minimum presentation length of 180ft to determine the number of devices. Area required per devices is based upon slope plate carousel devices. Positive claim assumes 15ft of queue around the device and area for passenger circulation.

Table 4-44 – Domestic Claim Hall (Simultaneous Demand)

	2017	2022	2027	2032	2037
Domestic Bag Claim Devices	4	4	4	4	5
Domestic Claim Length Required	643ft	664ft	730ft	792ft	848ft
Domestic Claim Device Area	6,400sf	6,400sf	6,400sf	6,400sf	8,000sf
Domestic Positive Claim Area	34,425sf	34,425sf	34,425sf	34,425sf	41,850sf
Total Area	***40,825sf***	***40,825sf***	***40,825sf***	***40,825sf***	***49,850sf***

International Claim Hall

As with Domestic Claim, International devices are sized by determining the claim length required to accommodate the expected occupancy of the claim hall. The Simultaneous Peak Hour International Arriving Passenger count is adjusted by the percentage of passengers claiming bags and how many of them are at claim at one time. This number is multiplied by the assumed frontage per passenger with the final length considering passengers forming a single row around the device. The minimum presentation length of 260ft is then used to determine the number of devices. Area required per device is based upon slope plate carousel devices. Positive claim is determined by providing 15ft of queue around the device and area for passenger circulation.

Table 4-45 – International Claim Hall (Simultaneous Demand)

	2017	2022	2027	2032	2037
International Bag Claim Devices	0*	1	1	1	1
International Claim Length Required	0ft*	128ft	141ft	153ft	165ft
International Claim Device Area	0sf*	2,400sf	2,400sf	2,400sf	2,400sf
International Positive Claim Area	0sf*	13,050sf	13,050sf	13,050sf	13,050sf
Total Area	***0sf****	***15,450sf***	***15,450sf***	***15,450sf***	***15,450sf***

***no International demand during Simultaneous Peak Hour*

The sizing of the Domestic and International Claim Halls utilize the Simultaneous Peak Hour as their basis. This number is the largest concentration of arriving passengers in any 60-minute period throughout the day. This gives ultimate device demand but the ratio of domestic and international claim devices can change (swing) throughout the day as the individual domestic and international peaks change. To determine the dedicated international demand a separate analysis utilizes the Non-Simultaneous Peak Hour Arriving International Passenger numbers (the largest concentration of arriving international passengers in any 60-minute period throughout the day). When the international device demand as determined by the Non-Simultaneous Peak Hour (below) exceeds that of the Simultaneous Peak Hour (above), unused domestic devices will be utilized to satisfy international demand. The Non-Simultaneous results are listed below for reference but are not-included in the section nor the total facilities requirements summaries:

Table 4-46 – International Claim Hall (Non-Simultaneous Demand)

	2017	2022	2027	2032	2037
International Bag Claim Devices	1	1	1	1	1
International Claim Length Required	203ft	241ft	265ft*	288ft*	308ft*
International Claim Device Area	2,400sf	2,400sf	2,400sf	2,400sf	2,400sf
International Positive Claim Area	13,050sf	13,050sf	13,050sf	13,050sf	13,050sf
Total Area	***15,450sf***	***15,450sf***	***15,450sf***	***15,450sf***	***15,450sf***

**assumes single device will be adequate*

Baggage Hall Customer Services

This area uses an industry standard sf/pax ratio of 1sf per 10 peak hour arriving passengers.

Restrooms

Restroom calculations assume 60% of men and 40% of women occupants will use the facilities at one time. Fixture counts are determined and then have applied a sf/fixture factor to determine overall required square footage for restrooms. Provisions for janitor's closets, companion care, and circulation are included as well. These are for facility masterplan efforts and compliance with local plumbing standards should be verified as part of any future terminal work.

Baggage Claim Hall Operations and Support

Support spaces adjacent to the Baggage Claim Hall are typically 2.5% of overall terminal operations space (per benchmarking).

Arrivals Public Concourse

The size of the public concourse is established by taking the arrivals public concourse occupancy (determined by assuming domestic passengers at a 20-minute dwell time and international passengers at a 30-minute dwell time) and multiplying it by 23.14sf per passenger LOS Optimum Criteria.

Arrivals Meeter/Greeter Area

This area is calculated by first determining its occupancy. It is assumed that every fifth passenger will have one meeter and greeter, spending either 20 minutes (for domestic) or 30 minutes (for international) within the terminal. This occupancy is then multiplied by 23.14sf per IATA LOS standards.

Table 4-47 – Arrivals Baggage Claim Hall Summary

	2017	2022	2027	2032	2037
Domestic Claim Hall	40,825sf	40,825sf	40,825sf	40,825sf	49,850sf
International Claim Hall	0sf*	15,450sf	15,450sf	15,450sf	15,450sf
Baggage Claim Customer Services	200sf	200sf	200sf	200sf	200sf
Restrooms	1,031sf	1,103sf	1,254sf	1,254sf	1,296sf
Baggage Claim Hall Ops and Support	700sf	800sf	900sf	1,000sf	1,000sf
Arrivals Public Concourse	7,938sf	9,488sf	10,437sf	11,317sf	12,127sf
Arrivals Meeter / Greeter Area	1,597sf	1,921sf	2,106sf	2,291sf	2,453sf
Total Area	***52,291sf***	***69,786sf***	***71,171sf***	***72,337sf***	***82,376sf***

***no International demand during Simultaneous Peak Hour*

4.5.10 Other Program Areas

Based upon past project experience and benchmarks, the following assumptions can be made to provide for operations and support areas.

- Operations and Support: 1000sf per 100 peak hour passengers
- Back of House Operations and Support: 92% of Total Operations (remainder allocated in public spaces itemized above)
- Loading Dock: 2 docks for first six gates with an additional dock for every six additional gates
- Mechanical, Electrical, Plumbing & IT Systems: 10% of total net terminal area
- Structure: 2% of total net terminal area

Table 4-48 – Additional Program Areas

	2017	2022	2027	2032	2037
Operations and Support	24,564sf	28,051sf	30,857sf	33,460sf	35,871sf
Loading Dock	2,880sf	2,880sf	2,880sf	3,600sf	3,600sf
Mechanical, Electrical and Plumbing & IT Systems	45,836sf	53,554sf	58,233sf	60,572sf	65,578sf
Structure	9,168sf	10,711sf	11,647sf	12,115sf	13,116sf
Total Area	***82,448sf***	***95,196sf***	***103,617sf***	***109,747sf***	***118,165sf***

4.5.11 Terminal Facility Requirements Summary

Total areas for the above functions are summarized below. A detailed program is shown in **Appendix B**.

Table 4-49 – Facilities Requirements Summary

	2017	2022	2027	2032	2037
Check-In Hall	41,984sf	47,017sf	51,643sf	55,274sf	59,717sf
Departures Passenger Processing	30,345sf	32,725sf	37,019sf	39,237sf	43,456sf
Departures Concourse	***124,290sf***	***143,435sf***	***159,286sf***	***165,619sf***	***177,084sf***
Concessions	***69,919sf***	***81,692sf***	***88,829sf***	***92,398sf***	***100,034sf***
Baggage Processing	***82,013sf***	***92,341sf***	***99,549sf***	***102,649sf***	***112,392sf***
International Arrivals Processing	***30,072sf***	***37,610sf***	***41,087sf***	***41,141sf***	***41,249sf***
Arrivals Baggage Claim Hall	***52,291sf***	***69,786sf***	***71,171sf***	***72,337sf***	***82,376sf***
Operations and Support + Loading Dock	27,444sf	30,931sf	33,737sf	37,060sf	39,471sf
Mechanical, Electrical and Plumbing & IT Systems	45,836sf	53,554sf	58,233sf	60,572sf	65,578sf
Structure	9,168sf	10,711sf	11,647sf	12,115sf	13,116sf
Total Area	***513,362sf***	***599,802sf***	***652,200sf***	***678,402sf***	***734,472sf***

4.6 PARKING AND VEHICLE TRAFFIC

This section of the report details the existing inventory of parking, both on- and off-airport, as well as the existing traffic conditions at the departure and arrival levels of the airport. The data presented was gathered from a variety of sources, including on-site observations by DESMAN, information provided by the CAA's parking operator, SP+, previous studies of the airport, and online research.

For reference, DESMAN's on-site observations were conducted on Tuesday, November 15, 2016, a day of the week identified by the CAA as typical of a busy weekday.

4.7 ON-AIRPORT PARKING

The on-airport parking facilities are owned by the CAA and are operated by SP+, the largest parking operator in the United States. These facilities provide parking for a combination of public parkers, employees of airport vendors and the airlines and CAA employees.

4.7.1 Existing CAA Facilities

Parking facilities owned and controlled by the CAA consist of one parking garage, nine surface parking lots and additional parking spaces in close proximity to the airport designated for use by the CAA. In total, the CAA controls 8,362 parking spaces, of which 7,442 are for public parking and 920 are for airport employee and CAA parking.

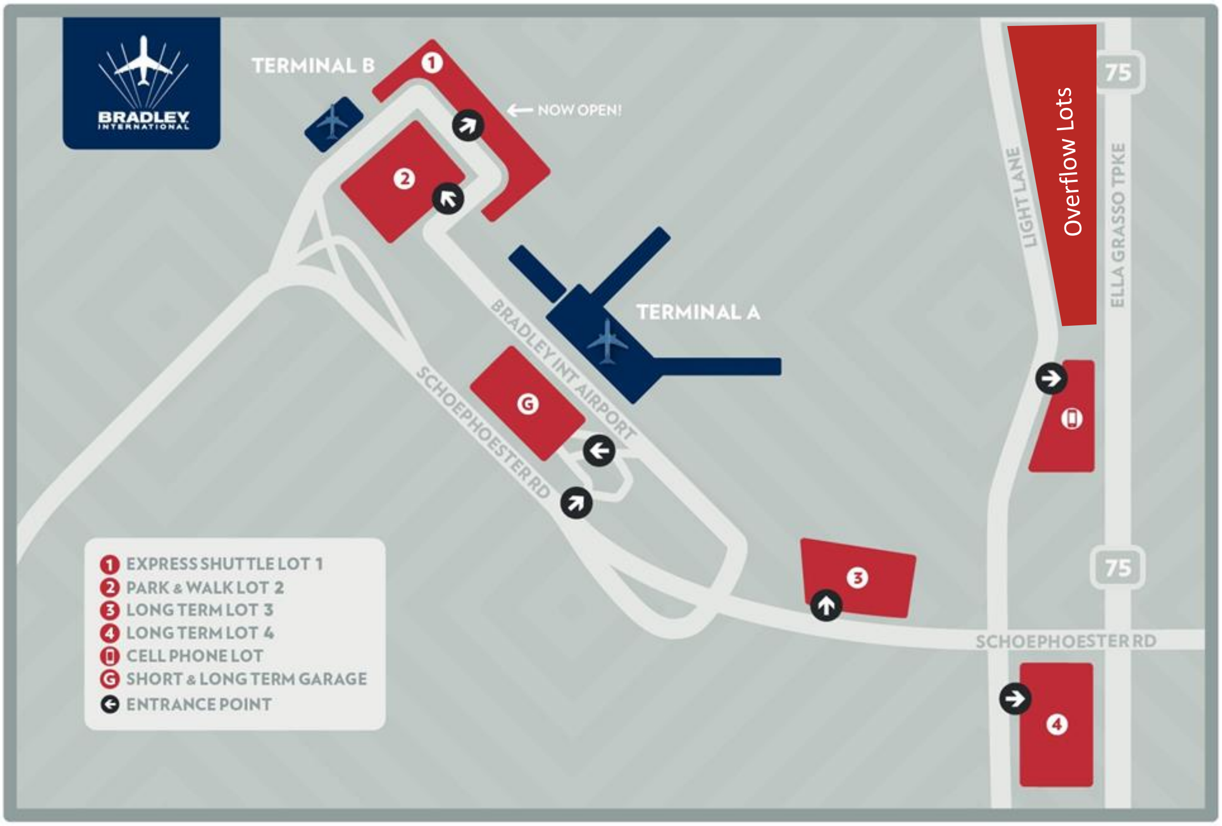
Table 4-50 presents a detailed breakdown of the existing CAA parking inventory by facility and type of user served. As shown in the "Facility ID" column in the table, each facility, aside from the parking garage, is identified by a number and/or letter, which corresponds to the labelling system used by the CAA. The geographical locations of the parking facilities are shown in Figure 4-14.

Table 4-50 – Existing CAA Parking Facilities

Facility ID	Public Parking Inventory	Employee Parking Inventory	Total Parking Inventory
Lot 1	794	0	794
Lot 2	794	0	794
Lot 3	728	0	728
Lot 4	577	0	577
Lot 5A (overflow)	377	0	377
Lot 5B (overflow)	572	0	572
Lot 5C (employee)	0	830	830
Cell Phone Lot	58	0	58
Garage	3,414	0	3,414
Garage Overflow Lot	128	0	128
VIP	0	90	90
Total Parking Inventory	**7,442**	**920**	**8,362**

Source: CAA, 2016; Updated 2019

Figure 4-14 – On-Airport Parking Facilities



Source: CAA, 2019

A few items of note related to the existing on-airport parking inventory:

- The Garage inventory is broken-down into 3,017 spaces for long-term parkers and 397 spaces for short-term parkers, spaces which are physically separated within the Garage
- The VIP facility indicates spaces in close proximity to the airport which may only be used by the CAA, not public parkers or other employees working at the airport
- At the time of DESMAN's on-site observations, Lot 5A was not in use

Shuttle buses are used to move public parkers from lots 1, 3, and 4 to the terminal building, as well as employees who park in Lot 5C. Public parkers who park in Lot 2B, as well as public parkers from the Garage, must walk from their parking location to the terminal.

4.7.2 Observed Occupancy

The choice to conduct on-site observations of parking and traffic activity on a Tuesday was made in order to capture typical peak activity levels at the airport. Based on DESMAN's past experience, which was confirmed by the CAA, Tuesday is a day when airports, including Bradley, experience typical peak levels of activity. While the absolute peak activity period for most airports in the U.S. is around the Thanksgiving holiday, in terms of providing an adequate quantity of parking capacity, the idea is to try and accommodate the typical peak demand, not these periods of extraordinary demand. If airports constructed enough parking spaces to accommodate these occasional demand spikes, a large number of spaces would sit empty for all but a few days out of the year.

On the survey day, Tuesday, November 15, 2016, all the CAA's public parking facilities, except for Lot 5B, were full and closed to additional parkers by noon. Signs were posted at the entrances to each of the facilities indicating that they were full, while additional signs directed parkers to Lot 5B.

In the parking industry, parking facilities and systems are typically designed so that, even during peak demand periods, some percentage of the parking spaces remain empty. Ideally, during a typical peak demand period, 5%-15% of the spaces in a facility or on-street remain available to accommodate new parkers. Maintaining an inventory of available spaces, even during the peak demand period, makes it easier for parkers to find a space, reduces the amount of time drivers spend searching for empty spaces and generally results in a more positive parking experience. This concept, referred to as "practical capacity", refers to that point at which a parking facility or system has reached its functional limit and is unable to efficiently or safely accommodate additional parking demand.

With an observed peak utilization of 5,926 stalls, the CAA's public parking inventory is currently operating at approximately 83% of capacity. If we assume that the Airport's practical capacity is 95% of the actual supply, the CAA's parking system is currently approaching its practical capacity on a typical day.

4.7.3 Current Parking Rates

Table 4-51 presents the current rates charged for public parking at each of the CAA's facilities.

Table 4-51 – Existing CAA Public Parking Facility Rates

Facility ID	Public Parking Inventory	Current Parking Rates
Lot 1	520	Up to 1 Hr. - \$4.00 1 – 2 Hrs. - \$5.00 2 – 3 Hrs. - \$6.00 Each Add. Hr. - \$1.00 Daily Max. - \$12.00 Weekly Max. (5-7 days) - \$72.00
Lot 2B	401	Up to 1 Hr. - \$4.00 1 – 2 Hrs. - \$5.00 2 – 3 Hrs. - \$6.00 Daily Max. - \$10.00 Weekly Max. (6-7 days) - \$60.00
Lot 3	728	Up to 1 Hr. - \$4.00 1 – 2 Hrs. - \$5.00 2 – 3 Hrs. - \$6.00 Each Add. Hr. - \$1.00 Daily Max. - \$8.00 Weekly Max. (6-7 days) - \$48.00
Lot 4	577	Up to 1 Hr. - \$4.00 1 – 2 Hrs. - \$5.00 Daily Max. - \$6.00 Weekly Max. (6-7 days) - \$36.00
Cell Phone Lot	58	FREE (only for very short-term use)
Garage	3,414	Up to ½ Hr. - \$3.25 ½ – 1 Hr. - \$5.50 1 – 1 ½ Hrs. - \$7.25 Each Add. 30 Mins. or Part - \$1.75 Daily Max. (Long Term) - \$28.00 Daily Max. (Short Term) - \$32.00 Weekly Max. (4-7 days LT) - \$112.00
Garage Overflow Lot	128	Same as LT Garage Rates

Source: CAA, 2016

In addition to the parking fees listed in the above table, the State of Connecticut adds a 6.35% tax to the total parking charge.

4.7.4 Current Parking Operator

CAA currently outsources the operation of its on-airport parking facilities to SP+, one of the largest providers of parking management services in North America. According to their website, the Airport Services group, "…focuses exclusively on the airport market, so our personnel are experts at understanding and addressing the unique demands of an airport environment. With more than 50 years' experience in airport parking and landside services, we coordinate parking, transportation, curbside management and related services for airports around the country, large and small." Additionally, SP+ "…has more than 22,000 employees and operates approximately 3,700 facilities with 2.0 million parking spaces in hundreds of cities across North America, including parking-related and shuttle bus operations serving more than 60 airports."

4.8 OFF-AIRPORT PARKING

In addition to the more than 7,400 public parking spaces offered on-site by the CAA, a significant number of private companies operate off-airport parking in the vicinity of Bradley Airport. Of the 14 competing parking facilities identified by DESMAN, all but 2 of the facilities are located within a 3-mile drive of the airport entrance. At an estimated 11,500 spaces combined, these facilities eclipse the total supply of public parking provided by the CAA itself.

4.8.1 Existing Competing Facilities

Competing public parking is offered in 14 individual locations, all of which are surface parking lots. A few of the facilities provide a small number of covered parking spaces, but most of the spaces are open-air. Additionally, while most of the spaces are self-park, several locations also offer valet parking. As with the CAA's more remote on-airport parking locations, each of the off-airport parking competitors offers shuttle service from their parking facility or facilities to and from the terminal.

Table 4-52 presents a detailed list of the existing competing off-airport parking locations including the: facility name/owner/operator, address, estimated parking capacity, type of operation, and driving distance from the parking location to the airport entrance. In addition, the table includes a "Facility ID", which corresponds to the map of facility locations presented in **Figure 4-15**.

It should be noted that, for the self-park facilities, the parking capacities were counted from aerial photographs dated April 2016. For the valet or self-park/valet locations, the parking capacities were estimated based on the assumption that, at maximum efficiency, a valet parking facility can accommodate one vehicle in each 250 square feet of space. The actual capacities of these parking facilities may vary from the information provided herein, but DESMAN was unable to access the competing parking locations or speak to their owners/operators in order to verify these figures.

4.8.2 Observed/Calculated Occupancy

Unlike the on-airport parking facilities owned by the CAA, it was only possible to gain very limited access to the off-airport competing parking facilities during the data gathering effort. This lack of access, along with a lack of publicly-available information on the CAA's competitors, made it impossible to verify the utilization of the off-site facilities during DESMAN's on-site surveys.

Table 4-52 – Competing Off-Airport Parking Facilities

Facility ID	Facility Name/ Owner/Operator	Facility Address	Estimated Capacity	Type of Operation	Driving Distance to Airport
A	Z Airport Parking	3 International Dr., East Granby, CT 06026	790	Self-Park/Valet	2.6 mi.
B	Executive Valet Parking	1186 South Street, Suffield, CT 06078	1,760	Valet	2.8 mi.
C	Dollar Airport Parking	593 Elm St., Windsor Locks, CT 06096	140	Valet	1.0 mi.
D	Days Inn	185 Ella Grasso Tpke., Windsor Locks, CT 06096	146	Self-Park	0.7 mi.
E	Econo Lodge Inn & Suites	34 Old Country Rd., Windsor Locks, CT 06096	190	Self-Park	1.2 mi.
F	Roadway Inn & Suites	161 Bridge St., East Windsor, CT 06088	290	Self-Park	6.2 mi.
G	Baymont Inn & Suites	260 Main St., East Windsor, CT 06088	132	Self-Park	4.9 mi.
H	LAZ Fly Economy Parking	110 Ella Grasso Tpke., Windsor Locks, CT 06096	1,060	Self-Park/Valet	0.8 mi.
I	La Quinta Inn & Suites	64 Ella Grasso Tpke., Windsor Locks, CT 06096	107	Self-Park	1.0 mi.
J	LAZ Fly Premier Parking	35 Ella Grasso Tpke., Windsor Locks, CT 06096	859	Self-Park	1.1 mi.
K	Quality Inn	5 Ella Grasso Tpke., Windsor Locks, CT 06096	191	Self-Park	1.1 mi.
L	LAZ Fly Premier Parking	24 Ella Grasso Tpke., Windsor Locks, CT 06096	1,360	Valet	1.1 mi.
M	Roncari Valet Parking	9 Schoephoester Rd., Windsor Locks, CT 06096	3,410	Valet	0.3 mi.
N	Galaxy Self-Park	9 Schoephoester Rd., Windsor Locks, CT 06096	1,047	Self-Park	0.3 mi.

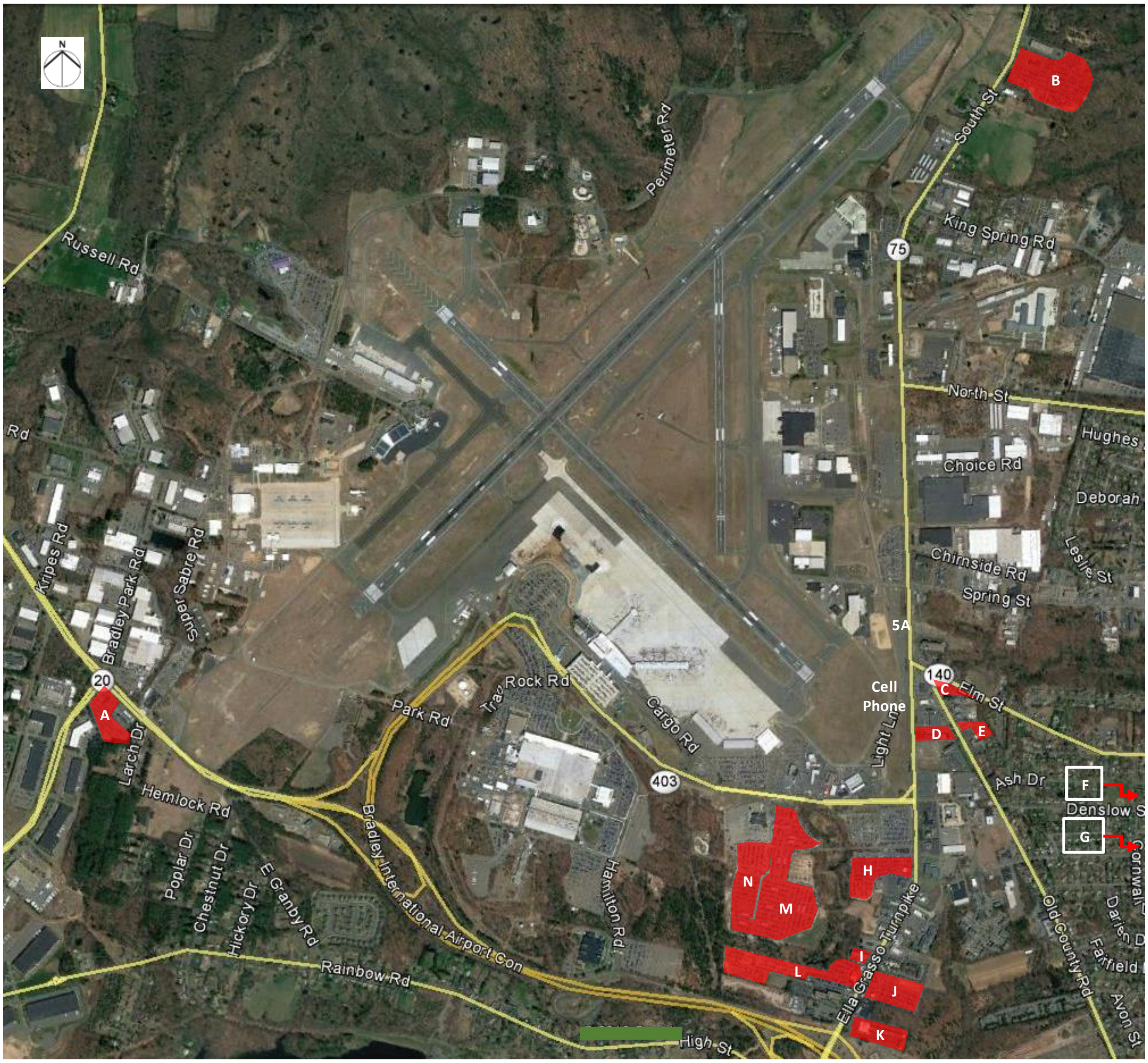
Source: CAA, 2016

While on site, DESMAN did observe high levels of activity at the largest off-airport parking locations. However, the activity levels at the hotel properties that also provide long-term airport parking were not identifiable, due to the fact that hotel patrons do not appear to be segregated from long-term parkers at most locations.

An examination of aerial photographs dated April 2016 provided an additional data point. In these aerials, aside from the hotel properties, all the off-site competing parking locations appear to be very well utilized, with occupancy of the striped spaces in excess of 80%.

While this utilization data is mostly anecdotal, in combination with the high level of demand observed first-hand at all the on-airport parking facilities, it is reasonable to conclude that, during peak demand periods, there is currently little parking capacity available to serve the airport.

Figure 4-15 – Competing Off-Airport Parking Facilities



Source: DESMAN, 2016

4.8.3 Current Parking Rates

Table 4-53 presents the current rates charged at each of the competing off-airport parking locations.

Table 4-53 – Existing Parking Rates Charged by Off-Airport Competitors

Facility ID	Facility Name/ Owner/Operator	Estimated Capacity	Type of Operation	Current Parking Rates (per day)
A	Z Airport Parking	790	Self-Park/Valet	$9.99/Self-Park; $11.99/Valet
B	Executive Valet Parking	1,760	Valet	$10.00
C	Dollar Airport Parking	140	Valet	$7.99
D	Days Inn	146	Self-Park	$7.00
E	Econo Lodge Inn & Suites	190	Self-Park	$6.00
F	Roadway Inn & Suites	290	Self-Park	$6.00
G	Baymont Inn & Suites	132	Self-Park	$6.00
H	LAZ Fly Economy Parking	1,060	Self-Park/Valet	$5.95/Self-Park; $9.95/Valet
I	La Quinta Inn & Suites	107	Self-Park	$7.50
J	LAZ Fly Premier Parking	859	Self-Park	$7.49
K	Quality Inn	191	Self-Park	$6.00
L	LAZ Fly Premier Parking	1,360	Valet	$11.99
M	Roncari Valet Parking	3,410	Valet	$10.95
N	Galaxy Self-Park	1,047	Self-Park	$5.95

Source: Company Websites, 2016

As noted with the on-airport parking rates, each of the off-site competitors charges a 6.35% tax (paid to the State of Connecticut) on top of the daily parking charge.

It is also important to note that, while these are the posted rates on the various company's websites and advertised at the facilities, a number of these facilities offer discount coupons, frequent parker programs or other incentives which many reduce the per day price paid to park.

4.9 CURB-FRONT TRAFFIC

In order to determine the capacity of the airport curb front to accommodate future levels of vehicular activity, it is necessary to first understand the functionality of the curb front during current periods of peak demand. For this reason, observations of traffic flow and congestion were performed at the airport on the same day as the observations of parking activity, Tuesday, November 15, 2016. On this day, vehicle volumes were recorded for a sample time period, traffic backups were noted, and pictures were taken of the current conditions.

The following sections present the existing traffic conditions observed at the airport on a peak travel day.

4.9.1 Observations

Vehicle volumes were observed on the Departures level of the airport roadway from 6AM – 6:30AM on the survey day. This time period was chosen, based on statements from the CAA and others familiar with the airport, as a period of peak departure activity. During this time period, the number of different types of vehicles that passed the terminal building on this level were recorded. The type and number of vehicles recorded were as follows:

- Passenger Cars: 114
- Taxi Cabs: 4
- Parking Shuttles: 32
- Hotel Shuttles: 5
- Rental Car Shuttles: 9
- Other Vehicles: 3

A few items of note related to the observations:

- It was impossible to determine which of the passenger cars were family or friends dropping fliers off at the airport and which were riding sharing services (i.e. Uber, Lyft, etc.).
- The “Parking Shuttle” figure includes both those from off-site competitors and the CAA’s shuttles from the more remote on-airport parking lots.
- The “Other Vehicles” category accounts for Police vehicles, delivery trucks and vehicles that did not fall into another category.

The majority of loading and unloading activity observed occurred at the near end of the terminal building, closest to the entrance to the airport roadway. This is the location of the Southwest and JetBlue ticket counters, as well as the location of the pick-up/drop-off airport for the airport employee shuttle, although no employee shuttles were observed during this time period. Unloading, especially by passenger cars, seemed to occur as close as possible to the near end of the terminal building – this is the most visible area of curb to a vehicle approaching the terminal. Many vehicles, including CAA and third-party parking shuttles, unloaded from the 2nd lane from the curb, although parking shuttles were the most frequent culprits. This type of activity even occurred, on occasion, when the curb lane was open.

In addition to the traffic volumes and unloading activities, in general, passenger vehicles were observed to slow down significantly upon approach to the terminal looking for an open curb to unload. This, in turn, caused any vehicles behind the slowing vehicle to also slow down. Several passenger vehicles were also observed parked on the airport roadway, near the employee shuttle stop, with no one in the vehicles.

From 6AM-7AM on the survey day, vehicles were never observed queuing past the end of the bridge on the departure level. In other words, no traffic backups were observed while DESMAN was on-site.

4.9.2 Projected Parking Needs

This section presents DESMANS projections of future airline passenger and Bradley employee parking needs, based on the "Airport Master Plan Working Paper #2 Aviation Activity Forecasts", May 2017, as well as a summary of the anticipated future changes in the CAA parking inventory. Projected enplanement growth by year (2017 to 2037) was applied to existing (2016) peak on-airport public and employee parking accumulations to project future parking need. Information provided by the CAA was used to determine the magnitude and timing of changes to the existing parking inventory.

4.10 PASSENGER PARKING DEMAND PROJECTIONS

Table 4-54 presents the results of the parking projections.

Table 4-54 – Projected Parking Needs

Year	Master Plan Enplanement Projections	Peak Utilization of Airport Public Parking
2016 (Actual)	3,025,166	5,926
2017	3,187,046	5,931
2018	3,276,184	6,097
2019	3,464,001	6,446
2020	3,595,967	6,692
2021	3,621,511	6,739
2022	3,640,759	6,775
2023	3,713,574	6,911
2024	3,785,988	7,046
2025	3,858,679	7,181
2026	3,931,609	7,317
2027	4,003,164	7,450
2028	4,073,619	7,581
2029	4,143,686	7,711
2030	4,212,471	7,839
2031	4,278,185	7,962
2032	4,341,075	8,079
2033	4,403,152	8,194
2034	4,464,796	8,309
2035	4,527,750	8,426
2036	4,591,591	8,545
2037	4,653,118	8,659

Source: DESMAN

Beginning with the Master Plan Enplanement Projections from 2017 to 2037, existing peak parking utilization was increased in line with enplanement growth. However, we assumed a 5 percent reduction in parking demand in 2017, based on an increase in the use of ride-sharing services such as Uber, Lyft and other car services. The table shows that at an enplanement level of about 3.6 million passengers, the parking system will approach its current capacity of 6,775 public parking spaces. At 4.6 million enplanements, the demand for passenger parking is projected to exceed the existing supply of public parking by more than 1,400 vehicles.

4.10.1 Parking Supply Changes

While parking demand is projected to increase in the future as enplanements grow, several projects will also impact the supply of parking owned and controlled by the CAA. These projects, the Consolidated Rental Car Facility (CONRAC for short) and the construction of a second Terminal, will both impact the available supply of parking, but will not, by agreement, reduce the total available supply of parking below the existing number of spaces.

Construction of the CONRAC facility, which will house all of the rental car companies when complete, as well as the associated roadway reconfiguration, will eliminate all of parking in the existing Lot 1 (520 spaces) and a portion of the spaces in the existing Lot 2B and Garage Overflow Lot (265 of 929 total spaces will be eliminated). In order to maintain at least the current number of parking spaces while construction is underway, a new Lot 1 will be built containing 794 spaces, which will be open prior to the closure of the existing Lot 1. In addition, a planned reconfiguration of Lot 2B that is expected to coincide with the completion of the CONRAC will result in that lot containing 890 spaces. Finally, the CONRAC itself is expected to contain approximately 540 covered spaces and 300 ground-level spaces (840 total spaces) for use by the CAA. The net result of these projects will be the addition of 1,075 spaces to the CAA’s parking supply by the end of 2018 (520+929=1,449 existing spaces; 794+890+840=2,524 spaces in 2018).

As for the new Terminal building, it is anticipated that construction of this facility will eliminate the 794-space Lot 1 – the re-built Lot 1 is seen as temporary construction. With the elimination of these spaces, the net change in the CAA’s parking supply from the current level will be an increase of 281 spaces (1,075 spaces added minus 794 spaces in Lot 1).

Due to the fact that the timing of construction for the new Terminal building is unknown, for the purposes of the parking analysis, it has been assumed that construction will begin in 2026, eliminating Lot 1 at that time.

Table 4-55 presents the anticipated supply of public parking owned and controlled by the CAA each year from 2017 through 2037, as well as the total number of spaces in the CAA’s inventory in each year.

Table 4-55 – Projected CAA Parking Inventory

Year	Projected CAA Public Parking Inventory	Projected CAA Employee Parking Inventory	Net Change in CAA Inventory vs. 2016
2016 (Actual)	7,175	920	0
2017	7,175	920	0
2018	7,805	965	1,075
2019	7,805	965	1,075
2020	7,805	965	1,075
2021	7,805	965	1,075
2022	7,805	965	1,075
2023	7,805	965	1,075
2024	7,805	965	1,075
2025	7,805	965	1,075
2026	7,011	965	281
2027	7,011	965	281
2028	7,011	965	281
2029	7,011	965	281
2030	7,011	965	281
2031	7,011	965	281
2032	7,011	965	281
2033	7,011	965	281
2034	7,011	965	281
2035	7,011	965	281
2036	7,011	965	281
2037	7,011	965	281

Source: Connecticut Airport Authority

4.11 FUTURE ADEQUACY OF THE CAA PARKING INVENTORY

In addition to the need to account for the anticipated growth in passenger parking demand, it is also necessary to factor-in the anticipated growth in the demand for employee parking when determining the adequacy of the CAA's future parking supply. Similar to the way in which future passenger parking demand was calculated, enplanement growth projections we used to calculate the anticipated growth in peak employee parking demand. However, unlike the growth in passenger demand, employee parking demand was not assumed to be reduced by the effects of ride-sharing services. This projection methodology was used in place of any actual projections of employment growth at the Airport, which were unavailable at the time of this project.

As shown in **Table 4-56**, based on observed peak utilization of employee parking of 905 vehicles, it has been projected that peak demand for employee parking will reach nearly 1,400 spaces by 2037.

Table 4-56 – Projected Adequacy of the CAA Parking Inventory (w/ New Terminal)

Year	Master Plan Enplanement Projections	Peak Utilization of CAA Public Parking	Projected CAA Public Parking Inventory	Anticipated Peak Public Surplus/ (Deficit)	Projected CAA Employee Parking Inventory	Peak Utilization of Airport Employee Parking	Projected CAA Total Parking Inventory	Anticipated Total Peak Surplus/ (Deficit)
2016 (Actual)	3,025,166	5,926	7,175	1,249	920	905	8,095	1,264
2017	3,187,046	5,931	7,175	1,244	920	953	8,095	1,211
2018	3,276,184	6,097	7,805	1,708	965	980	9,170	2,093
2019	3,464,001	6,446	7,805	1,359	965	1,036	9,170	1,687
2020	3,595,967	6,692	7,805	1,113	965	1,076	9,170	1,402
2021	3,621,511	6,739	7,805	1,066	965	1,083	9,170	1,347
2022	3,640,759	6,775	7,805	1,030	965	1,089	9,170	1,306
2023	3,713,574	6,911	7,805	894	965	1,111	9,170	1,148
2024	3,785,988	7,046	7,805	759	965	1,133	9,170	992
2025	3,858,679	7,181	7,805	624	965	1,154	9,170	835
2026	3,931,609	7,317	7,011	(306)	965	1,176	8,376	(117)
2027	4,003,164	7,450	7,011	(439)	965	1,198	8,376	(271)
2028	4,073,619	7,581	7,011	(570)	965	1,219	8,376	(423)
2029	4,143,686	7,711	7,011	(700)	965	1,240	8,376	(575)
2030	4,212,471	7,839	7,011	(828)	965	1,260	8,376	(723)
2031	4,278,185	7,962	7,011	(951)	965	1,280	8,376	(865)
2032	4,341,075	8,079	7,011	(1,068)	965	1,299	8,376	(1,001)
2033	4,403,152	8,194	7,011	(1,183)	965	1,317	8,376	(1,135)
2034	4,464,796	8,309	7,011	(1,298)	965	1,336	8,376	(1,268)
2035	4,527,750	8,426	7,011	(1,415)	965	1,355	8,376	(1,404)
2036	4,591,591	8,545	7,011	(1,534)	965	1,374	8,376	(1,542)
2037	4,653,118	8,659	7,011	(1,648)	965	1,392	8,376	(1,675)

Source: DESMAN

As shown in the table, the anticipated inventory of public parking at the Airport is expected to be inadequate to satisfy the peak demand at a level of approximately 3.9 million enplanements.

It is important that the master plan identify and reserve parcels which can be utilized for surface parking or structured parking when enplanements grow beyond 3.9 million. At 4.65 million enplanements, nearly 1,700 additional spaces will be needed.

If we assume that no new terminal is built, the outlook becomes more positive from a parking perspective. As presently envisioned, the proposed new terminal building would eliminate nearly 800 spaces from the parking inventory. As shown in **Table 4-57**, with these additional spaces, the projected public parking inventory should be adequate to satisfy the parking demand associated with around 4.2 million enplanements.

Table 4-57 – Projected Adequacy of the CAA Parking Inventory (w/o New Terminal)

Year	Master Plan Enplanement Projections	Peak Utilization of CAA Public Parking	Projected CAA Public Parking Inventory	Anticipated Peak Public Surplus/ (Deficit)	Projected CAA Employee Parking Inventory	Peak Utilization of Airport Employee Parking	Projected CAA Total Parking Inventory	Anticipated Total Peak Surplus/ (Deficit)
2016 (Actual)	3,025,166	5,926	7,175	849	920	905	8,095	1,264
2017	3,187,046	5,931	7,175	844	920	953	8,095	1,211
2018	3,276,184	6,097	7,805	1,708	965	980	9,170	2,093
2019	3,464,001	6,446	7,805	1,359	965	1,036	9,170	1,687
2020	3,595,967	6,692	7,805	1,113	965	1,076	9,170	1,402
2021	3,621,511	6,739	7,805	1,066	965	1,083	9,170	1,347
2022	3,640,759	6,775	7,805	1,030	965	1,089	9,170	1,306
2023	3,713,574	6,911	7,805	894	965	1,111	9,170	1,148
2024	3,785,988	7,046	7,805	759	965	1,133	9,170	992
2025	3,858,679	7,181	7,805	624	965	1,154	9,170	835
2026	3,931,609	7,317	7,805	488	965	1,176	9,170	677
2027	4,003,164	7,450	7,805	355	965	1,198	9,170	523
2028	4,073,619	7,581	7,805	224	965	1,219	9,170	371
2029	4,143,686	7,711	7,805	94	965	1,240	9,170	219
2030	4,212,471	7,839	7,805	(34)	965	1,260	9,170	71
2031	4,278,185	7,962	7,805	(157)	965	1,280	9,170	(71)
2032	4,341,075	8,079	7,805	(274)	965	1,299	9,170	(207)
2033	4,403,152	8,194	7,805	(389)	965	1,317	9,170	(341)
2034	4,464,796	8,309	7,805	(504)	965	1,336	9,170	(474)
2035	4,527,750	8,426	7,805	(621)	965	1,355	9,170	(610)
2036	4,591,591	8,545	7,805	(740)	965	1,374	9,170	(748)
2037	4,653,118	8,659	7,805	(854)	965	1,392	9,170	(881)

Source: DESMAN

If we incorporate the principle of practical capacity, the outlook becomes less positive. As discussed previously, if we assume that 95% utilization of the CAA's spaces is the point at which the system is at capacity, this means that only 8,711 of the CAA's 9,170 parking spaces can fill before the system has reached its practical capacity. In this case, the CAA's parking facilities will not be able to accommodate additional peak parking demand beyond 4.0 million enplanements.

4.12 SUMMARY OF FACILITY REQUIREMENTS

This chapter identified Bradley International Airport's capacity and development needs for existing and anticipated activity levels. Largely based on the aviation activity forecasts presented in **Chapter 3**, the recommendations determined in this chapter will form the basis of the development concepts discussed in **Chapter 5**. The following summarizes the recommendations presented in this chapter.

Property / Land Use

- Preserve areas for terminal and commercial apron expansion.
- Preserve and promote compatible land use for potential Runway 15-33 extension.
- Preserve space for future GA facilities on the east side of the airfield – aprons, hangars, fuel farm, etc.
- Preserve space for expansion of FBO facilities
- Continue to promote development on the north side of the airfield along Perimeter Rd., adjacent to the Embraer facility and in proximity to the Runway 24 end.
- Continue to work with local government entities to sustain compatible land use around the airport.

Airfield Facilities

- Permanently close Runway 1-19, Mitigate Hot Spot 1
- Provide parallel taxiway extensions J and T to reduce active runway crossings.
- Extend Runway 15 end to mitigate direct access from the FedEx apron.
- Extend Runway 33 end to mitigate direct apron to runway access from the north and south. Retain current threshold and approach light location.
- Extend Runway 15/33 to 7,600ft.
- Upgrade Runway 33 MALS-F system to MALSR.
- Construct holding bays for Runway 6 and Runway 33.
- Expand existing deicing facility.

FAA Airfield Design Standards

- Provide taxiway clearance for ADG-V, TDG-5 aircraft between frequently used Runway ends 6 and 24.
- Mitigate acute angle intersections of Taxiway C/E and Taxiway E/T by constructing right angle intersections.
- Realign or remove access road beyond the Runway 24 end, access road goes through the extended RSA.
- Realign Taxiway R to mitigate direct apron to runway access.
- Increase the blast pad on the Runway 6 end to comply with D-V standards (currently 240' should be 400' in length).
- Relocate Glideslope Antenna/Shelter on the Runway 24 End or apply for MOS. Facility is the ROFA.
- To comply with D-V design standards, increase shoulder width on Runway 6-24 from 25' to 35'

- To comply with C-IV design standards, Runway 15-33 will need the following improvements:
  - Regrade RSA so that transverse grades are between 1.5% and 3.0% away from the runway edge
  - Relocate drainage ditches and structures to a distance 250’ beyond the runway centerline to comply with standard RSA width.
  - Relocate Glideslope Antenna/Shelter on 33 End or apply for modification of FAA design standards (MOS). Facility is located within the ROFA.
- Regrade Taxiways J and E pavement so transverse grades are no greater than 1.5% away from the taxiway centerline on Taxiways J and E.
- Regrade Taxiways C and S pavement so transverse grades are at least 1.0% away from the taxiway centerline on Taxiways C and S.
- As taxiway projects occur, improve taxiway fillets to comply with new FAA standards.
- Increase the blast pad size on the Runway 33 end to comply with C-IV standards.

Terminal

- Forecast gate demand will require additional positions beyond the existing 23 gates, starting in 2022 with 24 gates, and a facility total of 29 gates in 2037.
- Check-In demand will grow from 10 positions and a total of 41,984 square feet of space in 2017, to approximately 11 positions and a total of 59,717 square feet of space by 2037. There will be a decreasing proportion of full-service positions and increase in self-service kiosks and bag drops.
- Security demand is driven by an assumed PreCheck proportion of 40%, with 14 lanes needed in 2017, and 20 lanes by 2037 (this may decrease with changes in technology that enhance throughput).
- Holdrooms currently do not meet existing demand. Current area is 41,350 square feet, with an existing demand of 62,041 square feet, and a forecast demand of 89,509 square feet by 2037.
- Concession areas are assumed to require 15% of total usable terminal area, and currently do not meet existing demand. Current area is 37,750 square feet, with an existing demand of 69,919 square feet, and a forecast demand of 100,034 square feet by 2037.
- Baggage Screening should include a centralized inline system (with screening removed from the ticketing hall).
- Current domestic baggage claim hall 32,400 square feet, with total demand for combined international and domestic demand is 56,275 square feet by 2022 and 65,300 square feet by 2037.

Parking and Access

- Provide additional public parking (structure or surface) to accommodate PAL demands.
  - 5900 spaces needed to accommodate 3,000,000 enplanements (1,264 space existing surplus).
  - 8600 spaces needed to accommodate 4,600,000 enplanements (1,675 spaces needed by 2037).
  - Improve proximity of parking locations to the terminal.
- Provide additional rental car ready/return parking to accommodate PAL demands.
- Relocate cell phone lot to Schoephoester Road.

- Consider roadway improvements to the public access road (Schoephoester Road) to improve efficiency and customer convenience.
- Install automated parking access and revenue control system.

General Aviation

- Provide 18,000 SY of additional apron space to accommodate PAL 4 demands.
- Additional GA development including fueling and deicing facilities are required to accommodate future GA demand.
- Provide additional hangars for projected increase in GA based jet aircraft on an "as needed" basis, as evidence of demand increases.

5 AIRPORT DEVELOPMENT CONCEPTS

To satisfy the facility requirements identified in **Chapter 4**, many of the concepts, site configurations, and development options were created and reviewed for the various components of the airport. In many circumstances, multiple alternatives were identified, but eliminated early in the planning process. The concepts that were deemed most reasonable to support the long-term operational sustainability of the Airport were carried forward and are presented herein.

This chapter includes many separate concepts and configurations for runways, taxiway, aprons, passenger terminal facilities, etc., and concludes with initial recommendation of a Preferred Development Strategy for the overall airport. The number of potential recommendations are substantial; however, it is emphasized that although projects may be desired, they many not necessarily be financially or environmentally feasible. As such, recommendations presented in this chapter may be further narrowed during the environmental review and financial planning components of the Master Plan. The overall effort will refine the final strategy into actionable projects for implementation in phases.

5.1 CONCEPT EVALUATION

Regardless of timeframe or activity level, the overarching principals guiding facility recommendations are to provide an elevated level of customer service and promote regional economic wellbeing, while accommodating the evolving business model of the airlines and airport tenants. For some functional areas – such as the airfield – the logical recommendations were distinctly apparent as they are driven largely by FAA design standards and existing infrastructure. In contrast, improvements related to the passenger terminal building and automobile parking have more variability in their concepts. This is due to various existing and forecasted space deficiencies, potential financing and implementation challenges, and their influence on surrounding Airport facilities.

During the identification of facility requirements, it became evident that the Master Plan would not consist of overarching or competing alternatives for development of the airport. Rather, the concepts and alternatives presented consist of a series of separate improvements that are assembled into the overall strategy. As such, individual components are reviewed and recommended separately to develop the preferred improvements program.

5.2 RUNWAY ALTERNATIVES

Bradley International Airport (BDL) currently operates three runways, each with unique capabilities and constraints. Each runway was evaluated based on its operational requirements, with the identified improvements provided below. It was important to evaluate the strengths and weaknesses to identify the best methods to improve airfield operations with regard to the runway infrastructure. Each of the three runways is discussed below.

5.2.1 Runway 6-24

Based on the demands outlined in **Chapter 4**, the current length of the primary Runway 6-24 (9,510 feet) is adequate and is anticipated to remain adequate throughout the forecast period. The need for additional runway length was reviewed with the potential additional aircraft types, including widebody aircraft, and further non-stop destinations, particularly western Europe included **Chapter 3**. Based on this review, Runway 6-24 is adequate in length.

The runway width of 200 feet exceeds the identified needs, and provides support for occasional use by aircraft larger (i.e., Group VI) than the future design aircraft. Additionally, the existing instrument procedures and navigational aids are also sufficient throughout the planning period.

In summary, it is recommended that Runway 6-24 be maintained at its present length and capability throughout the planning period. No development alternatives are needed.

In order to satisfy operational efficiency, FAA design standards, and access to and from the runway, improvements and expansions to the associated taxiways systems serving Runway 6-24 were identified. These taxiway concepts are discussed in **Section 5.3**.

5.2.2 Runway 15-33

The runway length evaluation identified that crosswind Runway 15-33 is deficient in length to serve as the secondary runway for many airline and air cargo operations. An optimum length was determined to be 7,600 feet, based on the Runway Length Analysis in **Chapter 4**, or 753 feet longer than currently provided (i.e., 6,847').

A typical runway extension would include corresponding extension of the Runway Safety Area (RSA), Runway Object Free Area (ROFA), and Runway Protection Zones (RPZ) to provide unrestricted use of the extended runway for takeoff and landings. However, BDL does not own the required property to extend these required FAA design standards, and the location of existing public roads, private property, and commercial developments make such an extension impractical. As such, a traditional runway extension alternative was not developed as part of the Master Plan. However, a runway extension with the application of Declared Distances was identified as a feasible alternative. This alternative provides the necessary runway pavement, but may avoid extensions of the RSA, ROFA, and RPZs.

Declared Distances are used in this alternative as an incremental improvement technique that provides the key benefits of the runway extension (i.e., additional takeoff distance and landing distance), without the unfeasible extension of certain design standards. This alternative includes minor pavement extensions on both runway ends to provide a 7,600-foot runway length.

Figure 5-1, illustrates a 253-foot extension to the southeast Runway 33 end, but retains the landing threshold in the current location. As such, takeoff distances on Runway 33 are increased, but landing distance is not. This prevents the need to extend the RSA, ROFA, RPZ to the southeast across the Ella Grasso Turnpike and Schoephoester Road, and retains the Runway 33 Instrument Landing System (ILS) and approach lights in their current location.

Figure 5-2 illustrates the northwest Runway 15 end, with conversion of 500 feet of existing paved overrun into full strength runway. Again, the threshold is retained in the existing location. In addition, an Engineered Materials Arresting System (EMAS) bed is included in the concept, which enables the additional 500 feet for runway to be usable for both takeoffs and landings on Runway 33 without extending the RSA or ROFA. The Runway 33 end is the predominant use end based on prevailing winds. Thus, the EMAS bed is important on only this end of the runway. On the Runway 15 end, the additional 500' is usable for takeoff.

The formal FAA declared distances associated with this alternative are illustrated in **Figure 5-3** and listed below.

Table 5-1 – Runway 15-33 Future Declared Distances

Declared Distances	Runway 15	Runway 33
Takeoff Runway Available (TORA)	7,600'	7,600'
Takeoff Distance Available	7,600'	7,600'
Accelerate Stop Distance Available (ASDA)	7,347'	7,600'
Landing Distance Available (LDA)	6,847'	7,347'

The advantages of the alternative include:

- Provides 7,600' for key takeoff and landing movements
- Avoids the need for property acquisition or road relocations
- Avoids potential environmental impacts
- Takes advantage of existing pavement overrun
- Cost-effective alternative to extend runway length
- Mitigates direct apron to runway access on both ends
- Improves airfield safety

Potential disadvantages include:

- Requires multiple taxiway extensions to new runway ends
- Requires relocation of a portion of the airport service road
- Requires additional facility maintenance
- Requires pavement removal on both ends

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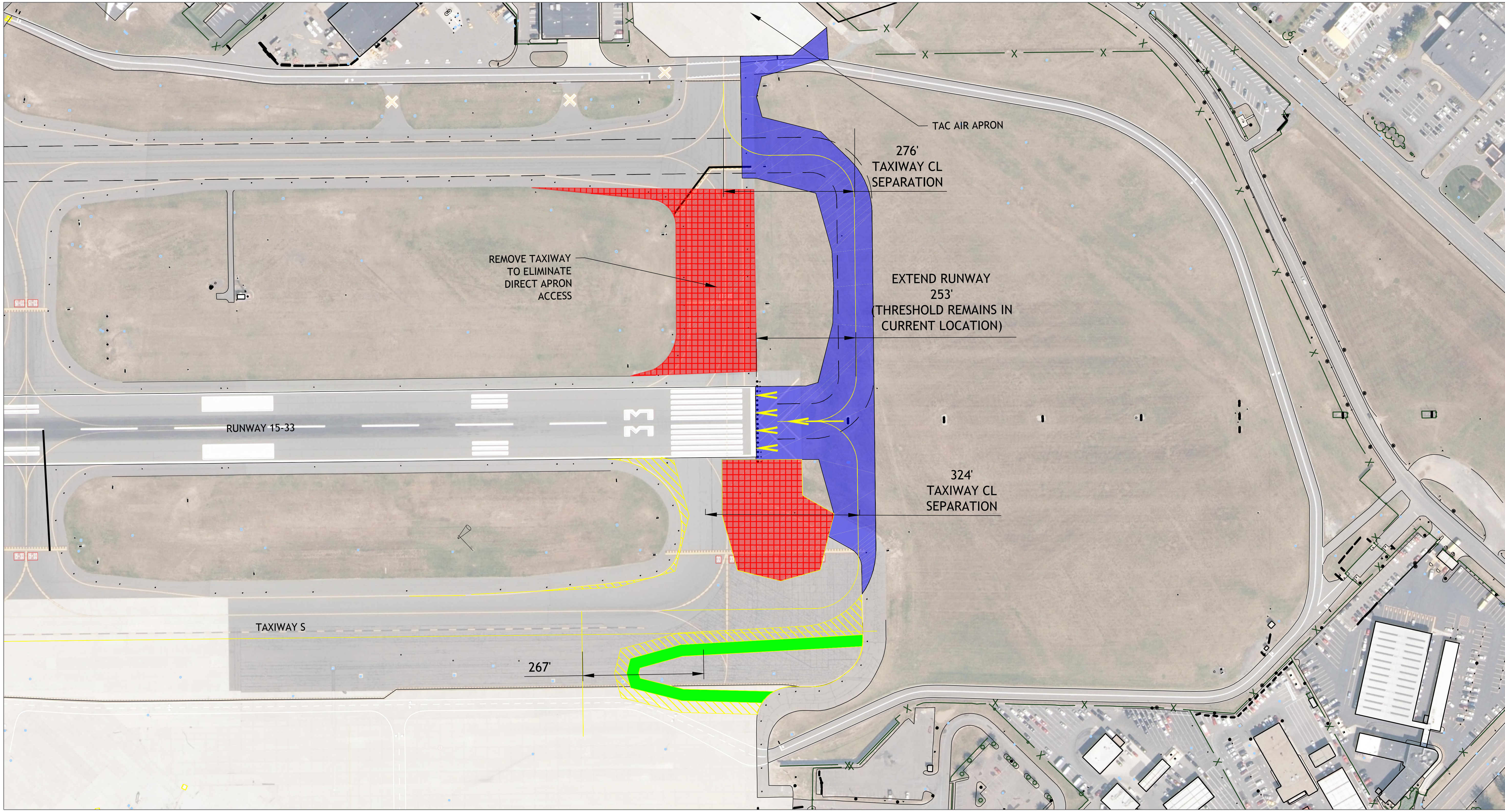

GRAPHIC SCALE (FEET)

0 100 200

LEGEND

Pavement Removal

Proposed Pavement

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MASTER PLAN UPDATE

Figure 5-1

Runway 33 End

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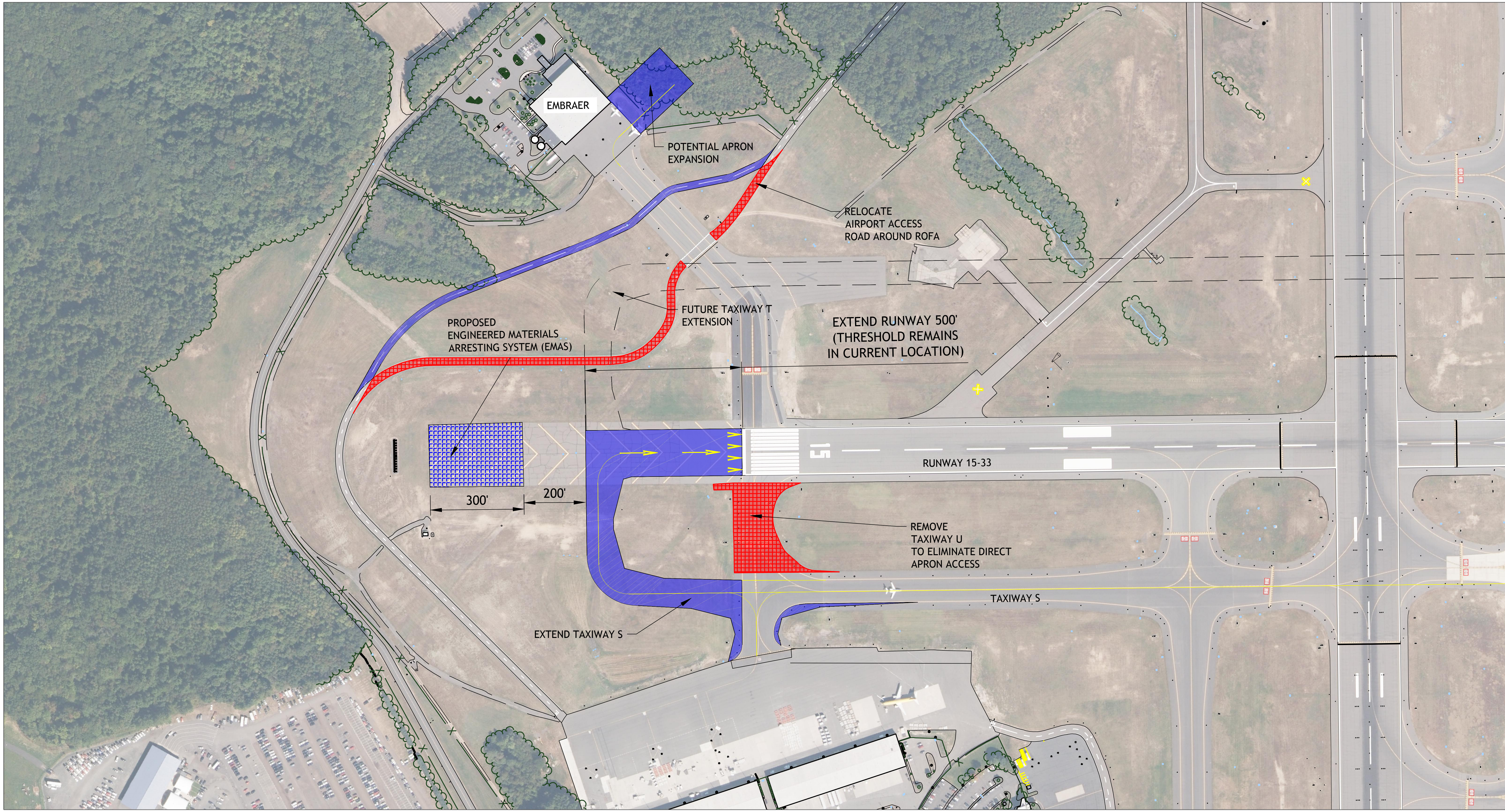

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MASTER PLAN UPDATE

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LEGEND

Pavement Removal

Proposed Pavement

Figure 5-2
Runway 15 End

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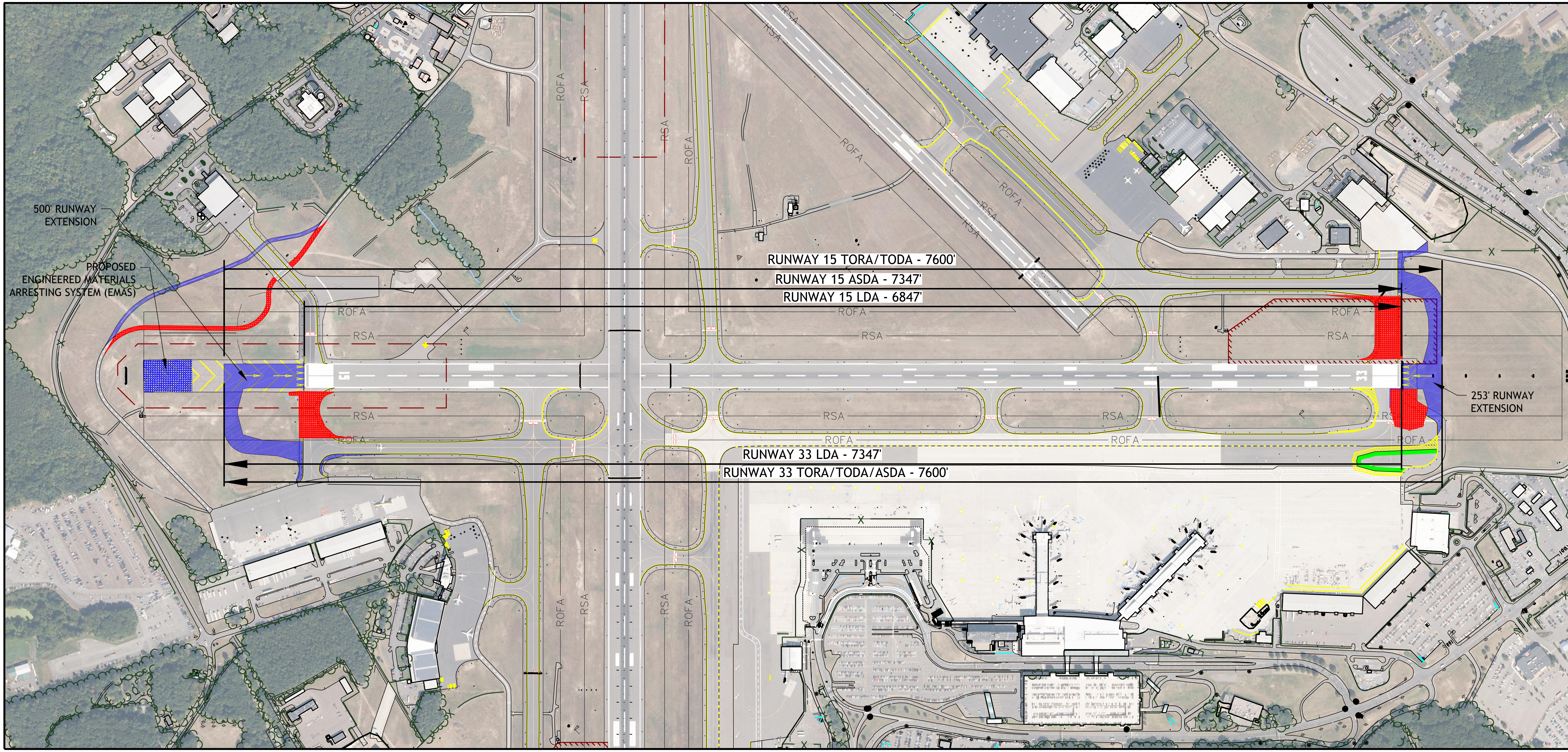

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MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)

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LEGEND

Pavement Removal

Proposed Pavement

DECALRED DISTANCES TABLE		
	RUNWAY 15	RUNWAY 33
TODA	7,600'	7,600'
TORA	7,600'	7,600'
ASDA	7,347'	7,600'
LDA	6,847'	7,347'

TODA = TAKEOFF DISTANCE AVAILABLE
TORA = TAKEOFF RUN AVAILABLE
ASDA = ACCELERATE STOP DISTANCE AVAILABLE
LDA = LANDING DISTANCE AVAILABLE

Figure 5-3

Runway 15-33 Extension
(with Future Declared Distances)

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5.2.3 Runway 1-19

As discussed in **Section 4.3.3**, Runway 1-19 currently facilitates minimal activity at the Airport, and is not employed for capacity, nor is it anticipated to be needed throughout the planning period. Constraints such as its one-way operation, and its intersection with the other two runways further restrict its use. As such, it is recommended that Runway 1-19 be permanently closed.

As discussed in later section, the runway pavement may be converted into a new alignment for Taxiway E.

5.3 TAXIWAY AND HOLDING AREA ALTERNATIVES

As activity levels increase, and congestion at airport Hot Spots become more of a concern, there are several potential taxiway improvements to consider that address existing and future shortcoming of the taxiway facilities. The need and benefit of each potential taxiway concept vary and include the following:

- Avoiding or reducing the need for aircraft to cross a runway – a safety improvement
- Reduced taxi times and distances – improved efficiency and reduced congestion
- Eliminate or improve Hot Spots – a safety improvement
- Elimination of direct apron-to-runway access – a design standard and safety benefit
- Improved hold locations – an improvement in operational efficiency

5.3.1 East Airfield Area

As depicted in **Figure 5-4**, multiple improvements concepts were developed for the area around the Runway 19 intersection with Runway 6-24, referred to as the Northeast Airfield Area. This location includes Hotspot 1. The overall alternative for this location consists of a set of related concepts.

Hotspot 1 Elimination

With the closure of Runway 1-19, the runway pavement between Runway 6-24 and Taxiway 'C' would be removed. This will reduce confusion to pilots, prevent inadvertent runway incursions, and returns the area to maintained grass. The removal of this intersection eliminates Hotspot 1. Other changes to the northeast airfield area will further improved aircraft flow and safety, as discussed below.

Taxiway E Realignment

Upon the Runway 1-19 closure, it is recommended that the existing runway pavement be converted into a new alignment for Taxiway 'E'. This concept relocates Taxiway 'E' and provides substantial additional space between the taxiway and the adjacent facilities operated by Bombardier, UPS, and TAC Air. The current pavement of Taxiway 'E' would be converted to a taxilane serving these existing tenants, and enables apron expansions as needed.

The pavement of Runway 1-19 is 100' in width, with 20' paved shoulders, for a total width of 140'. The Taxiway 'E' width requirement is 75', with 30' paved shoulders for a total width of 135'

(Taxiway Design Group - TDG 5 standards). Thus, it is recommended that the Taxiway 'E' relocation would be centered on the existing Runway 1-19 pavement.

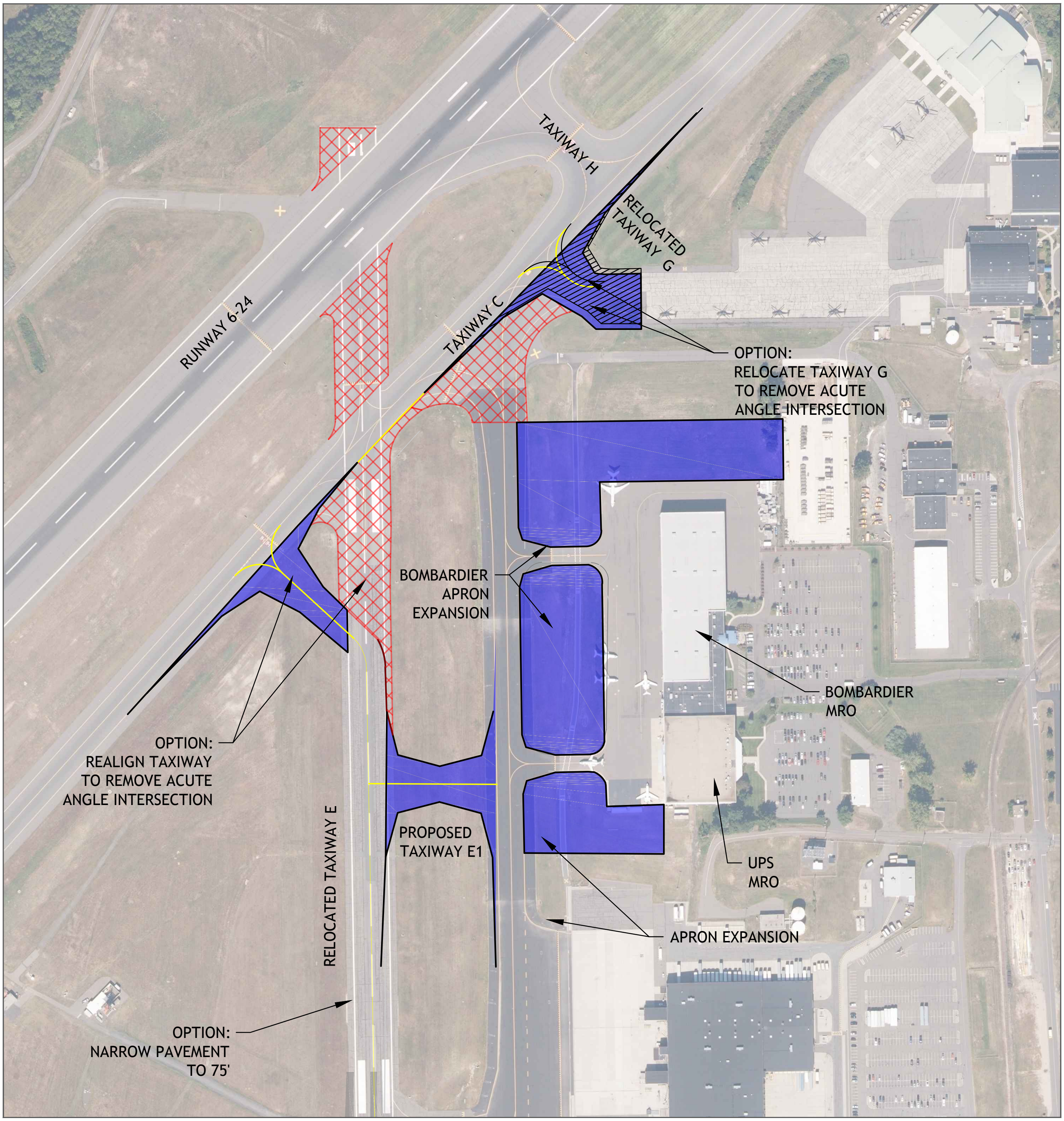
Another option shown is a change to the Taxiway 'E' and 'C' intersection to remove the acute angle. The FAA recommends right-angle intersections for improved visibility. Changing the geometry would satisfy this requirement. A similar change can be made to the south end of the realigned taxiway (currently Runway 1) at the intersection with Taxiway 'T'. **Figure 5-5** illustrates a potential right-angle intersection of Taxiway 'E' and 'T'. However, as shown, this concept could not be implemented until Taxiway 'T' is extended (as discussed in the following section).

Taxiway E1

In order to provide a second access point between the proposed Taxiway 'E' and the Bombardier and UPS aprons, a connector taxiway is illustrated on **Figure 5-4**. This connector (Taxiway 'E1') would be built to TDG 5 standards.

Taxiway G Relocation

In its current configuration, Taxiway 'G', which connects the Connecticut Army National Guard apron to Taxiway 'C', contains an acute angle (**Figure 5-4**). Thus, this intersection could also be improved by reconfiguring the angle, or relocating Taxiway 'G' further northeast and rebuilt it as a standard connector taxiway. Relocation would also centralize the taxiway within the apron area, improve visibility, and reduce potential pilot confusion. Note that relocation must avoid alignment with Taxiway 'H' to prevent direct access to Runway 6-24.



GRAPHIC SCALE (FEET)

0 200 400

LEGEND

Pavement Removal

Proposed Pavement

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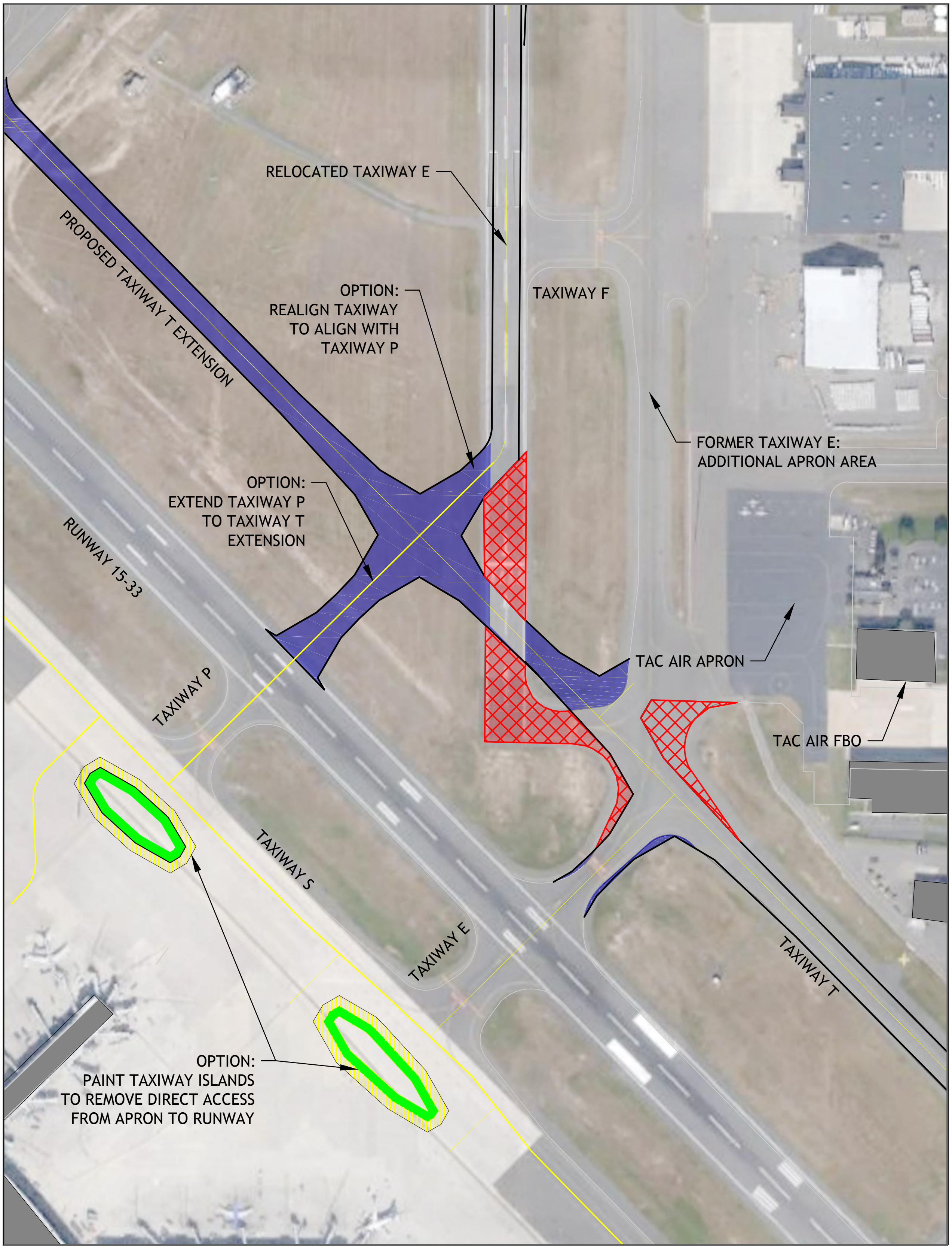
Figure 5-4

Northeast Airfield Area



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LEGEND

Pavement Removal

Proposed Pavement

Figure 5-5
Southeast Airfield Area

5.3.2 Parallel Taxiways

The most significant taxiway projects at BDL is to develop full parallel taxiways on both sides of Runways 6-24 and 15-33. **Figure 5-6** depicts an ultimate buildout and potential phasing of these parallel taxiways. The primary purpose of the additional taxiways is safety, with operational efficiency as a secondary benefit. As shown on the figure, this alternative includes over 12,000 linear feet of an additional taxiway pavement.

Phase 1 would extend the alignment of Taxiway 'T' from the Runway 15 end to the intersection with Runway 6-24. Phase 2 would continue this taxiway, from Runway 6-24 to connect with Taxiway 'W' and become a second full parallel taxiway for Runway 15-33. Finally, Phase 3 would continue Taxiway 'J' northeast to the Runway 24 end, and create a second full parallel taxiway for Runway 6-24.

Implementation of parallel taxiways would alleviate safety concerns associated with Hotspots 2 and 3. Hotspot 2 is at the intersections of Taxiway 'C' and Taxiway 'S', at the northwestern apex of the Terminal Apron. Alleviating traffic on 'S' by extending 'T', would address the issues creating this hotspot. This location is a bottleneck with bi-directional traffic to multiple destinations on the airport, in combination of aircraft exiting Runway 6-24 at Taxiway 'C'. Providing the second parallel taxiway on the opposite side of the runway provides a second flow corridor for aircraft, and would reduce blockages at Hotspot 2.

Similarly, Hotspot 3 is at the intersections of Taxiway 'J' and Taxiway 'S', and faces the same blockage and traffic conflicts as Hotspot 2. The full parallel extension of Taxiway 'T' to the Runway 15 end would have similar advantages.

Parallel taxiways are also used to eliminate the need for active runway crossings, a primary safety goal of FAA. Any runway crossing introduces the potential for a runway incursion; thus, eliminating the need for runway crossing substantially reduced runway incursions. As BDL has existing development, on both sides of both runways (i.e., development is location in all four quadrants of the airport), full parallel taxiway on both sides of the runways are needed to eliminate the need for runway crossing. The Phase 3 extension of Runway J, is recommended for this purpose. Without the taxiway extension all aircraft from the CT Air National Guard, Signature FBO, FedEx, Embraer, etc. that depart on Runway 24 must always cross the activity runway prior to departure.

The full build-out of these parallel taxiways for both runways would address the safety issues of these hotspots and runway crossing. The advantages of the alternative include:

- Addresses safety issue arising at Hotspot 2
- Addresses safety issue arising at Hotspot 3
- Provides dedicated runway access for all aircraft operations at BDL
- Improved operational efficiency, i.e., reduced delays, backups, congestion
- Provides additional capacity

Potential disadvantages include:

- Involves cost of construction for two full parallel taxiways
- Requires relocation of a portion of an existing airport service road
- Additional facility maintenance is required
- Includes wetland and environmental impacts in some areas

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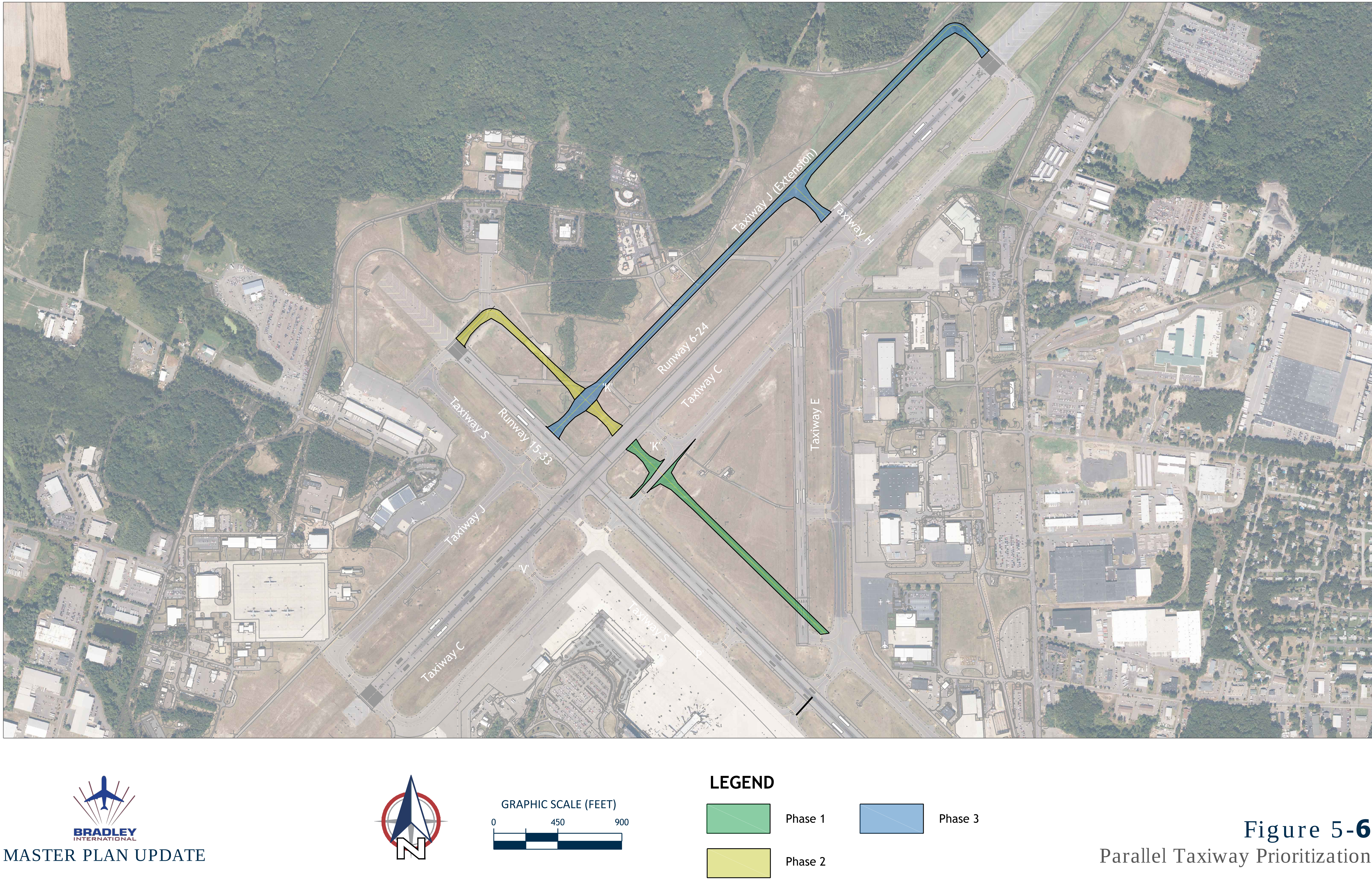

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Figure 5-6
Parallel Taxiway Prioritization

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5.3.3 Terminal Apron Connectivity

Another key issue addressing airfield operations at BDL is direct access between aprons and runways. As discussed in **Chapter 4**, a configuration that allows aircraft to taxi straight from a parking apron to a runway, without a turn, is no longer compliant with FAA design standards. Direct apron-to-runway access currently exists in several locations at BDL, and is now a nonstandard condition as defined in FAA AC 150/5300 13-A, *Airport Design.* These locations should be addressed during any improvements moving forward.

On the main airport terminal apron, there are several taxiways than enable direct access to a runway. As shown on **Figure 5-6,** Taxiways 'P' and 'E' provide this type of connection. The new FAA design standard describes the safety concern as leading to confusion when a pilot typically expects to encounter a parallel taxiway, but instead accidently enters a runway. As Taxiway 'S' is integrated with the terminal apron, a pilot could believe that Taxiway 'P' or 'E' is leading to the parallel taxiway, but they taxi directly to Runway 15-33. A comparable situation exists on the terminal apron with Taxiway 'V' and Runway 6-24.

As reconfiguration of the terminal apron is not generally feasible, an alternative to address these nonstandard conditions are the installation of 'grass Islands'. Installation of such islands may include areas of pavement removal, to require aircraft taxi around as opposed to across, and are an effective measure to address this issue. The islands require aircraft to make turns prior to entering and exiting the runway. While pavement removal and development of 'grass islands' is one option, simply repainting the pavement to create 'painted islands' is a more cost-effective method. By creating these green painted islands at the intersection with Taxiway 'P', 'E', and 'V', the safety issue and nonstandard condition can be addressed. **Figure 5-7** shows the Hotspot 2 area in greater detail, and potential islands to alleviate the direct access issue.

The advantages of this alternative include:

- Prevents direct apron-to-runway access– improved safety
- Is a cost effective method to alleviate a nonstandard condition

Potential disadvantages include:

- Reduces operational efficiency
- Requires revisions to terminal gate taxilanes
- Includes marking and potential lighting complications
- Includes potential impact to snow removal activities

Note: **Figure 5-6** also depicts the conversion of the former Runway 1-19 into the realigned Taxiway 'E', the subsequent removal of unnecessary pavement at its southern end, and the extension of parallel Taxiway 'T'. Finally, this shows a reconfiguration of access to and from the new Taxiway 'E'. This concept proposes extending Taxiway 'P' to intersect with the extended 'T', and then an angled alignment with the new 'E'. The reconfiguration of this section of the airfield would address safety issues, both existing as well as those that arise from both the extension of Taxiway 'T', and realignment of Taxiway 'E'.

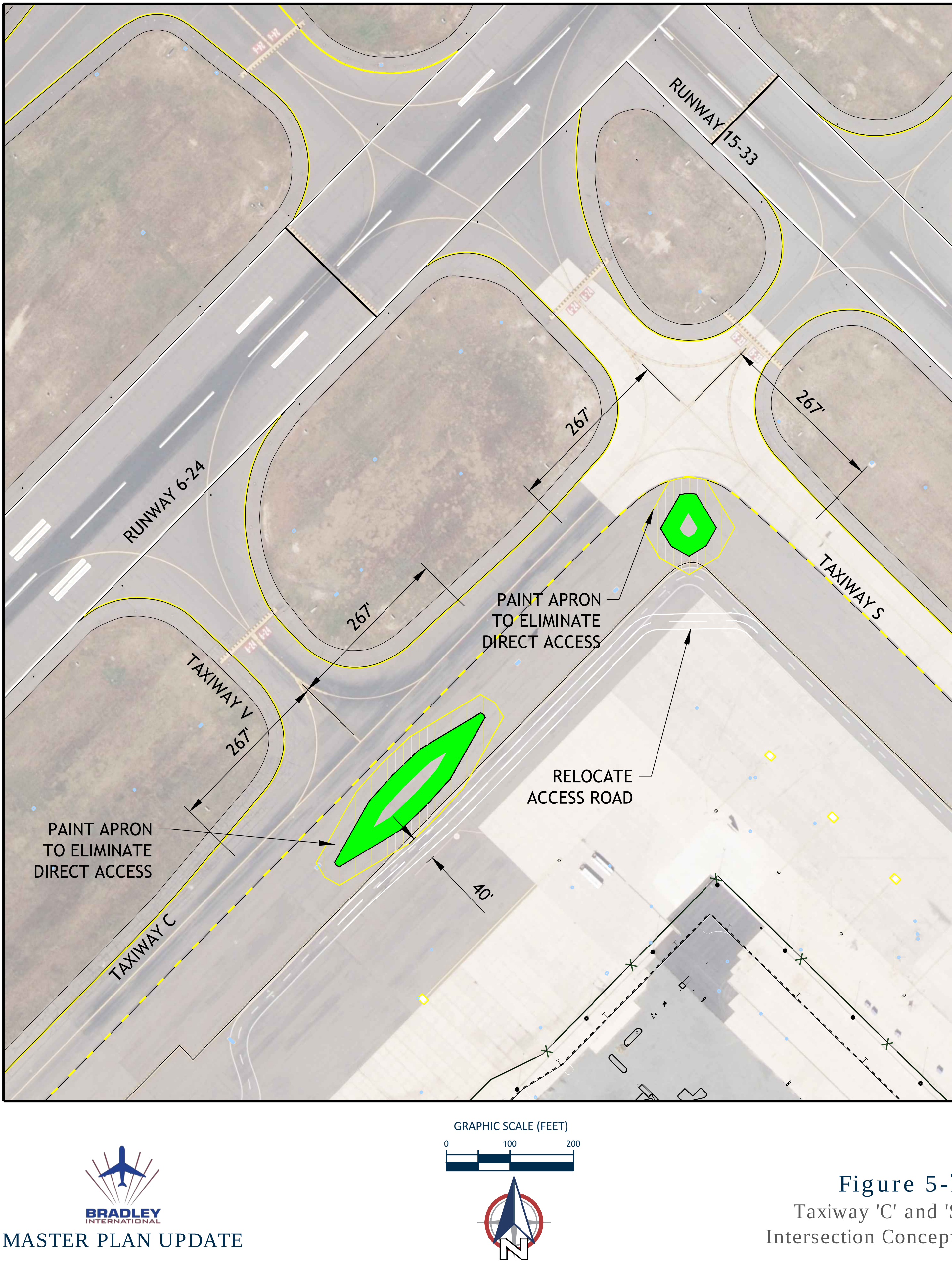

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Figure 5-7
Taxiway 'C' and 'S' Intersection Concept

5.3.4 Runway 6 Area

The north side exit of Runway 6 is served by Taxiway 'R' with a right-turn into 'J'. A review of this location identified two FAA design standard deficiencies in this location that require modifications. Concepts to address these issues are illustrated in **Figure 5-8**.

Primarily, Taxiway 'R' does not currently connect to end of Runway 6; rather its alignment joins the runway approximately 50' short of the end. As such, future upgrades or rehabilitation of the taxiway should include a modified alignment to connect to the very end of the Runway 6.

Additionally, Taxiway 'R' provides a direct apron-to-runway access between the adjacent CT Air National Guard aircraft parking apron and Runway 6. Coordination with the FAA has concluded that this nonstandard condition may need to be addressed for safety purposes, pending discussions with CTANG and the resulting determination will depend on the needs of the CTANG mission. An evaluation of location including a review of several potential configurations to eliminate the nonstandard condition. These configurations were reviewed with the CTANG and FAA to determine a preferred alignment as shown in **Figure 5-8**. The concept depicted requires a minimum amount of new pavement area, with a net reduction in impervious surface. It is also a cost-effective approach for this location.

5.3.5 Runway 24 Area

The existing glideslope antenna and shelter supporting the Runway 24 Instrument Landing System (ILS) is located at the northeast end of the primary runway. Currently, this infrastructure is within the Runway Object Free Area (ROFA) of Runway 6-24, and a designated glideslope critical area extend across Taxiway 'C'. While the glideslope is in use, aircraft on the taxiway must hold to the southwest of the glideslope.

To satisfy FAA design standards, it is recommended that this glideslope is relocated outside of the ROFA. While there is not sufficient space to do so on the south side of the runway (its current location), it can be relocated (along with the corresponding Glideslope Critical Area) to the opposite side of the runway (+400-feet north of the centerline), as shown on **Figure 5-9**. This would still allow for extension of Taxiway 'J' to Runway 24 end. An optional taxiway connector would allow aircraft to access the runway while remaining short of the new glideslope critical area.

As shown in **Figure 5-9**, the extension of Taxiway 'J' would require a relocation of the existing perimeter road, and result is a small area of wetland impacts with wetland areas (approximately 0.4 acres). The advantages of these alternatives include:

- Relocates the glideslope antenna and shelter outside of Runway 6-24 ROFA
- Allows for full parallel Taxiway 'J'
- Enables for bypass of ILS critical area and hold line with optional taxiway connector

Potential disadvantages include:

- Requires relocation of existing perimeter road
- Results in wetland impacts with new taxiway and road relocation

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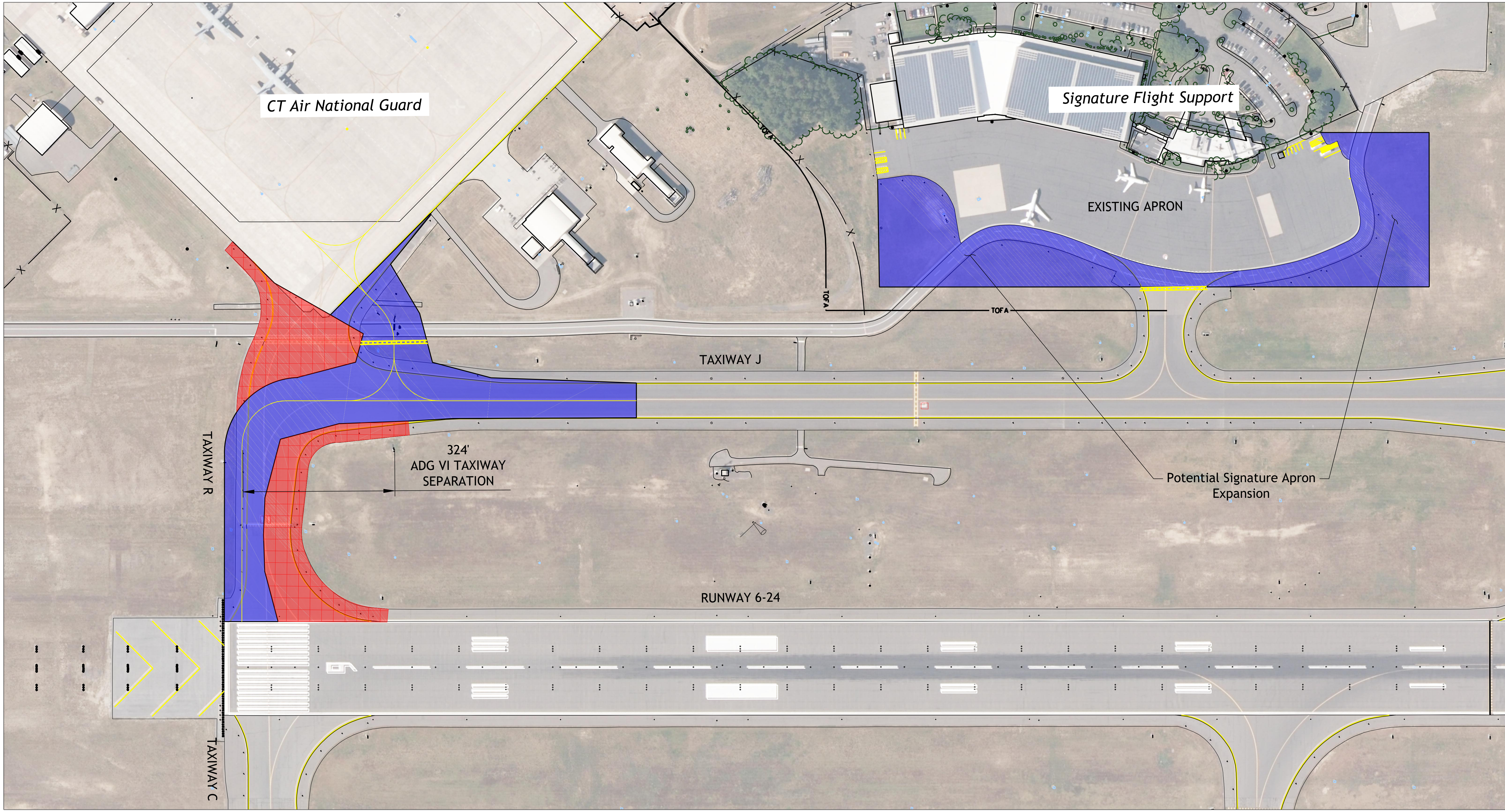

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Pavement Removal

Proposed Pavement

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Figure 5-8

Runway 6 Area

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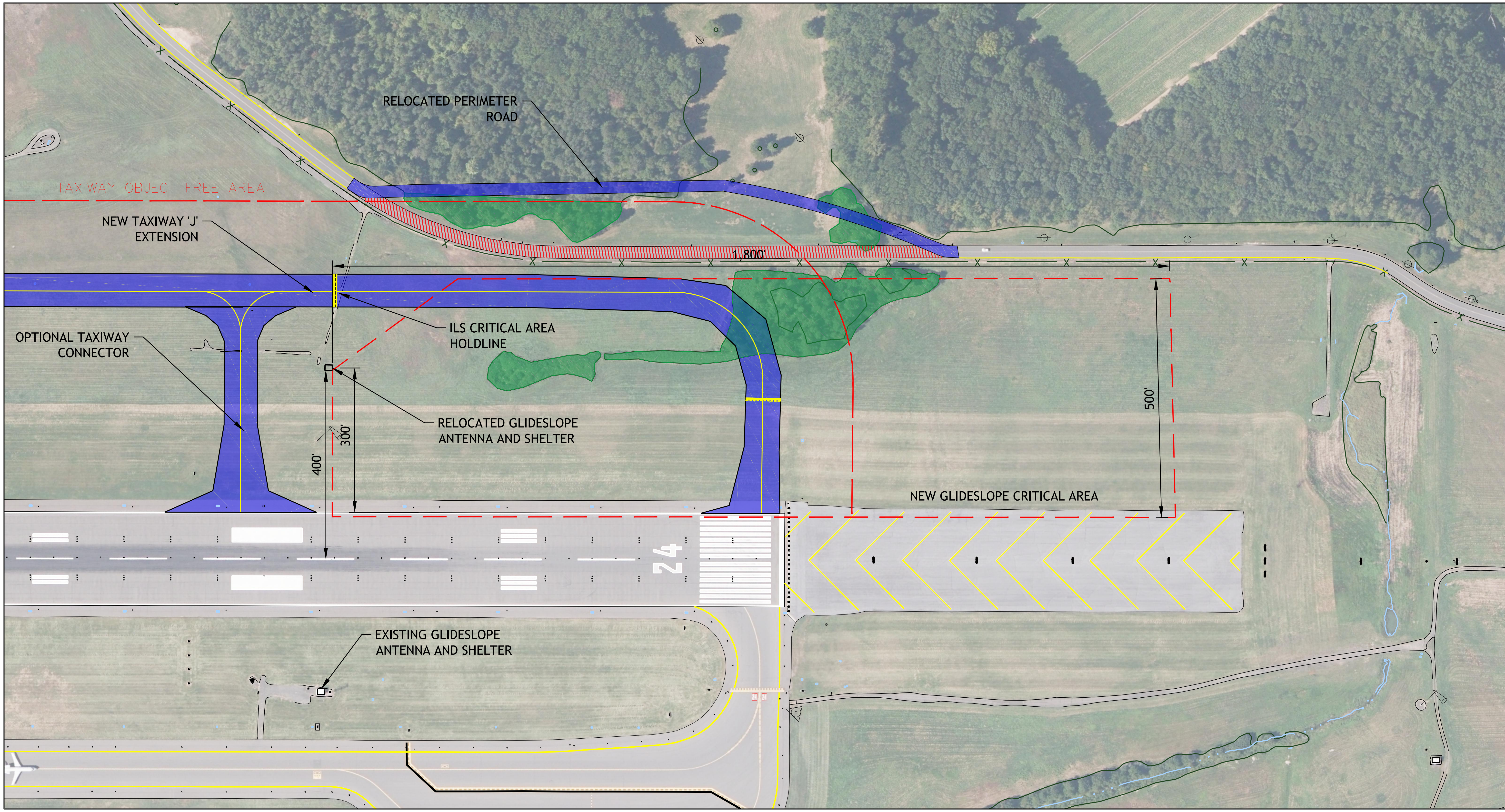

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LEGEND

Impacted Wetlands

Proposed Pavement

Figure 5-9

Runway 24 Area

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5.3.6 Runway 33 Area

As previously discussed, the Runway 33 end was discussed above for a potential runway extension, depicted in **Figure 5-1**. This location on the airfield is served by Taxiway 'S', which currently provides a direct apron-to-runway access, similar to other locations along the terminal apron. The layout shown resolves this nonstandard condition by adding a painted 'green island'. These markings would require aircraft parked on the airport to make turns prior entering at Runway 33, in compliance with the new FAA standard.

That concept as shown, retains the existing access to the runway, and adds a new taxiway connecting to the extended runway end. When there are two adjacent taxiway connectors to a runway end, the inbound connector is referred to as a bypass taxiway. The bypass taxiway provides a second holding location for aircraft that do not require the full runway length. Thus, the concept provides a second benefit providing an aircraft holding location.

As discussed in **Section 5.3.3**, painted islands have several disadvantages for airport operations. As such, an additional concept was prepared that eliminates the painted island, as well as surplus pavement. **Figure 5-10** is an alternate Runway 15 extension alternative that removes pavement of both the green island and the bypass taxiway. This layout provides a simpler layout for addressing the apron-to-runway nonstandard condition.

The Runway 33 area concepts above assume that Runway 15 is extended. However, if the extension is not pursued, or is considered later in the planning period, the Runway 33 area must still address the current nonstandard condition. This can be conducted in methods discussed above with either a painted island, or by creating an actual grass island while removing a small area of existing pavement.

A final concept was developed for the Runway 33 area, for aircraft holding using an existing area of pavement that extends beyond the current runway end. The pavement area appears to have been created as a holding bay, but is not marked with taxilanes to define airfield movements. An evaluation was conducted to determine if this pavement area could be marked to FAA standards and then used as an official holding bay for aircraft departing Runway 33. **Figure 5-11** depicts a configure that can accommodate Airplane Design Group IV (ADG IV) aircraft within the current pavement area. The layout includes the holding position along a large radius turn. This is permissible, but is atypical and could result in pilot confusion.

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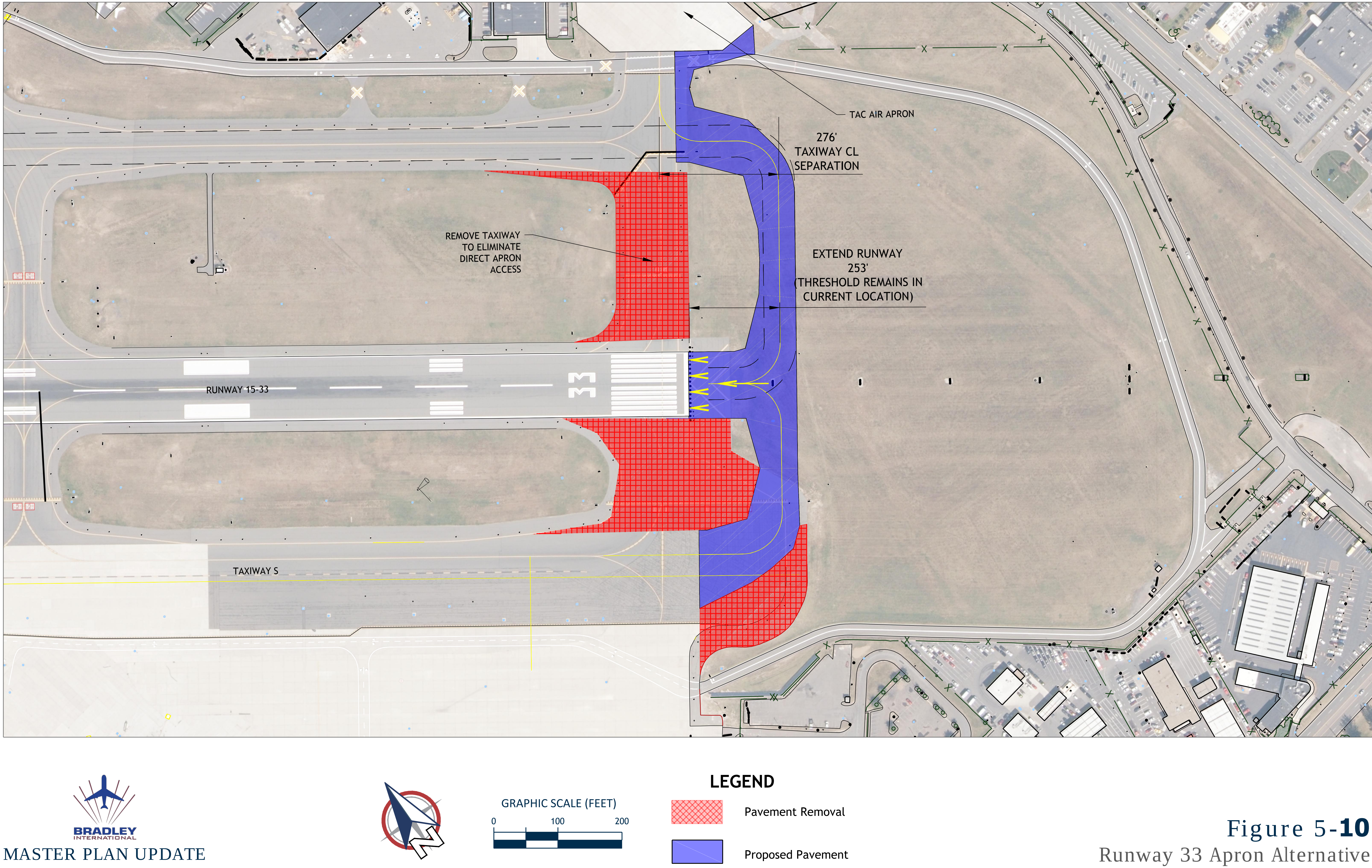

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Figure 5-10

Runway 33 Apron Alternative

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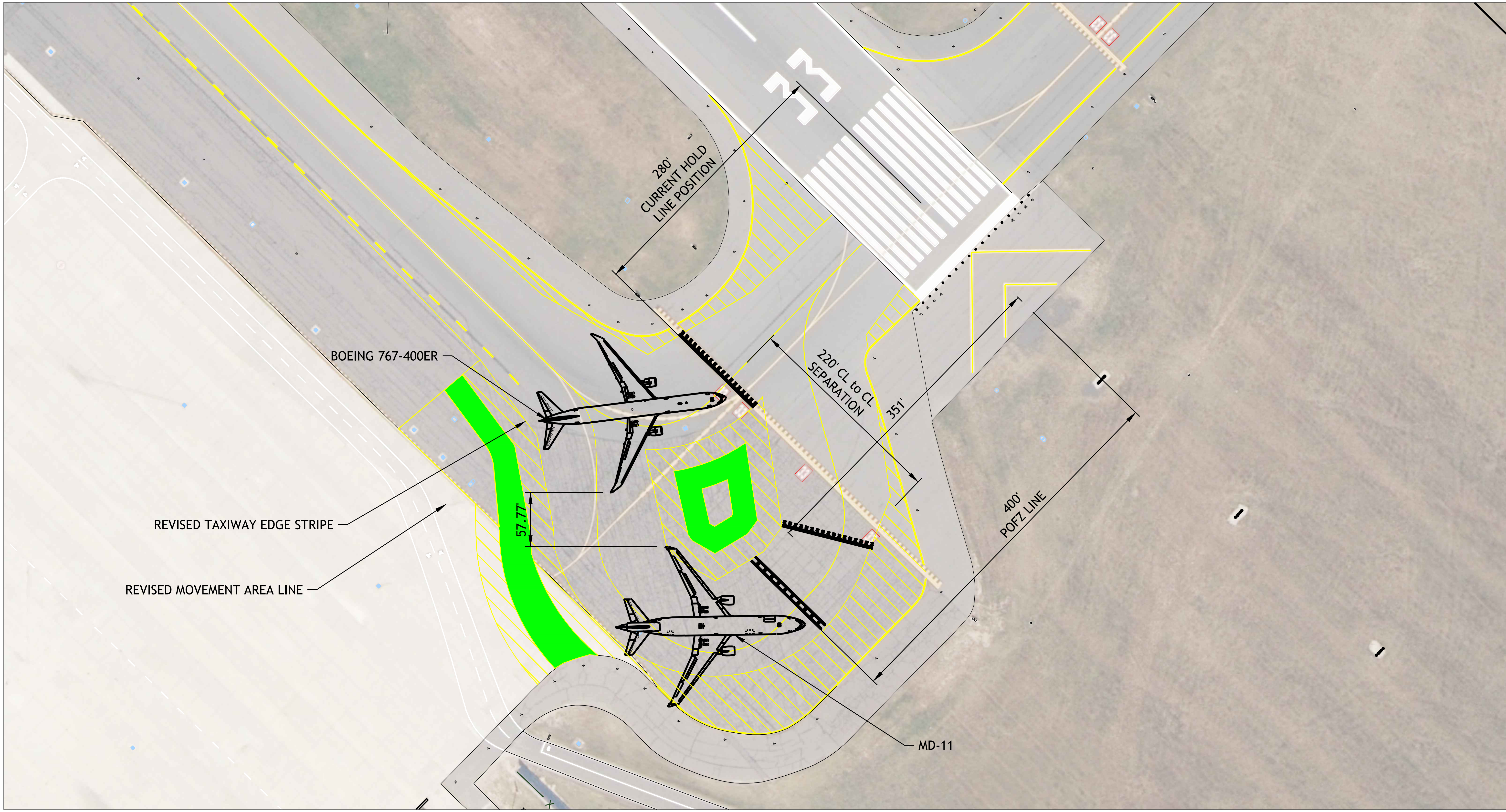

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LEGEND

Pavement Removal

Proposed Pavement

Figure 5-11
Runway 33 Holding Bay Alternative

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5.3.7 High-Speed Exits

High-speed exit taxiways are specifically defined as acute angle runway exits that form a 30-degree angle with the runway centerline allowing aircraft to proceed safely at a heightened speed following landing. The purpose of high-speed exits is to reduce the runway occupancy time of landing aircraft and enhance airport capacity. As such they are primarily used at airports with capacity constraints and associated delays.

At BDL, Air Traffic Control (ATC) personnel requested the consideration of high-speed exits to serve landings on Runways 6 and 24 near the midpoint of the runway. **Figure 5-12** illustrates a potential configuration of these exits applying FAA design standards. The Runway 6 exit would connect to Taxiway ‘C’ near the former location of Runway 19. The Runway 24 exit would connect to Taxiway ‘C’ at the location of Taxiway ‘K’. Taxiway ‘K’ would be removed under this concept.

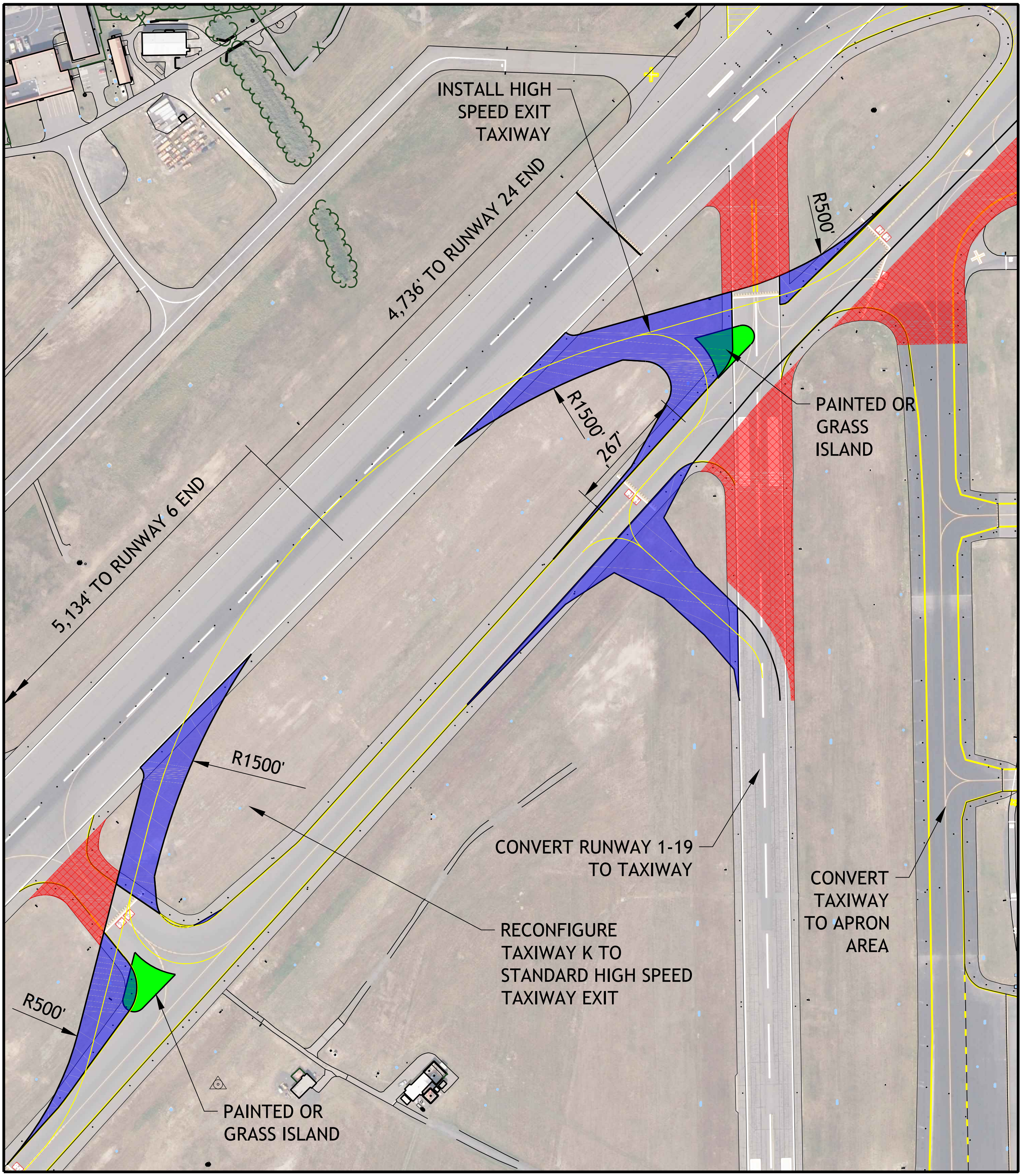
Based on FAA policy, it is unlikely that the FAA would support the development of high-speed exits at BDL because the airfield capacity evaluation does not document the need. Although safety may be improved with these exits, as well as some delay reduction, further analysis (e.g., airfield simulation modeling) would be needed to illustrated current condition deficiencies, such as aircraft backups on the runway, and how these exits would improve upon existing conditions. If high-speed exits are not recommended in this study, the concept illustrates a workable layout for future consideration.

The advantages of high-speed exits include:

- Improved operational safety
- Increased capacity & reduce delay on Runway 6-24
- Reduced taxi time to the Terminal Apron

Potential disadvantages include:

- Was not determined to be necessary by the facility requirement analysis
- Requires removal of Taxiway ‘K’
- Has a high cost for construction and maintenance
- May not be supported by FAA
- May not be eligible for FAA funding



LEGEND

Pavement Removal

Proposed Full Strength Pavement

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Figure 5-12
High-Speed Exit Taxiways

5.4 APRON ALTERNATIVES

The previous chapter addresses the distinct types of aprons at the Airport, their respective location and demand. The following subsection analyses the demands and constraints of the various aprons and alternatives to address forecasted capacity issues at each.

5.4.1 RON Parking & Aprons

At BDL many of the airlines park their aircraft at the airport overnight. This typically involves evening and night-time arriving flights remaining at the airport overnight, with the aircraft departing BDL on a commercial flight the following morning. The number of these Remain Overnight (RON) aircraft exceed the 23 existing terminal gates available, and thus are parked in one of 11 designated RON positions to the northwest of the terminal building. As discussed in **Chapter 4**, the airport has reached its capacity of these positions, with a forecast need for an additional 10-12 remote positions by the end of the planning period.

RON aircraft do not have an available flight crew and are thus towed to and from remote parking locations. As such, RON parking must be located within the passenger terminal apron or in proximity to the terminal apron, and avoid crossing runways and taxiways. This highly limits the locations available for RON positions. Fortunately, BDL has a location for additional parking positions on the East Cargo Ramp. This area was formally used for air cargo by the US Postal Service and other operators, but is now available for repurposing. This location includes over 0.5 million square feet of concrete apron (+12 acres) and can accommodate 10 to 15 RON aircraft, depending on the aircraft size.

A second, smaller area of approximately five acres, may become available in the future. The existing International Arrival Building is currently needed for clearing inbound international passengers by the US Customs and Border Protection (CBP). As discussed in **Chapter 4**, it is recommended that this important airport function be relocated to the main passenger terminal where all other passenger services are provided. Once this function can be relocated, the existing location could be converted for RON parking, and could accommodate up to five RON aircraft parking positions up to Group III. The proposed RON apron areas are depicted on **Figure 5-13**.

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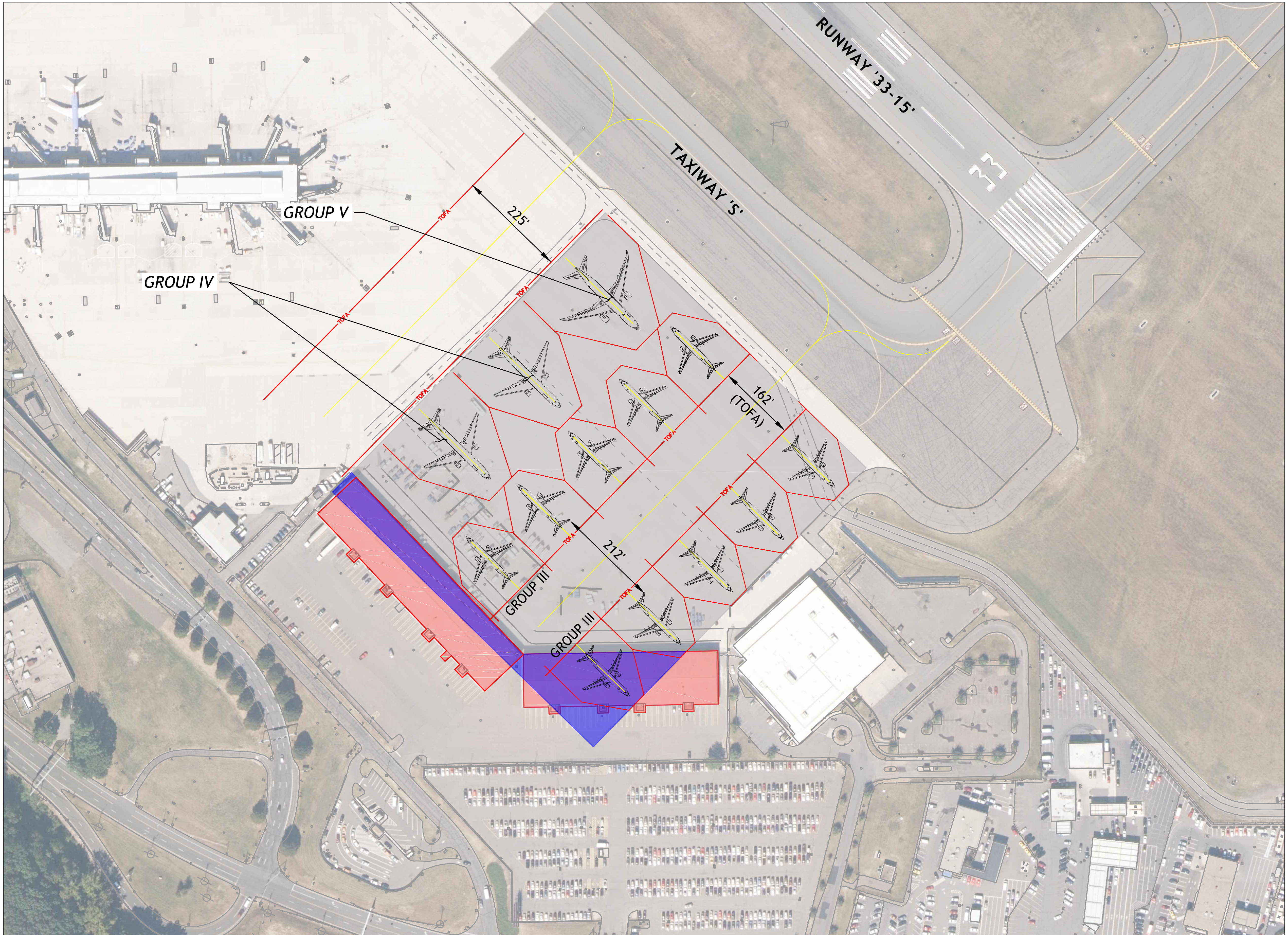

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- Building Demolition
- Proposed Full Strength Pavement

Figure 5-13
RON Parking

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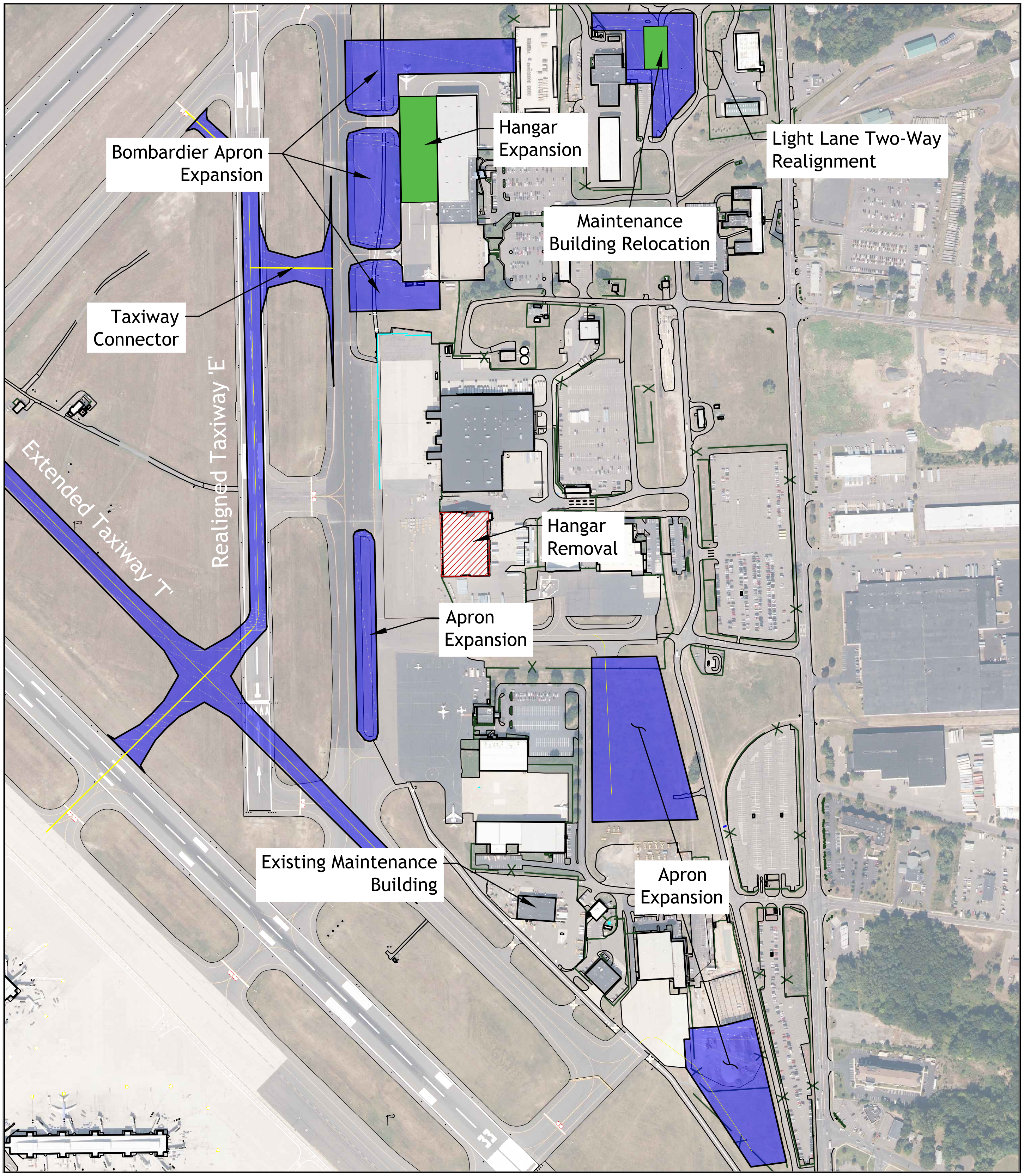
5.4.2 General Aviation Aprons

General aviation aprons at BDL include aircraft parking for both based and itinerant aircraft serviced by the two Fixed Based Operators (FBO) and by private corporate aviation facilities. For this study, locations for future corporate aviation facility development will be identified and reserved; however, such facilities are for the private use of the tenant and are not evaluated herein. As such, the general aviation apron space concepts are limited to the FBO facilities operated by Signature Flight Support and TAC Air.

The facility requirement evaluation identified that the total general aviation apron area of approximately 52,000 square yards (SY) is currently adequate, but may reach capacity with the next five years. In the long term, an additional 18,700 SY may be needed at BDL for a total area of 70,700 SY by 2037. Although, FBO facility improvements and expansion are the responsibility of the tenant, the potential for additional apron area was addressed to determine if and where additional apron area may be feasible. At the Signature Flight Support facility, on the west side of the airport, the existing parking apron follows a curvilinear layout that matches the architectural style of the FBO building complex. Although it may impact that aesthetic appearance of the apron, an additional +10,000 SY of apron expansion is possible, as shown previously in **Figure 5-8**.

The TAC Air facility on the east side of the airport, includes two potential locations for expansion along Light Lane. These areas could to provide over 25,000 SY of additional apron area, which exceeds the estimated future requirement, **Figure 5-14**. Reserving these locations for FBO and general aviation apron expansion can thus accommodate future apron and hangar facilities.



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LEGEND

Proposed Building

Proposed Pavement

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Figure 5-14
East Apron Area

5.4.3 Maintain, Repair & Overhaul (MRO) Facilities

BDL has two MRO tenants, Bombardier and Embraer. These services are private facilities that are not open to the general public. For this Master Plan, interviews were used to identify MRO needs and development goals, with the intent to accommodate future requirements to the extent possible.

Bombardier

As discussed previously, Bombardier, located on the east side of the airport, is interested in a substantial expansion of their hangar and apron complex. However, their timeline for expansion has not been determined. According to Bombardier representatives, the capacity of the existing hangar and apron have been reached. **Figure 5-14** also depicts a concept to accommodate a sizeable expansion of the apron, which is enabled by the realignment of Taxiway 'E' to the location of Runway 1-19. The expansion shown includes over 20,000 SY of additional apron area, with approximately 50,000 SF of additional hangar accommodation. This concept is intended to illustrate a potential maximum buildout of the existing facility; it is not a plan that has been advanced by Bombardier.

Embraer

The existing Embraer facility is smaller in size, but also has the potential for expansion. Additional capacity requirements have not been proposed by the tenant. Nevertheless, the Master Plan reviewed the ability for expansion if needed in the future. Due to the proximity of Runway 15 located to the south and west of the facility, future development would best be considered to the east of the existing hangar. Although no specific layout is recommended at this time, a simple apron expansion concept is illustrated previously, in **Figure 5-2**.

5.4.4 West Air Cargo Aprons

The West Air Cargo Apron serves FedEx and DHL's operations at the Airport. In its current state, the apron is reaching capacity for aircraft parking and movement, particularly larger aircraft that provide infrequent yet demanding service to BDL, such as the Antonov AN-124, and the increased airframes projected to serve BDL in a cargo capacity (B767-300 and A300). Expansion of the apron is limited due to space constraints created by existing property boundaries and building structures, and the proximity of Taxiway 'S'. A concept to expand the apron is depicted in **Figure 5-15**. The western side of the apron used by FedEx can be expanded to accommodate a larger aircraft, up to MD-11, along with improved taxilane access to the eastern side. An alternative version of this concept is depicted in **Figure 5-16**. This alternative version relocates of Taxiway 'U' further to the east. This enlarged taxiway would additionally provide improved access for aircraft accessing the eastern side of the apron, as well as the expansions to the western side.

The advantages of this alternative include:

- Increased parking capacity for cargo aircraft
- Parking capabilities provided for larger aircraft
- Improved access to the apron from Taxiway 'S' and Runway 15-33

Potential disadvantages include:

- Requires modification to adjacent drainage basin
- Impacts a potential wetland area on northwestern side

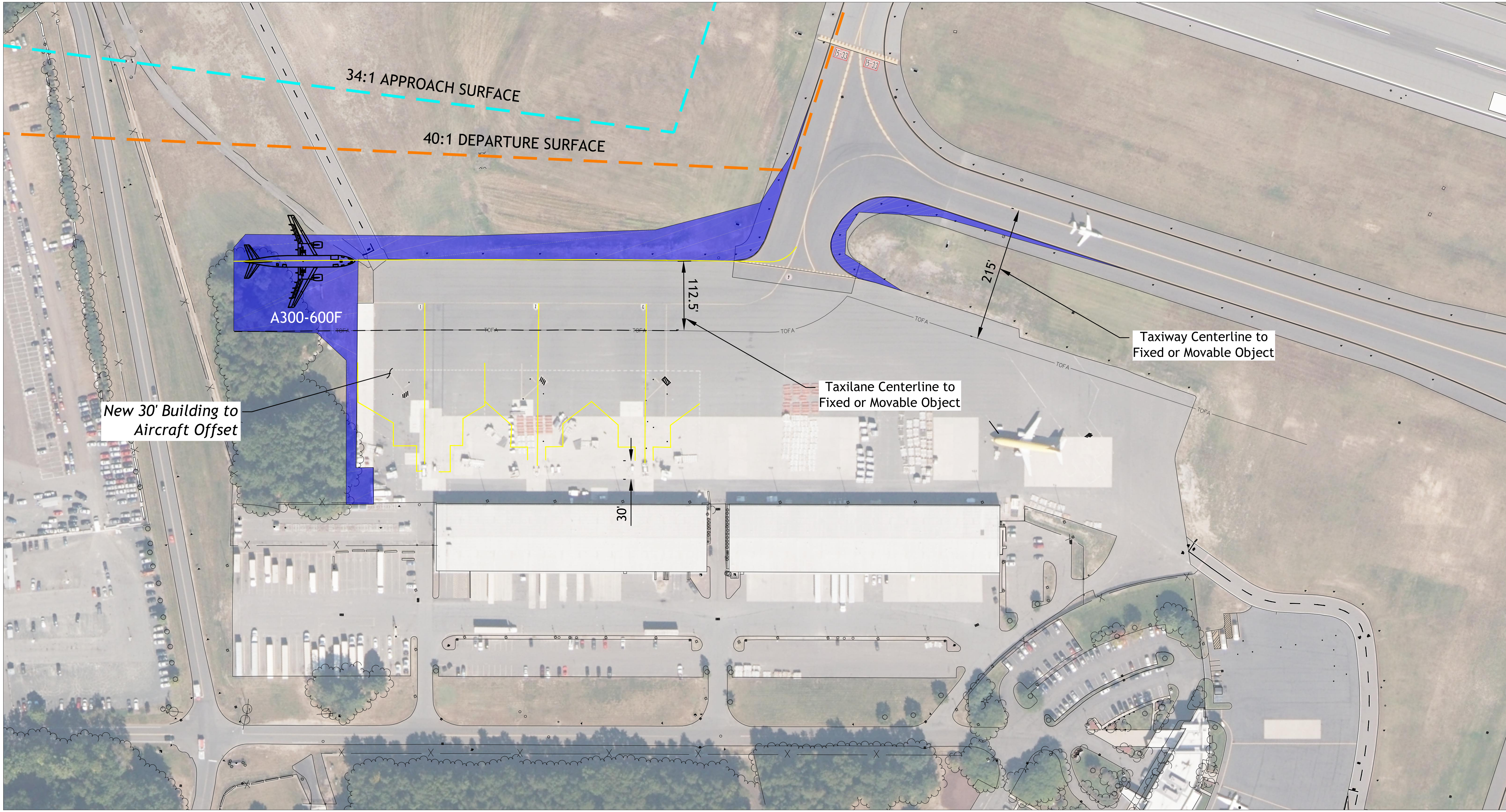
UPS operates from their regional sorting facility on the eastern side of the airport, with access to Light Lane. In general, the existing facility is adequate for their cargo activities levels, but future expansion was discussed. The facility has the potential for expansion of aircraft positions from two to four, with the ability to add a position on both the north and south sides.

Immediately south of the sorting facility, within the UPS lease area, is an unused hangar that is scheduled to be removed. With removal of the hangar, the location could be used as air cargo apron for aircraft as large as Boeing 747. Cargo aircraft of this size are not forecast for regular use at BDL, however, it is generally recommended that this location be reserved for potential future air cargo apron. **Figure 5-14** (shown previously) depicts this location. Similar to the discussion of the Bombardier facility, potential future expansion would be fostered by the realignment of Taxiway 'E' to the location of Runway 1-19.

5.4.5 Centralized Deicing Apron

In addition to the deicing activities that occur at gate and RON parking positions, the airport operates a deicing apron near the end of Runway 6. During significant storm events, this area reaches capacity, particularly during morning peak periods. As such, a concept was developed to expand the number of deicing positions from three to five, by enlarging the apron to the south, see **Figure 5-17**. Based on the location of the final approach to Runway 6, further positions beyond five in this location may not be feasible.

If additional deicing becomes needed, the potential location of existing or future RON parking positions may be able to serve a duel roll for this purpose. Additional drainage work would be required to collect glycol runoff if deicing is expanded in these RON areas.



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Proposed Pavement

Figure 5-15
West Air Cargo Apron Area

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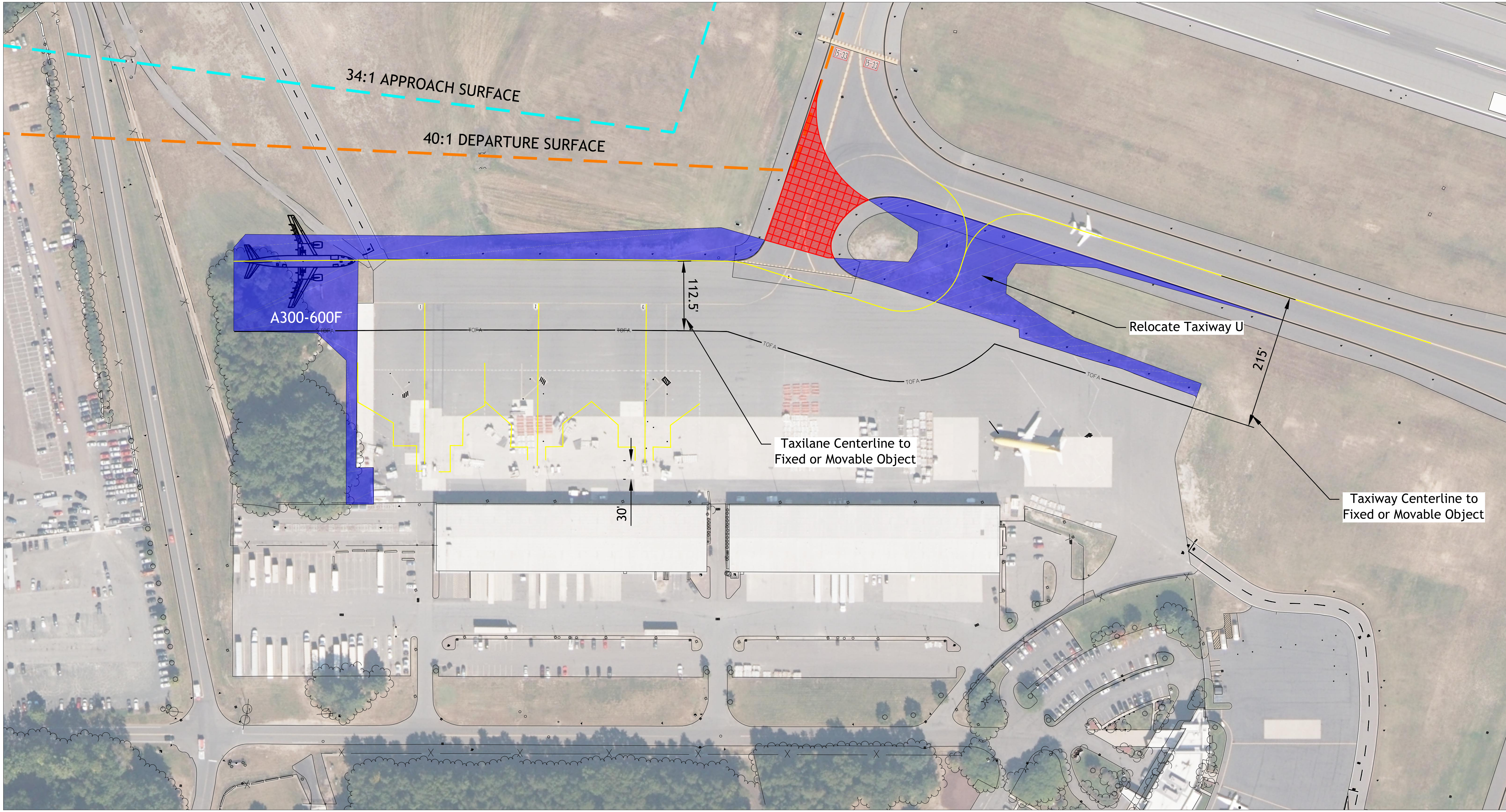

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LEGEND

Proposed Pavement

Pavement Removal

Figure 5-16
West Air Cargo Apron Area

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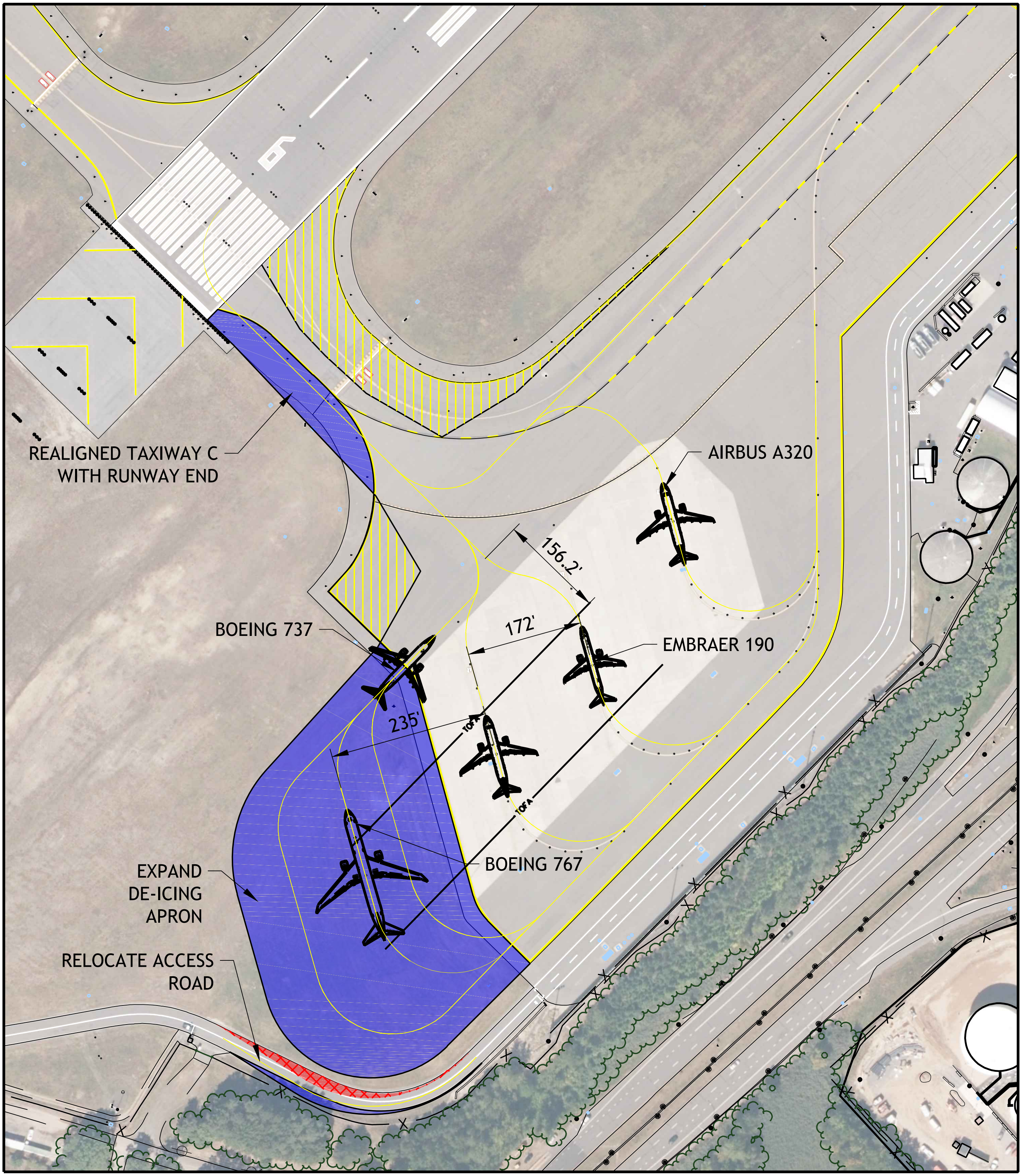

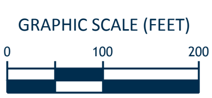

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Pavement Removal	
Proposed Full Strength Pavement	

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Figure 5-17
Centralized Deicing Area

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5.6 TERMINAL ALTERNATIVES

As part of the initial passenger terminal alternative evaluation, multiple terminal alternatives were studied and compared for overall passenger flow and integration, functionality, gross area, and gate count. All of the concepts developed were focused on the same general location, and would be integrated into the existing access roads, parking garage, and aircraft apron area. From the initial options, two alternatives were chosen for detailed study.

The first option is a revision or update to the current Terminal B terminal plan, which would develop independent Terminals A and B. The revision to the Terminal B configuration considers the revised forecast and programmatic requirements. The second alternative was an evolution of this plan, which seeks to capitalize on the reduced programmatic requirements generated by the new forecast to create a more unified terminal complex. These options were then studied over the 20-year planning horizon, with requires identified for current conditions, and the years 2022, 2027, 2032, and 2037.

The planning horizons can be grouped into two larger projects: short-term enabling projects and long-term build-out. Both alternatives have similar short-term enabling projects which focus on maximizing the processing capacity of existing Terminal A and deferring development a new Terminal B until 2027. Overall, the long-term build-outs for the two preferred alternatives had similar approaches but resulted in facilities with unique character and potential.

The following narrative is intended to be an overview detailing the short-term and long-term build-outs of the two alternatives. Appendix B provides functional plans of the interim years and the resulting facilities.

5.6.1 Short-term enabling projects: 2017 + 2022

The short-term focused on addressing previously acknowledged deficiencies in Terminal A, with t the primary goal to fully utilize Terminal A prior to investing in a new Terminal B. As such, the potential short-term projects will support either of long-term terminal alternatives. The existing deficiencies that significantly impact the existing terminal's processing capacity include:

Bag Screening Devices in Check-in Hall – These devices impeded Check-In circulation and created bottlenecks during peak hours.

Security Checkpoint – The constricted location limits expansion while inadequate queue space creates overflow during peak periods.

Vertical Circulation – The central location of these elements creates significant crossflow, crowding, and impacts the operations of the Security Checkpoint.

Bag Claim – While the Bag Claim Hall has excess capacity, the inability to provide international claim limits international operations.

These deficiencies are illustrated in **Figures 5-18** and **5-19**.

Figure 5-18 – Terminal A – Existing Departures Level Layout

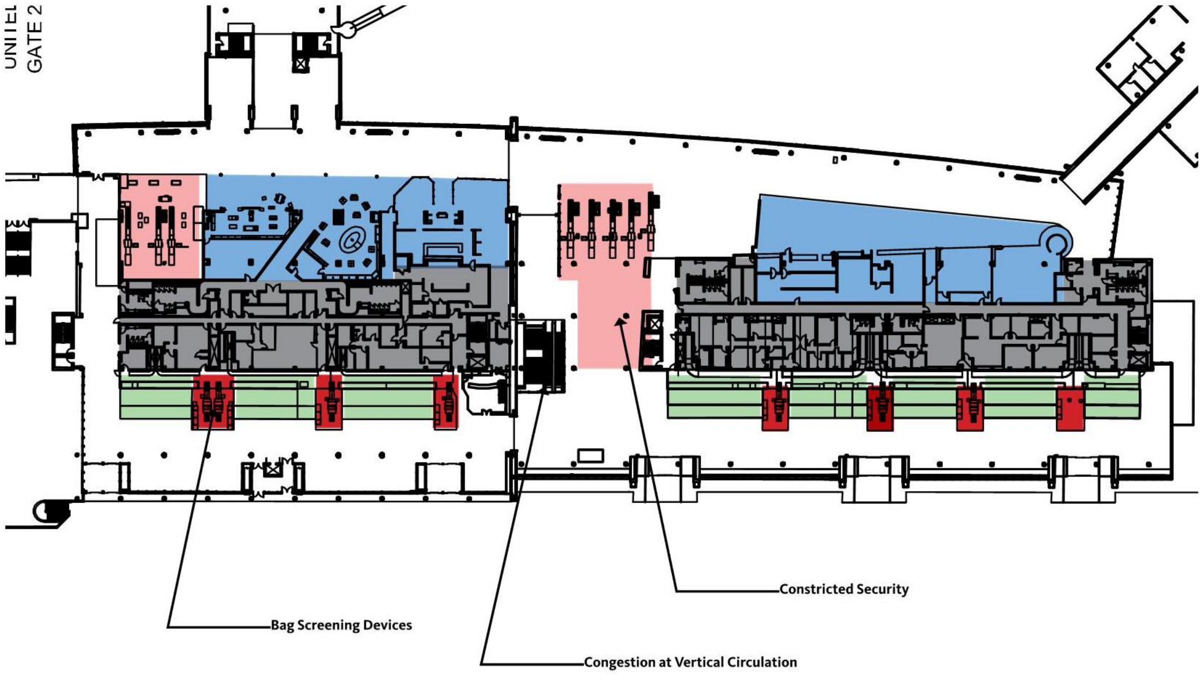
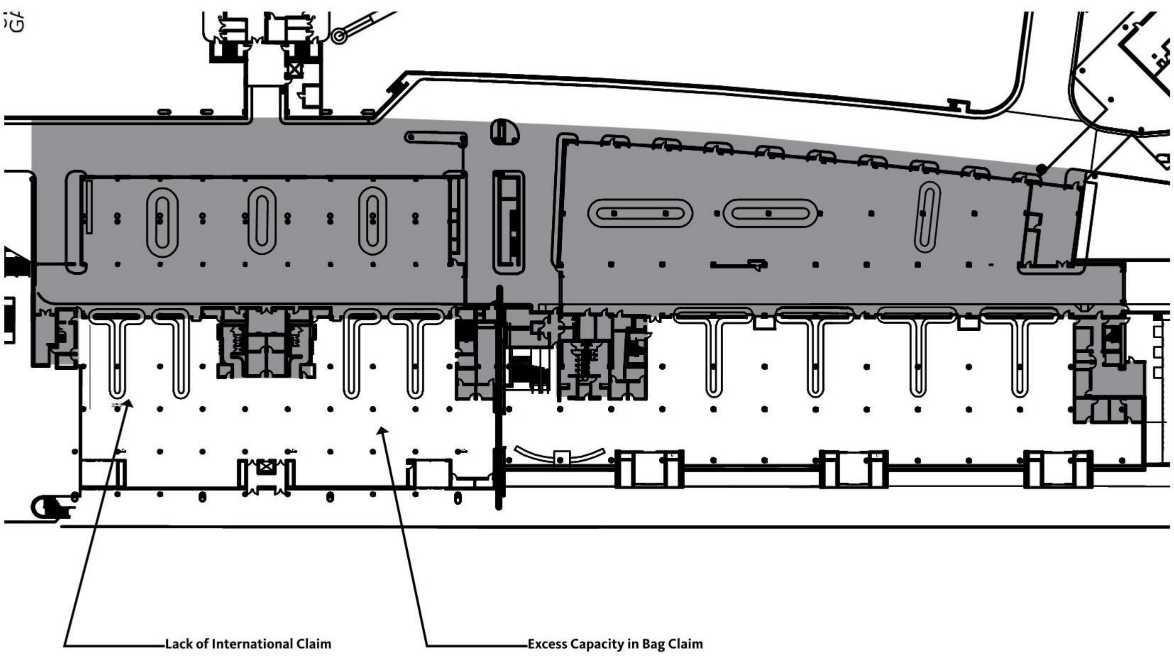


Figure 5-19 – Terminal A – Existing Arrivals Level Layout



The deficiencies are addressed by several interventions. First, new vertical circulation along the face of the terminal. Two new arrivals corridors are created through the central Airline Ticket Office (ATO) and support bar between the Check-In Hall and the airside retail. These allow arriving passengers to continue from the concourses directly to the landside vertical circulation, bypassing the central zone. This rectifies the crossflow and crowding in the center area while the removal of the central stairs and escalators allowed for additional security lanes and queue.

In addition, the bag screening units are removed from the Check-In Hall and a new central bag screening system was created on the apron level adjacent to the Terminal. With this, a new Customs & Boarder Protection (CBP) facility is placed within this expanded building area. International claim is provided by using operable partitions to create a swing bag claim device while a small temporary CBP exit area is created by removing constrained bag claim devices. This CBP arrangement will require coordination with and approval from CBP. By 2022, the bag claim hall may provide a slightly lower Level of Service during peak hours, however, when balanced with the investment of additional bag claim, this was deemed acceptable.

Concourse holdroom capacity is increased by an expansion at the end of Concourse B and additional holdrooms above the new CBP and bag screening areas. These upgrades should satisfy terminal capacity until the 2027 planning horizon. The **Figures 5-20**, **5-21**, and **5-22** illustrate the short-term enabling projects.

Figure 5-20 – Terminal A – Short-Term Departures Level Layout

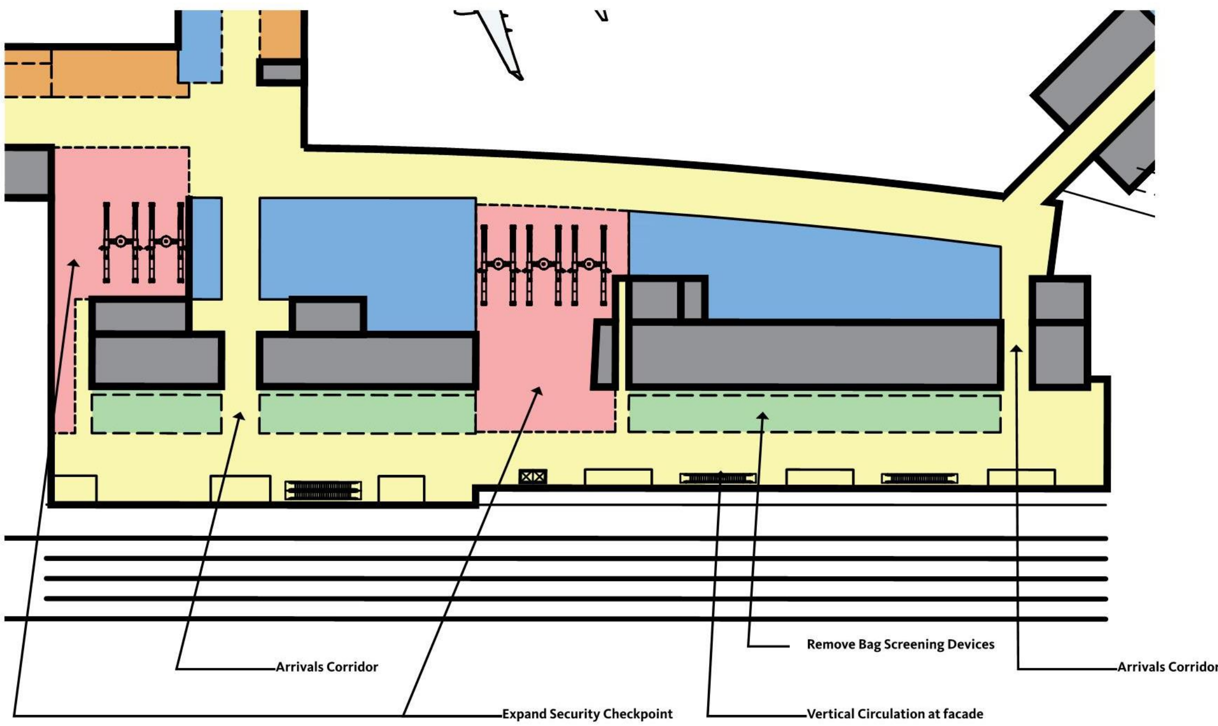


Figure 5-21 – Terminal A – Short-Term Departures Level Layout – Optional Security

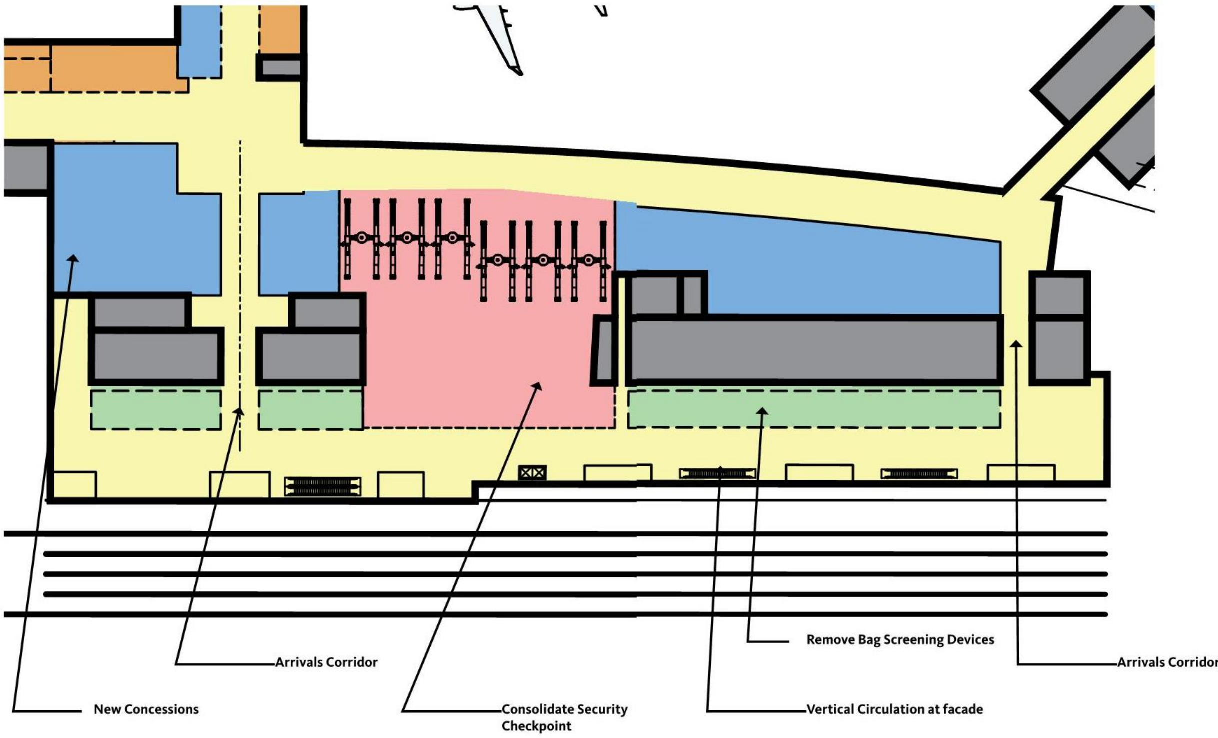
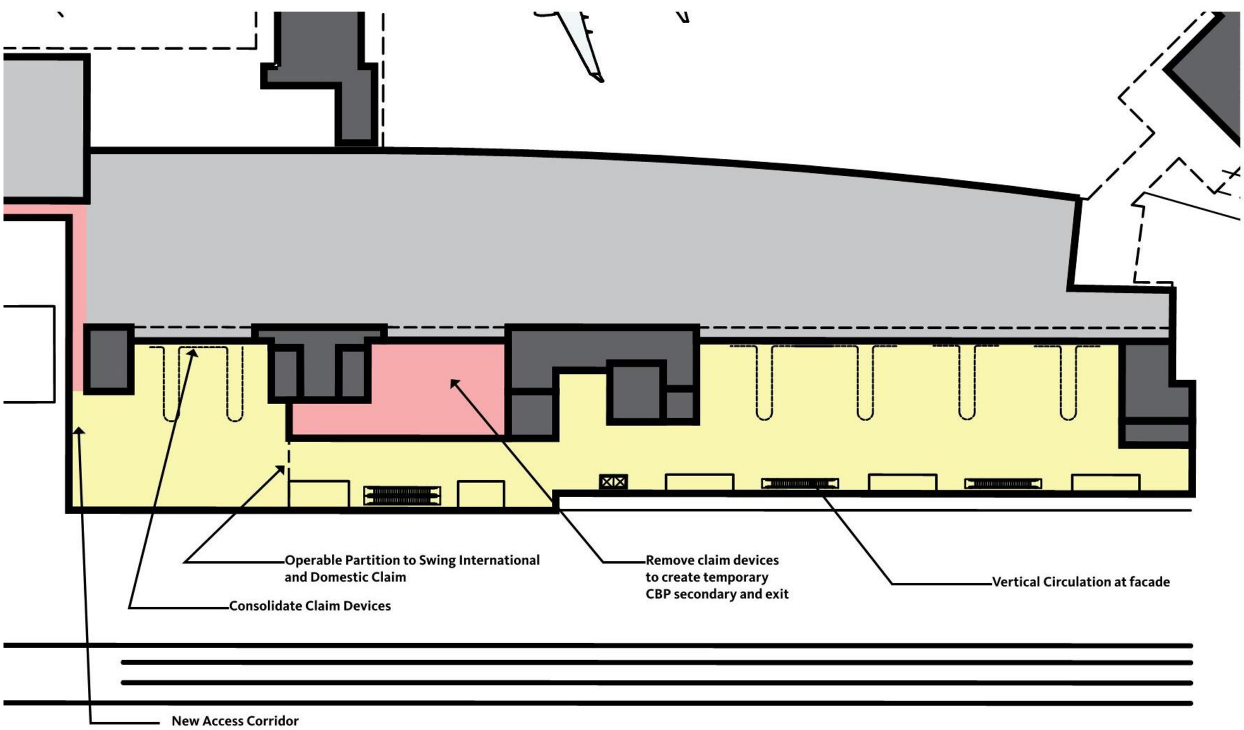


Figure 5-22 – Terminal A – Short-Term Arrivals Level Layout



5.6.2 Long-term Build-out: 2037

Independent Terminals Alternative

This alternative creates a new Terminal B independent of Terminal A. It is essentially the same as the current Terminal B plan, but reduced in building size and number of gates based on updated programmatic requirements. Distinct curbsides and apron taxilanes mimic the internal independence of the two terminals. Each has the potential for its own identity and branding with a secure-side connection between the two decidedly different buildings.

Terminal B maintains the existing functional arrangements of Terminal A. Both have a central security checkpoint with flanking Check-In areas. A concessions/amenity zone is located immediately after security. These would capture 100% footfall as passengers walk to their concourses where secondary concessions would serve the adjacent gates. Due to this arrangement the passenger experience would be focused on the concourses.

The CBP facility built in the short-term continues to be utilized but the temporary international claim and secondary/exit facility has been replaced with a new permanent facility in Terminal B. Walking distances between the two components have increased due to the location of the Terminal B processor. International arrivals would experience the new Terminal B and connect through it. However, connections back to Terminal A would involve increased walking distances.

The deployment of gates and the separate flightlines causes the majority of activity to migrate to Terminal B. This results in some processor duplication as processing potential is not fully utilized in Terminal A and replicated in Terminal B to serve the balance of gates.

This alternative has significant branding potential which may increase potential for development partners. It minimizes investment in Terminal A and focuses on maximizing number of passengers going through Terminal B. The international product would be focused on Terminal B. However, the justification of the flightline would result in some processor duplication and inefficiency. Increased walking distances (approximately 3,200 feet from farthest gate to farthest gate and an average walk of 730 feet from security to gate) is relatively long for a medium hub airport, and more than the current passenger experience. This alternative has 11 gates accessed via single taxilanes, which may impact operations with some delays in aircraft gate maneuvering.

The resulting total area for the Terminal A and B Bradley complex by the end of the long-term build-out is 948,000sf. This area is somewhat higher than would be needed under a single combined terminal complex. However, the dual terminal configuration has a substantial benefit during construction, as Terminal B can be built with little operational impacts on Terminal A.

Figure 5-23 – Terminal A + B – Long-Term Departures Level Layout

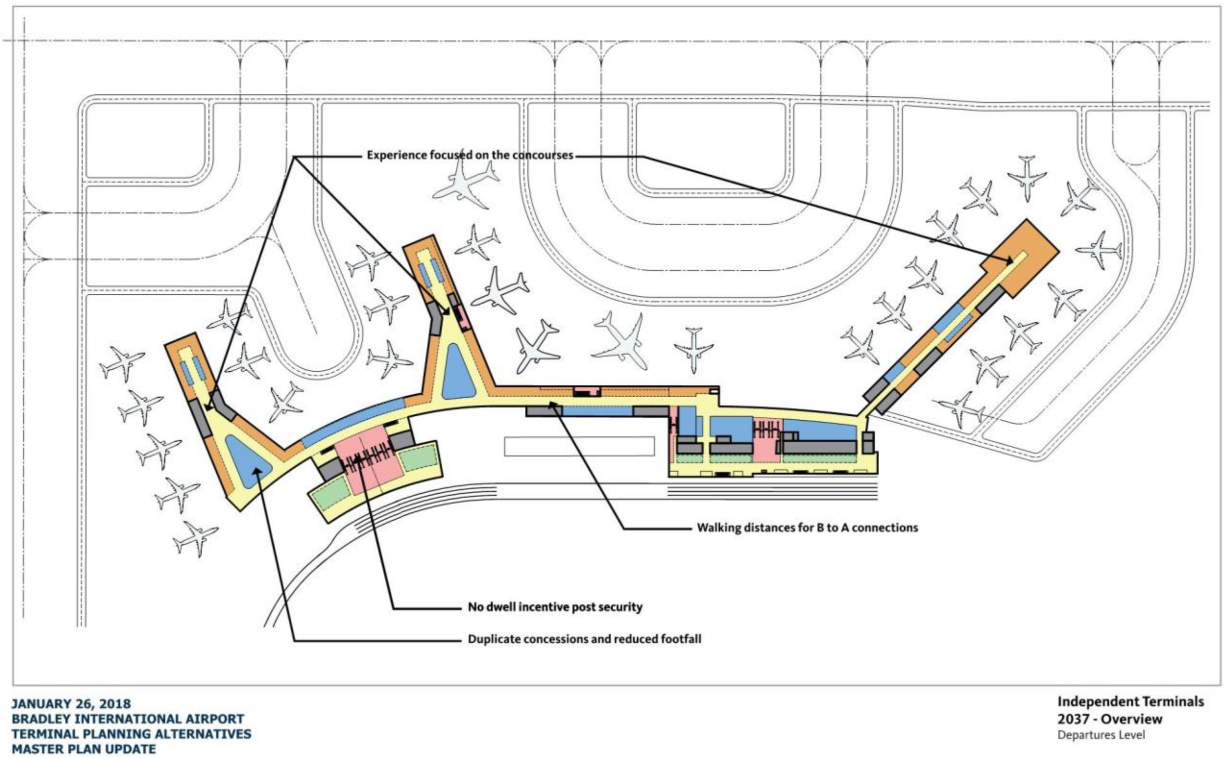


Figure 5-24 – Terminal A + B – Long-Term Arrivals Level Layout

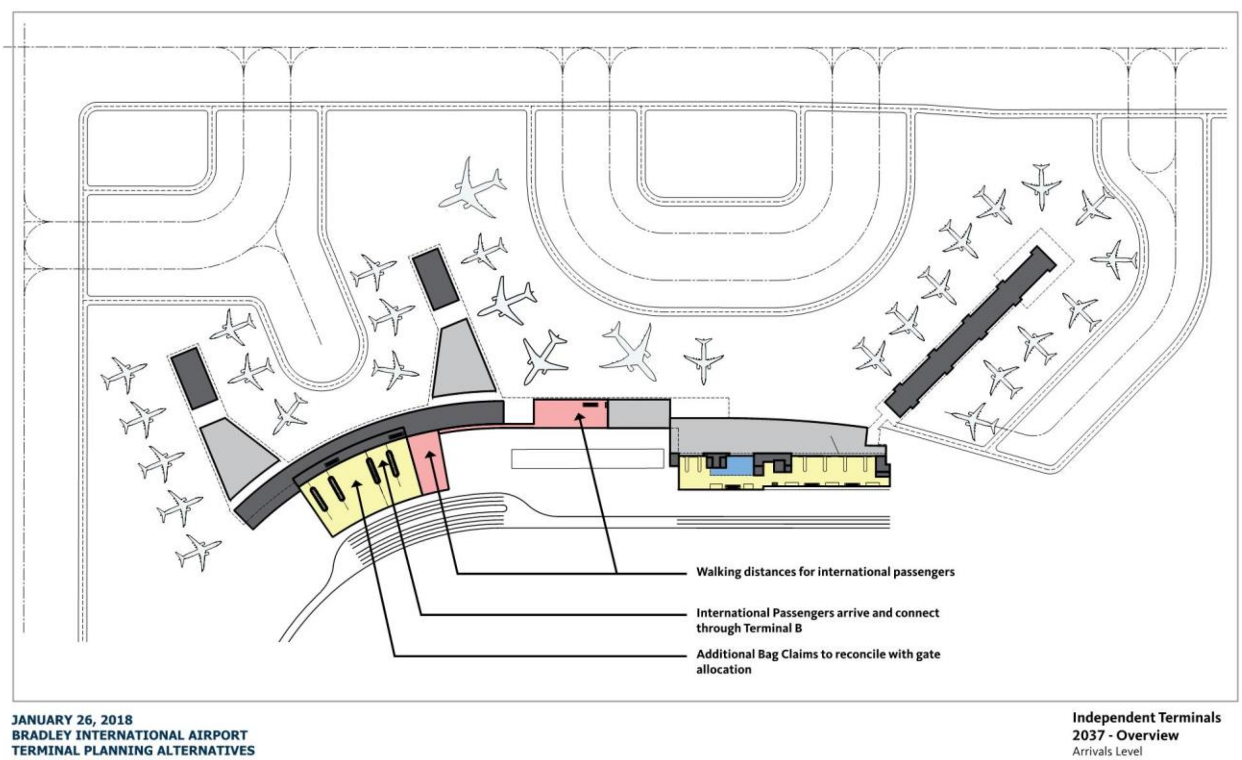
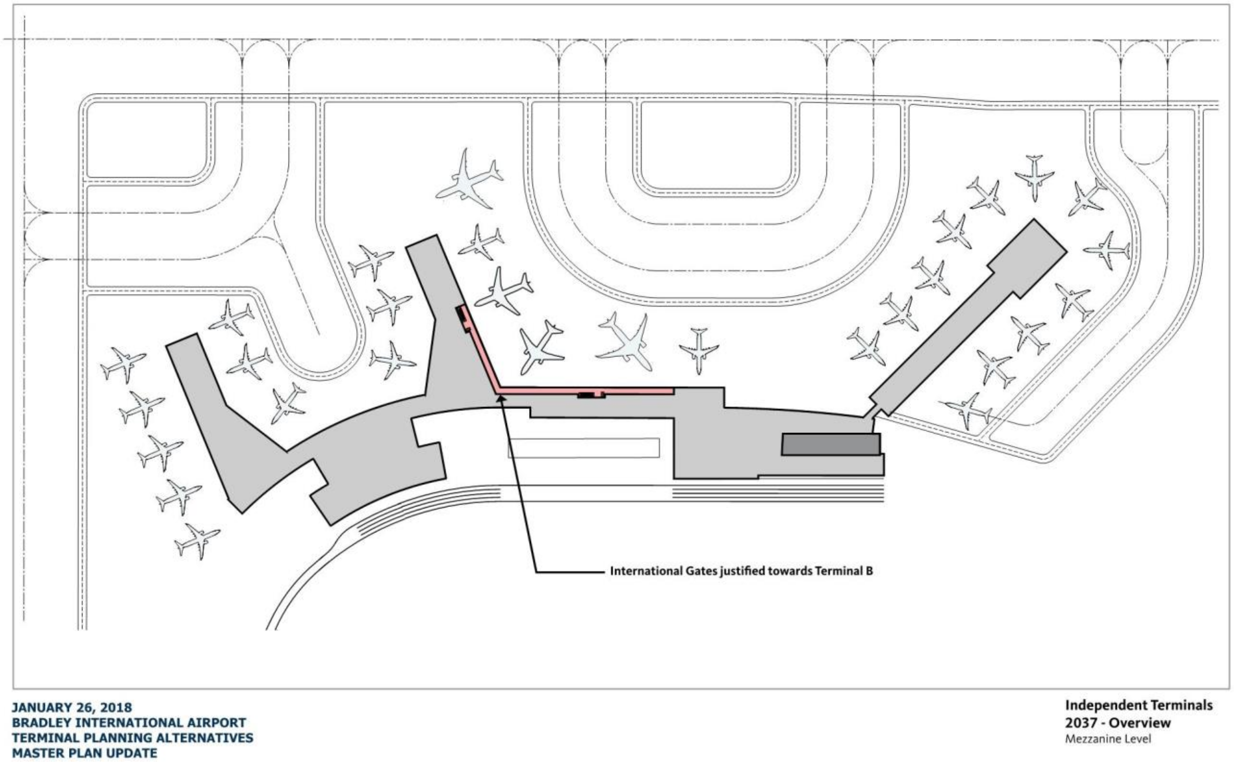


Figure 5-25 – Terminal A + B – Long-Term Mezzanine Level Layout



Consolidated Terminals Alternative

As discussed in previous chapters, the trend towards larger airline aircraft, but reduce frequency, has reduced the future number of gates required at BDL. This in turn enables this new alternative that creates a more unified Bradley terminal complex. Continuous curbsides and flightlines reduce the site development area while allowing for a compact building footprint. Branding and identity potential still exists with the individual processors but the continuous airside offers an opportunity to unify the building and experience.

As in the Independent Terminals Alternative, Terminal B maintains the existing functional arrangements of Terminal A with central security checkpoints flanked by Check-In. A central marketplace follows security, capturing 100% footfall as passengers exit security. Their central location and adjacency to gates, encourages passengers to dwell within this area, immersed within revenue-generating and amenity possibilities within sight of their gate. Support concession would be located in the concourse to supplement those specific gates. Thus, the passenger experience is focused on the marketplaces which capitalize on increased visibility and exposure, without requiring multiple locations throughout the terminal.

Due to the proximity of Terminal B to A, the two components of the CBP facility in Terminal B are closer to the one another with decreased walking distances. As in the previous alternative, International arrivals would experience the new Terminal B and connect through it. However, connections back to Terminal A would involve shorter walking distances and function as a continuous journey through a single building.

The consolidation of the flightline more equitably divides the activity between Terminals A and B. This reduces processor duplication as Terminal A's processing potential can be more fully utilized and reduces the need for additional capacity in Terminal B. The placement of the international gates in the center of the flightline makes them easily accessible from either Terminal and for international preclear flights (assuming widebody aircraft) would allow for easy walking connections to any gate.

While this alternative continues to have branding potential, its attributes encourage maximized efficiency while minimizing duplication by using existing capacity in Terminal A to reduce the footprint of the new Terminal B. The possibility of branding the entire Bradley International complex is enhanced by the continuous airside. The international arriving and connecting flights would be focused on Terminal B but departures could easily use either terminal. The passenger experience is focused on the marketplaces which may positively impact revenue-generation. Compared to the Independent Terminals Alternative, walking distances have been reduced (approximately 2,600 feet from farthest gate to farthest gate and an average walk of 630 feet from security to gate). Apron operations have been enhanced by reducing the number of gates accessed via single taxilanes to only five. The resulting area for the Terminal A and B Bradley complex by the end of the long-term build-out is 843,000sf, or 12 percent lower that the Independent Terminals Alternative.

In summary, the Consolidated Terminal Alternative is a possibility due to the changing programmatic requirements of BDL's passenger facilities. The concept is a modification of the original Terminal B plan rather that a fundamental change. However, it does provide several new advantages for the overall passenger experience as well as potentially lower costs. Nevertheless, a noted disadvantage of the Consolidated Alternative is additional difficultly and logistics of construction, while maintaining full terminal operations.

Figure 5-26 – Terminal A + B – Long-Term Arrivals Level Layout

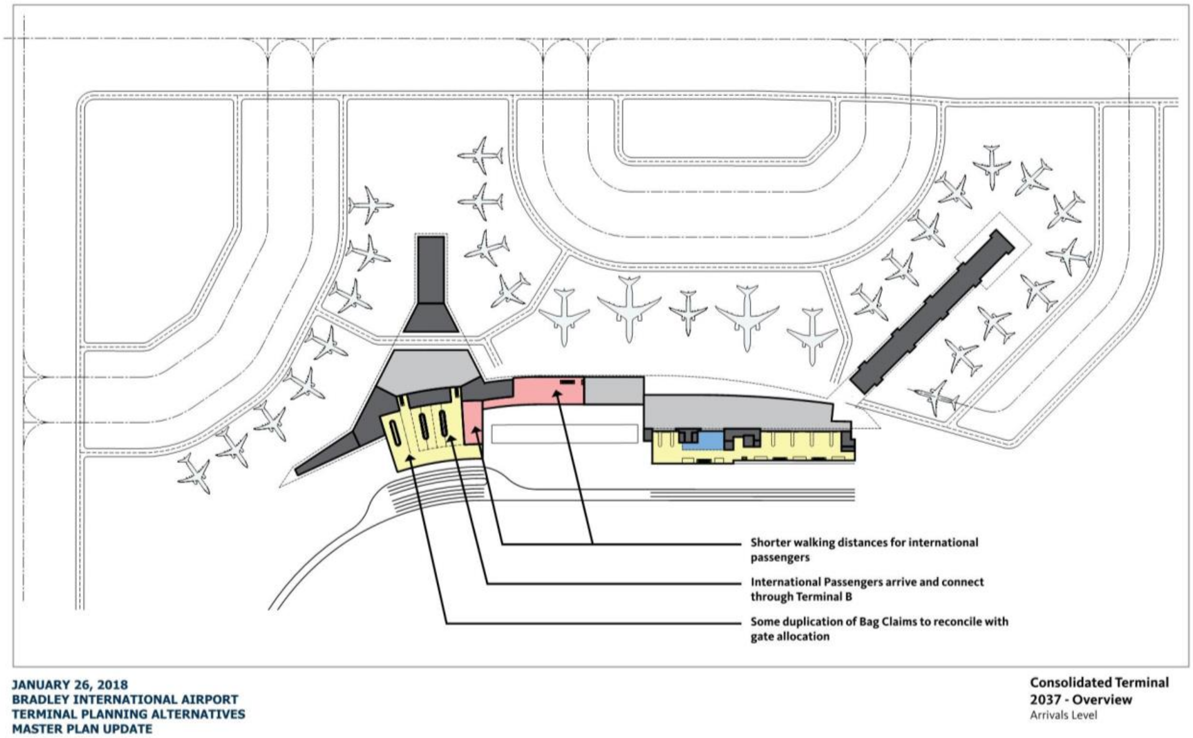


Figure 5-27 – Terminal A + B – Long-Term Departures Level Layout

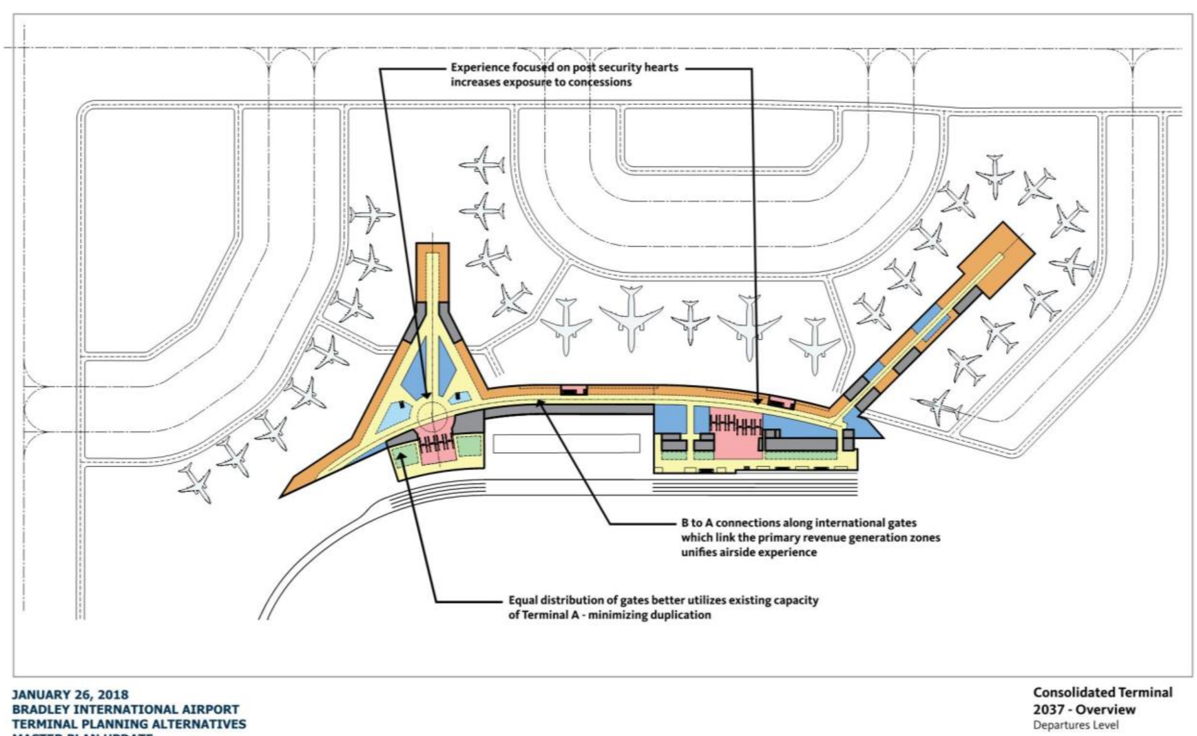
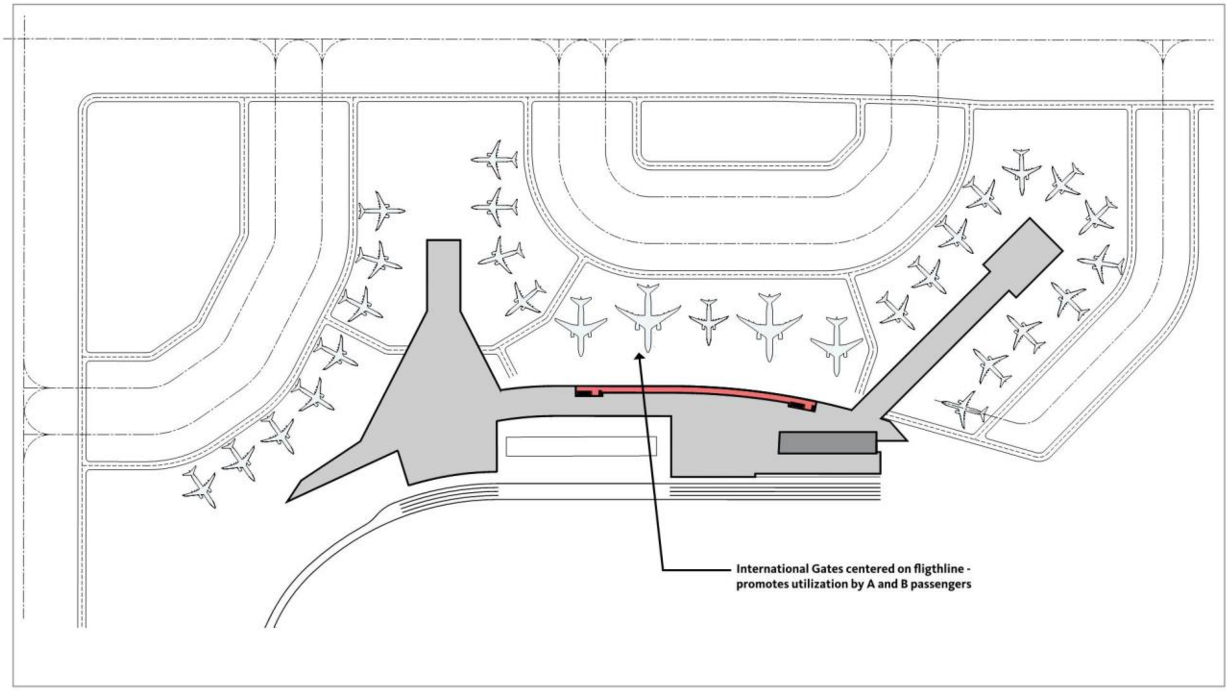


Figure 5-28 – Terminal A + B – Long-Term Mezzanine Level Layout



JANUARY 26, 2018
BRADLEY INTERNATIONAL AIRPORT
TERMINAL PLANNING ALTERNATIVES
MASTER PLAN UPDATE

Consolidated Terminal
2037 - Overview
Mezzanine Level

5.7 ROADWAY ALTERNATIVES

With the demolition of the former Murphy Terminal (2015), the terminal roadway is now being relocated and upgraded, including expanded passenger parking, in preparation for the Ground Transportation Center (GTC) and Consolidated Rental Car (CONRAC) facility. Upon completion of the roadway project, passengers will experience improved traffic flow to the terminal building, with more direct routing and fewer traffic signals.

However, this project does not address the remainder of Schoephoester Road, from Terminal A to Ella Grasso Turnpike (Route 75). Currently this portion of Schoephoester Road contains four signalized intersections, many driveways, and is the primary route to the remote parking facilities and off-airport hotels. To improve traffic flow, two roadway concepts were developed that remove all signalized intersections, with replacement by ramps, bridges, and roundabouts.

5.7.1 Roadway Alternative A – Flyover Ramp

This alternative, shown in **Figure 5-29**, includes a new two-lane flyover ramp (i.e., new bridge structure) serving primary passenger traffic coming from Route 20 to the Terminal A curbside. The ramp replaces the existing at-grade signalized intersection. Westbound traffic on Schoephoester Road coming to Terminal A would have dedicated ramps to both the upper level (departure) and lower level (arrival) curbsides.

The remaining signalized intersections along Schoephoester Road would be replaced with a series of roundabouts. It should be noted that the Connecticut Department of Transportation (CTDOT) is currently planning two of these roundabouts at Light Lane and Ella Grasso Turnpike. This alternative adds a third roundabout at the Postal Road intersection.

The multilane configuration of this concept would increase traffic capacity and substantially reduce traffic delays and queues along Schoephoester Road. Capacity would remain sufficient throughout the planning period, and likely greater than necessary for near-term conditions. As such, the number of lanes necessary would be evaluated during the design phase and could be reduced as appropriate. As noted in **Chapter 3**, Schoephoester Road is owned by CTDOT not CAA, thus the upgrades of this alternative would be a collaborative effort with regards to funding and implementation.

5.7.2 Roadway Alternative B – Roundabouts

This alternative, depicted in **Figure 5-30**, replaces all existing at-grade signalized intersections with roundabouts. A roundabout instead of a flyover ramp would have lower construction and maintenance costs, and provides opportunities for landscaping and gateway signage features. For Alternative B, the roundabout also enables integration of Cargo Road. A potential disadvantage of roundabouts is there difficult for some drivers to navigate, particularly as they are still a newer intersection type in Connecticut. The remaining features of Alternative B are identical to Alternative A.

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BRADLEY INTERNATIONAL
MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 150 300

Figure 5-29
Roadway Alternative A

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BRADLEY INTERNATIONAL
MASTER PLAN UPDATE

Figure 5-30
Roadway Alternative B

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5.8 PASSENGER PARKING ALTERNATIVES

Following the planned development of the Ground Transportation Center (GTC) and Consolidated Rental Car (CONRAC) facility, the area currently used for rental cars may be repurposed for on-airport passenger parking. This location on the north side of Schoephoester Road currently contains Lot 3. With expansion into the existing rental car area, capacity may be increased to accommodate 2,000 to 4,000 vehicles, depending on the area allocated for parking.

5.8.1 Passenger Parking Alternative A

This concept, shown in **Figure 5-31**, maximizes this portion of the airport for vehicle parking with the removal of several underutilized facilities. Specifically, the alternative removes each of the following facilities for the development of convenient and expanded parking:

- Two existing East Cargo buildings
- US Postal Service cargo building and post office
- All existing rental car facilities
- Taxi / Bus staging lot

This maximization enables over 3,800 passenger parking spaces in proximity to Terminal A, similar to the capacity of the parking garage, and greater than all existing remote passenger parking provided by CAA. This new facility may replace the need for parking in remote lots 4, 5A, 5B, 5C, and the existing Cell Lot.

As illustrated, the closest portion of the parking lot to the Terminal Building could include an elevated and enclosed walkway to the terminal. As this walkway would be over 1,500 feet in length, it would be equipped with moving sidewalks to reduce the walking time to approximately five minutes. Due to its large size, all areas of the parking lot would include ground level covered walkways, with shuttle bus stops throughout the facility. Additionally, portions of the lot may also be configured for valet parking service.

As the most distant location of this parking lot is ¾ miles to the terminal curb, the facility would provide the greater passenger convenient compared to the other available BDL and off-airport remote parking facilities.

This alternative can be implemented in phases as existing facilities are removed, with implementation commencing upon the completion of the CONRAC facility. An advantage of surface parking alternatives is their low cost of construction and ease of expansion. Furthermore, if parking demands significantly decrease in the future, conversion to other uses is readily feasible. Thus, the alternative as shown may be considered the maximum or full buildout of surface parking for BDL. Many scaled-back variations of this alternative could be considered with parking capacity of 2,000 to 3,000 spaces.

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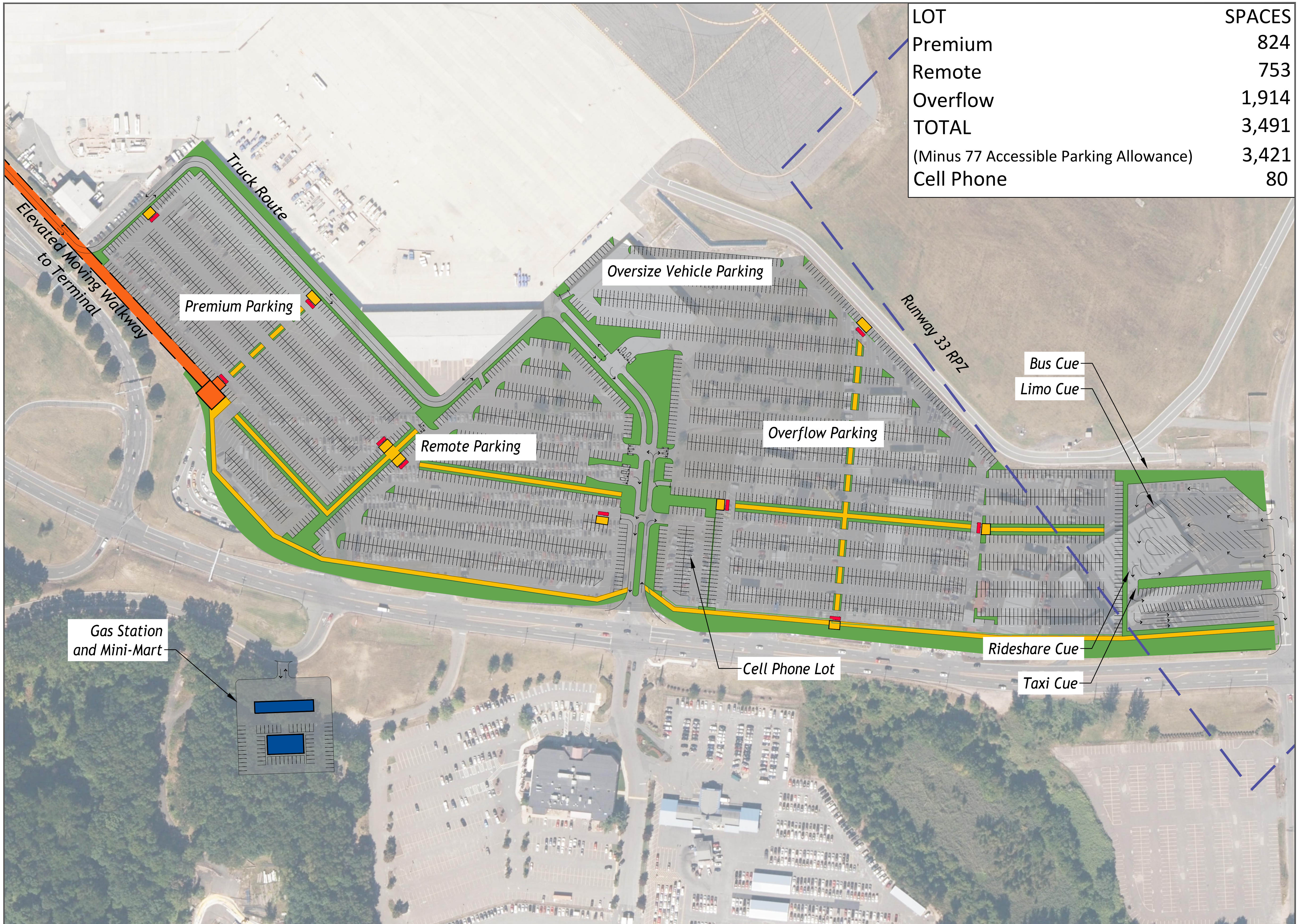

LOT	SPACES
Premium	824
Remote	753
Overflow	1,914
TOTAL	3,491
(Minus 77 Accessible Parking Allowance)	3,421
Cell Phone	80

GRAPHIC SCALE (FEET)
0 50 100 200

LEGEND

- Shuttle Bus Stop
- Walkway
- Elevated Walkway
- Landscape

Figure 5-31
Remote Parking Plan

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5.8.2 Passenger Parking Alternative B

The concept depicted on **Figure 5-32** is one such variation that positions the Cell Lot closer to Terminal A and retains the Taxi / Bus staging lot on Schoephoester Road. As shown, this alternative still provides over 3,000 passenger parking spaces.

It is noted that even with the new CONRAC facility, space for rental car heavy maintenance will still be needed in proximity to the terminal, as will a location for Taxi / Bus staging, and a US Post Office. With the development of either of the above alternatives, locations for these other services could be provided at the current location of Parking Lots 4, 5A, 5B and 5C, as well as the parcel located on the south side of Schoephoester Road. Other potential reuses of these sites may include any airport-related services such as a gas station/convenience store or hotel. This depiction also illustrates a potential gas station located on the parcel south of Schoephoester Road.

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LOT	SPACES
Premium	851
Remote	753
Overflow	2,294
TOTAL	3,898
(Minus 78 Accessible Parking Allowance)	3,820
Cell Phone	80

BRADLEY INTERNATIONAL
MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 50 100 200

LEGEND

- Shuttle Bus Stop
- Walkway
- Elevated Walkway
- Landscape

Figure 5-32
Alternate
Remote Parking Plan

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5.9 RECOMMENDED DEVELOPMENT PLAN SUMMARY

Based on the review of the Airport's goals and objectives, as well as its needs and constraints identified in this Chapter and previous Chapters, specific alternatives were identified as the most reasonable to form the recommended development plan for BDL. This plan improves the safety, operational efficiency, and functionality of the airfield, and incorporates all necessary facilities. This section provides a summary of the major concepts and the Preferred Development Strategy in support of the short and long-term operation of the Airport.

As mentioned previously, there are a substantial number of areas on the Airport that were evaluated and have recommended improvement concepts. It should be emphasized that this is a long-term plan, and that some desired improvements may not be financially or environmentally feasible.

The recommended plan for BDL is illustrated in **Figures 5-33** and **5-34**. **Tables 5-2**, **5-3**, **5-4**, and **5-5** provide a summary of the advantages and disadvantages of each key alternative or concept.

5.9.1 Runway 6-24

The primary runway at BDL was found to be adequate throughout the planning period. An analysis was conducted to determine if an extension to 10,000 feet or more was necessary for future international service. Based on the potential future destinations (i.e., stage lengths), additional runway length was not needed. Similarly, runway width, lighting, and instrumentation were also determined to be adequate.

Note that at the end of Runway 6, Taxiways 'C' & 'J' are currently aligned with the runway at point 50 feet short of the true runway end. As such, as part of an ongoing taxiway pavement reconstruction project, the taxiway intersection alignment at Runway 6 is being revised to relocate the taxiway connections to the end of the runway. This minor change is reflexed in project figures.

Also note that the existing Runway 24 glideslope antenna and shelter supporting the Instrument Landing System (ILS) is located within the Runway Object Free Area (ROFA). To remove the glideslope from the ROFA, it is recommended that it be relocated to the opposite side of the runway.

Finally, it is also noted that an airport obstruction analysis identified off-airport tree obstructions in the final approach to Runway 6 that penetrate the critical 34:1 slope. Separately from the Master Plan, CAA will pursue avigation easements and removal of these tree obstructions.

5.9.2 Runway 15-33 Extension

Runway 15-33 is deficient in length to serve as the secondary runway for many airline and air cargo operations. For this reason, it is recommended that the runway extensions of 753' in total, to a final length of 7,600 feet, are included in the long-term plan for BDL. Although airfield capacity does not require a secondary runway at BDL, there operational and safety advantages to retaining and improving Runway 15-33, and thus the extensions are recommended for inclusion in the final plan for the reasons outline above and summaries in **Tables 5-2**, **5-3**, **5-4**, and **5-5**.

This recommendation has three components:

- Runway 33 – minor extension of 253’
- Runway 15 – conversion of 500’ of pave overrun to full strength runway
- EMAS – add an EMAS bed on the stop end of Runway 33 to increase ASDA & LDA.

An optimum length was determined to be 7,600’, based on the Runway Length Analysis in **Chapter 4**, or 753’ longer than currently provided (i.e., 6,847’). The use of declared distances are recommended to prevent the need to extend the RSA, OFA, and approach RPZs. Due to the prevailing winds, the majority of operations are on Runway 33. Even with the implementation of declared distances, the takeoff lengths for Runway 33 are increased to 7,600’ and landing length increased to 7,347’.

At the end of Runway 15, the existing airport service road is located within the Runway Object Free Area (ROFA). Relocation is recommended.

Runway 33 is currently equipped with a Medium Intensity Approach Light System, with Sequenced Flashing Lights (MALSF) extending 1,400’ form the runway end. It is recommended that this system be upgraded to a 2,400’ long Medium Intensity Approach Lighting System, with Runway Alignment Indicator Lights (MALSR). This upgrade could reduce the visibility minimum on the Runway 33 ILS to ½ mile, but would result in five pole mounted lights extending across Ella Grasso Turnpike (Route 75) onto private property.

5.9.3 Runway 1-19 Closure

Due to lack of use, need, and existing restrictions, Runway 1-19 is recommended for permanent closure (i.e., removal from the ALP).

5.9.4 Full Parallel Taxiways

The recommendation for full parallel taxiways on both sides of Runways 6-24 and 15-33 is included for safety. With existing and future development located on both sides of these runways, parallel taxiways are needed to avoid the need for aircraft runway crossings. This is an FAA priority, as it has been shown as an effective method to reduce runway incursions (i.e., inadvertent entry of an aircraft onto an active runway). This recommendation also has other safety, efficiency, and economic develop benefits. Based on high costs and limited funding available, this recommendation is separated into phases, as follows:

- Taxiway “W” extension to Runway 6-24 – Short-term (5+ years)
- Taxiway “W” extension to Runway 15 end – Mid-term (10+ years)
- Taxiway “J” extension to Runway 24 end – Long-term (15-20 years)

The short-term extension of Taxiway ‘W’ would result in closure, and potential pavement removal of Taxiway ‘K’. The Taxiway ‘W’ extension replaces the use of Taxiway ‘K’, which may be converted into an airport service road.

In the long-term, existing and future trees located on the north side of the airport property may inhibit the Air Traffic Control Tower (ATCT) line-of-sight to the extension of Taxiway ‘J’. As such, some tree clearing may be needed in locations with proximity to the Taxiway ‘J’ extension.

5.9.5 Eliminate Apron-to-Runway Access

As discussed above, many locations on the airport include direct access from an aircraft parking apron to a runway, without a required turn. These locations are described as having direct 'apron-to-runway access', and include several places along the passenger terminal apron, as well as at taxiway connections from the aprons serving the CTANG, FedEx, East Cargo Area, and TAC Air.

To adhere to FAA standards, it is recommended that each of these configurations are addressed during the planning period, and incorporated into a rehabilitation or reconstruction project for the associated facility. As none of these locations at BDL have been shown to have a history of or greater risk of runway incursions or other aircraft incidents, they have not been designated by the FAA as hotspots. As such, in lieu of separate projects to specifically address these non-standard conditions, it is recommended that such improvements are incorporated into periodic rehabilitation projects for the associated locations.

For example, a 2018 project to reconstruct Taxiway 'C' South will incorporate 'painted islands' to eliminate the direct apron-to-runway access along Taxiway 'C' at intersecting Taxiways 'S' and 'V'. It is also noted that the recommended extensions to Runway 15-33 include elimination of direct apron-to-runway access as a secondary outcome at the location of the FedEx, TAC Air, and East Cargo aprons.

Note - as shown previously, a recommended configuration is provided to remove direct apron-to-runway access at Air National Guard apron. However, the Air Force is coordinating with the FAA to determine if that change should be implemented. Based on military readiness requirements, the direct access may be retained at this location. CAA will support the final determination of the FAA and Air Force.

5.9.6 Taxiway "E" Relocation

As the existing location of Taxiway 'E' prevents expansion of the adjacent aprons and tenant facilities, it is recommended that Taxiway 'E' is relocated to the location of Runway 1-19. Existing Taxiway 'E' would then be converted to a taxilane, and could ultimately become part of the leased area of airport tenants. The Taxiway 'E' relocation is recommended in two phases:

- **Short-term**: This initial phase could be combined with the permanent closure of Runway 1-19, and would include revisions to the markings, signage, and lighting. Removal of some existing pavement is also recommended, particularly the existing Runway 1-19 pavement connecting to Runway 6-24. As shown in **Figure 5-33**, the pavement removal would eliminate BDL Hotspot 1.

- **Long-term**: Ultimately, the pavement at the Taxiway "E" intersections with parallel Taxiways "C" and 'T' may be reconfigured to remove the acute angles, as shown on **Figure 5-34**. The FAA recommends 90^{o} right-angle intersections for improved visibility. Changing the geometry could also be accomplished as part of other projects such as rehabilitation of Taxiways 'C' and 'T', or the extension of Taxiway 'T'. This long-term recommendation would improve operational efficiency, but is not an FAA requirement, and could be deferred at CAA's discretion.

Ultimately, an additional connector taxiway could be considered (i.e., Taxiway 'E1'), connecting new Taxiway 'E' to the adjacent taxilane and apron area.

5.9.7 Taxiway "G" Realignment

Taxiway 'G' currently contains an acute angle connecting to Taxiway 'C'. Ultimately, this taxiway could be reconfigured to connect at a standard 90^o right angle to improved visibility. This project could be considered during the next rehabilitation project for Taxiway 'C' or 'G'.

As Taxiway 'G' only serves the CT Army National Guard facility, the Airport's financial responsibility for the project is limited to up to the taxiway-taxiway hold line. Thereafter Taxiway 'G' is the responsibility of the Guard.

5.9.8 Aircraft Parking Aprons

The provision of aircraft aprons is based primarily on capacity. As such, apron expansion is currently recommended for RON parking for airline tenants, as well as for the deicing apron. These facilities currently experiencing congestion and capacity constraints, and are recommended for improvement in the short-term. RON parking expansion is recommended on the former East Cargo Apron area and at the FIS facility (following development of new FIS facility within the terminal building). The deicing apron expansion can accommodate two additional positions (expansion from 3 to 5 positions). It is also recommended that major terminal building improvements consider deicing fluid separation and collection to better accommodate at-gate deicing.

Other apron expansions are the responsibility of airport tenants, who lease and maintain their own facilities. The timeframe and configurations are also the tenant's responsibility; however, the long-term plan includes an area planned or reserved for future expansion for each of the following aprons: UPS, FedEx, Signature Flight Support, TAC Air, Bombardier, and Embraer.

5.9.9 Passenger Terminal Building

Terminal A currently experiences various deficiencies in space, layout, and use. It is recommended that short-term development should prioritize fully utilizing Terminal A prior to investing in a new Terminal B. These interventions include creating new arrivals corridor to limit crossflow and crowding with departure passengers, remove current bag screening devices and create a new central bag screening facility, and expanding security checkpoints to limit overflow of passengers.

Due to changing programmatic requirements of BDL's passenger facilities, it is recommended that Terminal B should follow the Consolidated Terminal Alternative. This concept is a modification of the original Terminal B plan that allows for a more cohesive terminal experience for passengers as well as the added benefit of lower costs.

5.9.10 Roadway and Parking

Following completion of the planned Ground Transportation Center (GTC) and Consolidated Rental Car (CONRAC) facility, it is recommended that access and parking improvements are pursued along Schoephoester Road. The recommended alternative would replace the existing at-grade signalized intersections with roundabouts to reduce congestion and maintenance costs. The roadway improvements could include enhanced landscaping, lighting, and incorporate sidewalks and bus shelters.

Separately or as a consolidated project, passenger parking Lot 3 should be substantially expanded, providing overflow parking that is closer to the terminal than all other remote parking provided by BDL or privately. The parking expansion can be pursued in phases following property availability as existing airport leases expire in that location.

Table 5-2 – Recommended Plan-Airside

Alternative/Concept	Advantages	Disadvantages	Recommended?	
			Yes/No	Phase
Runway 6-24 Extension (not illustrated)	• Improved runway length, if future requirements justify an increase in the future	• Not necessary per Facility Requirements • Cost & additional maintenance requirements	No	N.A.
Runway 15-33 Extension	• Provides secondary runway that accommodates most commercial operations with a 7,600' length • Runway 33 is the predominant wind runway • Potential safety improvement • Improved operational flexibility/efficiency • Reuse of existing airfield pavement	• A portion of the extensions are not useable for landings (due to declared distances • Requires multiple taxiway extensions • Cost & added maintenance requirements)	Yes	Long-Term
Runway 1-19 Closure	• Runway 1-19 is not used, and no desired use was identified • Operations restricted to single direction due to adjacent terminal facilities. • Eliminates Hotspot No. 1 • Enables relocation of Taxiway E & apron expansion • Improved taxiway routes/efficiency	• A portion of the existing runway pavement (between Runway 6-24 and Taxiway C) should be removed.	Yes	Short-Term
Full Parallel Taxiways	• Eliminates need for active runway crossings /improves safety (reduces potential of runway incursions) • Reduces impacts associated with Hotspots No. 2 & 3 • Reduced taxi times/increased efficiency • Increased airfield capacity	• Cost & added maintenance requirements • Potential grassland habitat impacts • Additional impervious surface and stormwater drainage considerations • Potential wetland impacts (near Runway 24) • Some tree removal necessary for ATCT line-of-sight.	Yes, in phases	Short, Mid., & Long-Tern

Table 5-3 – Recommended Plan-Airside (continued)

Alternative/Concept	Advantages	Disadvantages	Recommended?	
			Yes/No	Phase
Eliminate Apron-to-Runway Access	• Improves safety (reduces potential of runway incursions) • Required to meet FAA Design Standards	• Increases taxi times • Reduced operational efficiency • Cost & added maintenance requirements)	Yes	With assoc. facility*
Taxiway 'E' Relocation –	• Improves taxiway routes/efficiency • Enables apron expansion • Repurposes Runway 1-19 pavement • Provides an overflow aircraft parking location of aircraft diversions • Moderate costs • No environmental impacts	• Requires revised lighting, marking, and signage. • Requires removal of existing pavement	Yes, in phases	Short & Long-Term
RON Apron Expansion	• Provide needed capacity • Reduces at-gate congestion and delays • Supports efficient use of existing apron area • Reduces / delays need to increase number of gates.	• May not be eligible for FAA funding • Cost & added maintenance requirements) • RON locations not configured for deicing fluid collection	Yes	Short-Term

*Apron-to-Runway Access can be address in association with rehabilitation or reconstruction projects of the related facility.

Table 5-4 – Recommended Plan-Airside (continued)

Alternative/Concept	Advantages	Disadvantages	Recommended?	
			Yes/No	Phase
Deicing Apron Expansion	• Provide needed capacity • Reduces congestion & departure delays • Supports efficient use of existing apron areas • Improved flight safety • Reduces congestion on Taxiway "C" and existing facility • Reduces at gate deicing activities • Reduces stormwater pollution.	• May not be eligible for FAA funding • Location not ideal for Runway 24 and 33 departures • Cost & added maintenance requirements)	Yes	Short-Term
Other Apron Expansions	Aircraft Parking apron expansions are the responsibility of the airport tenant. Concepts were provided for the potential expansion of all primary general aviation and air cargo tenants. It is recommended that overall airport development plan retain the capability for all tenants to expand their facilities as necessary. However, the ultimate size and configuration of any expansion would be defined by the tenant.		TBD	As needed

Table 5-5 – Recommended Plan-Terminal Area

Alternative/Concept	Advantages	Disadvantages	Recommended?	
			Yes/No	Phase
Consolidated Passenger Terminal Building	• Utilizes capacity of Terminal A • International equally accessible from A or B • Short walking distances • International arrive and connect through Terminal B • Unified airside experience • Lower Cost	• Minor duplication of processors • 5 gates with single taxilane access • Complex construction phasing	Yes, in phases	Short, Mid., & Long-Term
Roadway Improvements	• Improves passenger experience • Increases roadway capacity & reduced traffic queues • Supports pedestrian and mass transit facilities • Can be developed in phases • Improvement of existing facilities • Moderate construction costs	• Construction is difficult on active roadways • Coordination required with CTDOT • Drainage improvements are needed for stormwater	Yes	Mid-Term
Parking Lot Expansion	• Reduces distance to passenger terminal • Can be developed in phases as existing facilities are redeveloped • Redevelopment of existing facilities • Moderate construction costs • Potential for significant parking capacity improvement • Potential for passenger walkway to terminal	• Shuttle service will still be required • New location will be need for heavy maintenance of rental cars • A portion of parking area is within RPZ (FAA approval required) • Drainage improvements are needed for stormwater • Building demolition is necessary	Yes	Mid-Term

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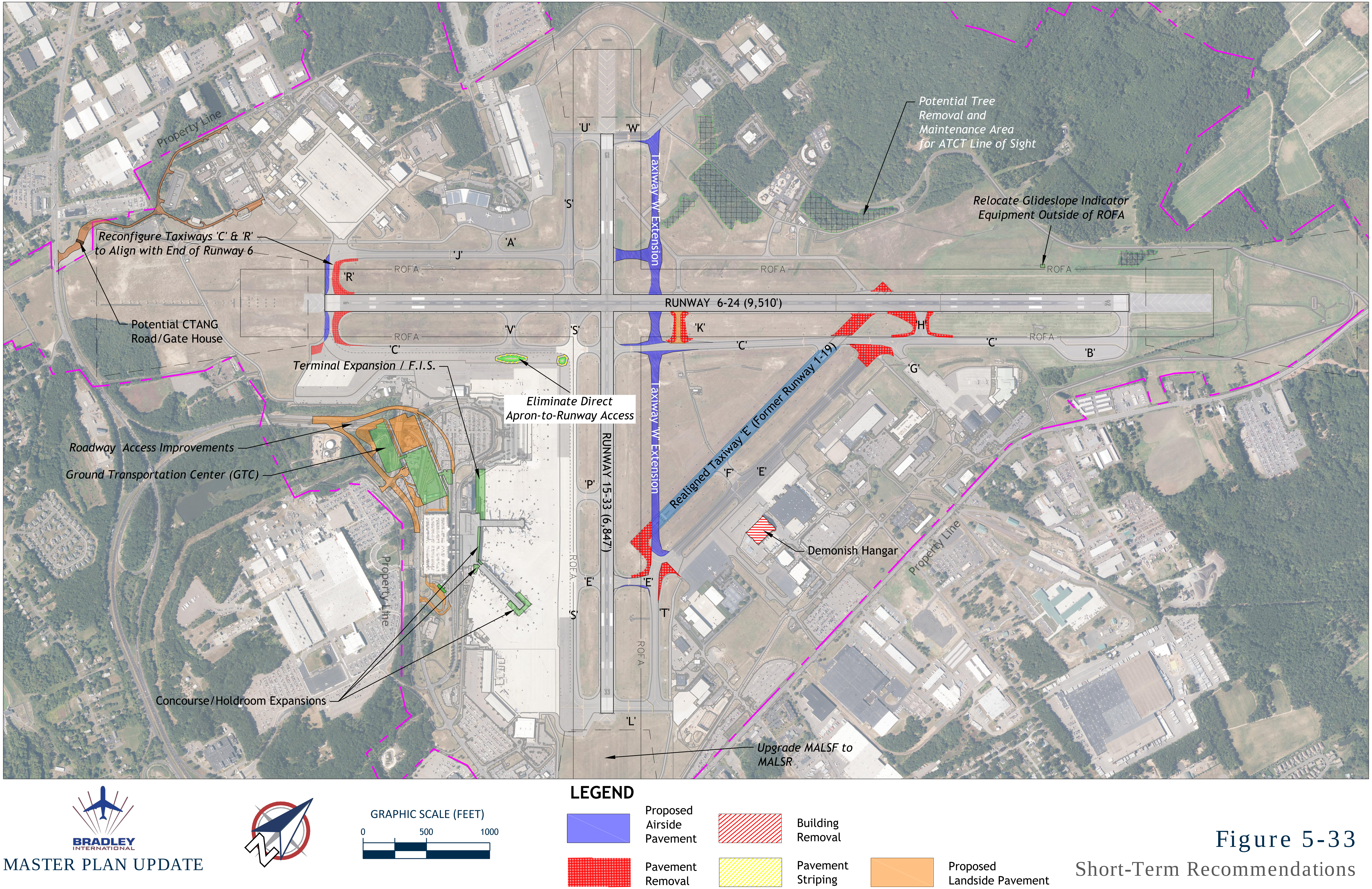

MASTER PLAN UPDATE

Figure 5-33

Short-Term Recommendations

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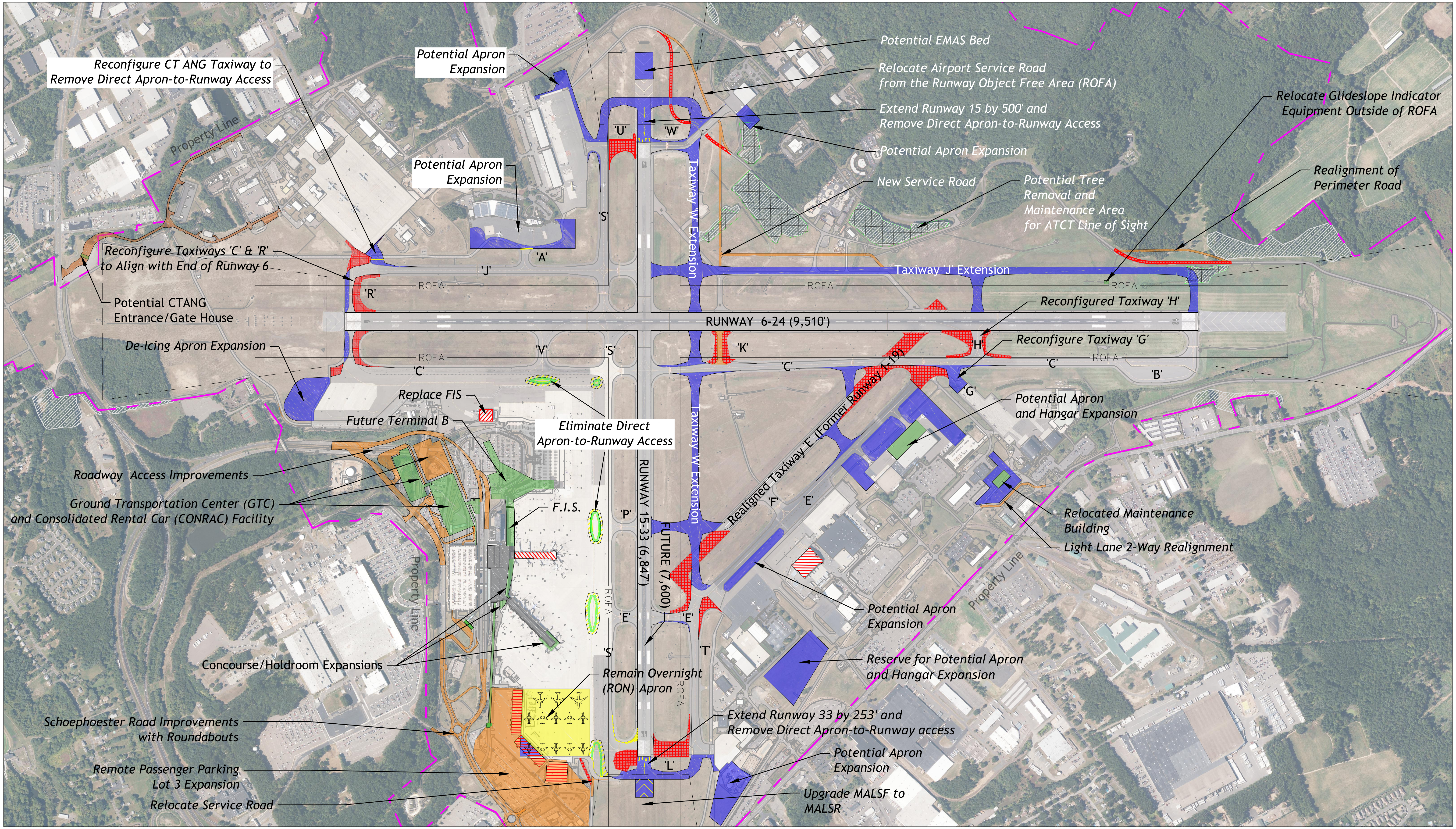


BRADLEY INTERNATIONAL
MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 500 1000

LEGEND

Proposed Airside Pavement	Building Removal	Proposed Building
Pavement Removal	Pavement Striping	Proposed Landside Pavement

Figure 5-34
Recommended Plan

6 ENVIRONMENTAL OVERVIEW

This section provides a preliminary assessment of the environmental factors considered as part of the development and implementation of the Preferred Alternative. This review was conducted in accordance with the FAA Orders 5050.4B, *National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions* and 1050.1F, *Environmental Impacts: Policies and Procedures*. This review does not provide a complete investigation sufficient for obtaining environmental permits or compliance with environmental documentation, such as an Environmental Assessment (EA) under the requirements of NEPA, as amended. Previous environmental documentation completed at Bradley International Airport, a review of existing GIS data and hard-copy maps, and coordination with relevant environmental regulatory agencies were relied upon to develop an inventory of resources and to identify potential impacts related to the implementation of the recommended development plan illustrated in Figure 5.34. As shown in the figure, the primary recommendations include the following:

Airfield:

- Closure of Runway 1-19, with conversion to Taxiway 'E'
- Full Parallel Taxiways on both sides of the runways
- Relocation or reconfiguration of Taxiways 'G', 'H', 'K'
- Expansion of various aircraft parking aprons
- Expansion of centralized deicing apron near Runway 6 end
- Improvements to Runway 15-33
    - Removal of direct Apron access
    - Runway extensions, with displaced thresholds
    - Engineered Materials Arresting System (EMAS)

Terminal/landside:

- Development of the Ground Transportation Center (GTC)
- Improvements to existing Terminal A
- Construction of a new Passenger Terminal Building
- Expand on-airport passenger parking facilities (Lot 3)
- Roadway improvements along Schoephoester Road
- Relocation of an existing maintenance building and realignment of Light Lane

The purpose of this review is to identify the potential environmental impacts, environmental issues, and environmentally sensitive areas that may affect future development at the Airport and to identify those environmental issues that may require additional environmental analysis prior to implementation. The environmental impact categories evaluated herein are:

- Noise
- Compatible Land Use
- Social and Economic Environment

- Air Quality
- Water Quality
- Department of Transportation Act, Section 303
- Historic, Architectural, Archaeological, and Cultural Resources
- Biotic Communities
- Threatened and Endangered Species
- Wetlands
- Floodplains
- Coastal Zone Management Program
- Prime and Unique Farmlands
- Wild and Scenic Rivers
- Energy Supply and Natural Resources
- Light Emissions
- Visual Effects
- Solid Waste
- Hazardous Waste
- Transportation

6.1 NOISE

The Airport's *Part 150 Airport Noise Compatibility Program* completed 2004, identified over 200 acres of residential development adjacent to the Airport that were subjected to elevated aircraft noise levels. The incompatible land uses consisted of residential properties, and the airport implemented a program of noise insulation. The updated *Part 150 Noise Exposure Map Update*, prepared in 2013, depicted modified noise contours of the Day-Night Average Noise Level (DNL), the method by which FAA requires airports to evaluation noise impacts. Pursuant to FAA regulations, the DNL 65 dB represents the points at which noise-sensitive land uses become significantly impacted, and therefore, incompatible with the Airport. In addition to homes, other noise sensitive uses include schools, churches, hospitals, libraries, and nursing homes.

As shown in the *2013 Noise Exposure Contours* map (Figure 6-2a), the DNL 65 dB contour extends approximately 0.5 mile beyond both ends of Runway 15-33 into a combination of commercial and undeveloped land uses. The DNL 65 dB contour extends beyond the Runway 6-24 ends by over a mile into a combination of residential, commercial, industrial, governmental, and undeveloped land uses. According to the Noise Exposure Update, several dozen single-family residences occurred within the 65 DNL contour in 2013, with several dozen more anticipated by 2018 (Figure 6-2b); however, no schools, churches, hospitals, libraries, or nursing homes occur within the 65 DNL noise contour. As no residents are subject to noise over 70 DNL, residential noise insulation remains the recommendation for affected homes. After 2018, an additional update to the Noise Exposure Map should be considered.

6.2 COMPATIBLE LAND USE AND ZONING

6.2.1 Compatible Land Use

Land uses that are/are not compatible with Airport use, based on noise sensitivity associated with each use, are defined in the FAA Order 1050.1F, Environmental Desk Reference. Incompatible land uses based on noise sensitivity include residential areas and facilities such as schools, hospitals, and libraries, as discussed in Section 6.1 above. Further, land uses on airports and in the immediate vicinity of runway ends are further constrained by FAA's protected airspace area regulations, to avoid obstructions to navigable airspace. At BDL, the evaluation determined that airspace impacts are limited to off-airport trees in proximity to the runway ends.

Based on data provided by the Capital Region Council of Governments (CRCOG), in general, land uses surrounding the Airport are compatible with the Airport, and include commercial, industrial, and undeveloped areas (see Figure 6-1). This is consistent with data provided in previous planning documents for the Airport. As shown on Figure 6-1, land uses north of the Airport are primarily commercial, undeveloped, or agricultural. Further north, as noted in previous reports, land uses are residential along Hale Street, Spencer Street, and Austin Street, approximately one mile north of the Airport. Most of the land to the west is commercial and industrial, with residential and undeveloped areas present as well. Land uses east of the Airport comprise mostly commercial, industrial and undeveloped. Areas to the south of the Airport are primarily industrial (associated with the Hamilton Sundstrand facility), but also include a combination of residential, undeveloped/wooded areas, and agricultural fields.

It should be noted that some commercial properties southeast of the Airport, near the intersection of Schoephoester Road and Route 75, are within the Runway Protection Zone (RPZ) for the Runway 33 end (see Figure 2-1). For land use protection and compatibility, properties within the RPZ are eligible for FAA-funded acquisition. If such properties become available, CAA should consider purchasing to prevent potential incompatible development.

Most of the actions recommended in this study are contained on the Airport and would not affect off-Airport property or impact compatible land use. The only recommendation that would support increased capacity at the Airport is the proposed construction of a new passenger terminal building (Terminal B). Impacts of construction of this new terminal were evaluated in the *Environmental Assessment and Environmental Impact Evaluation for the New Terminal B Passenger Facility and Associated Improvements at Bradley International Airport Environmental Assessment (EA)*, prepared in 2012. With respect to land use, the Terminal B EA concludes that construction of the new terminal building:

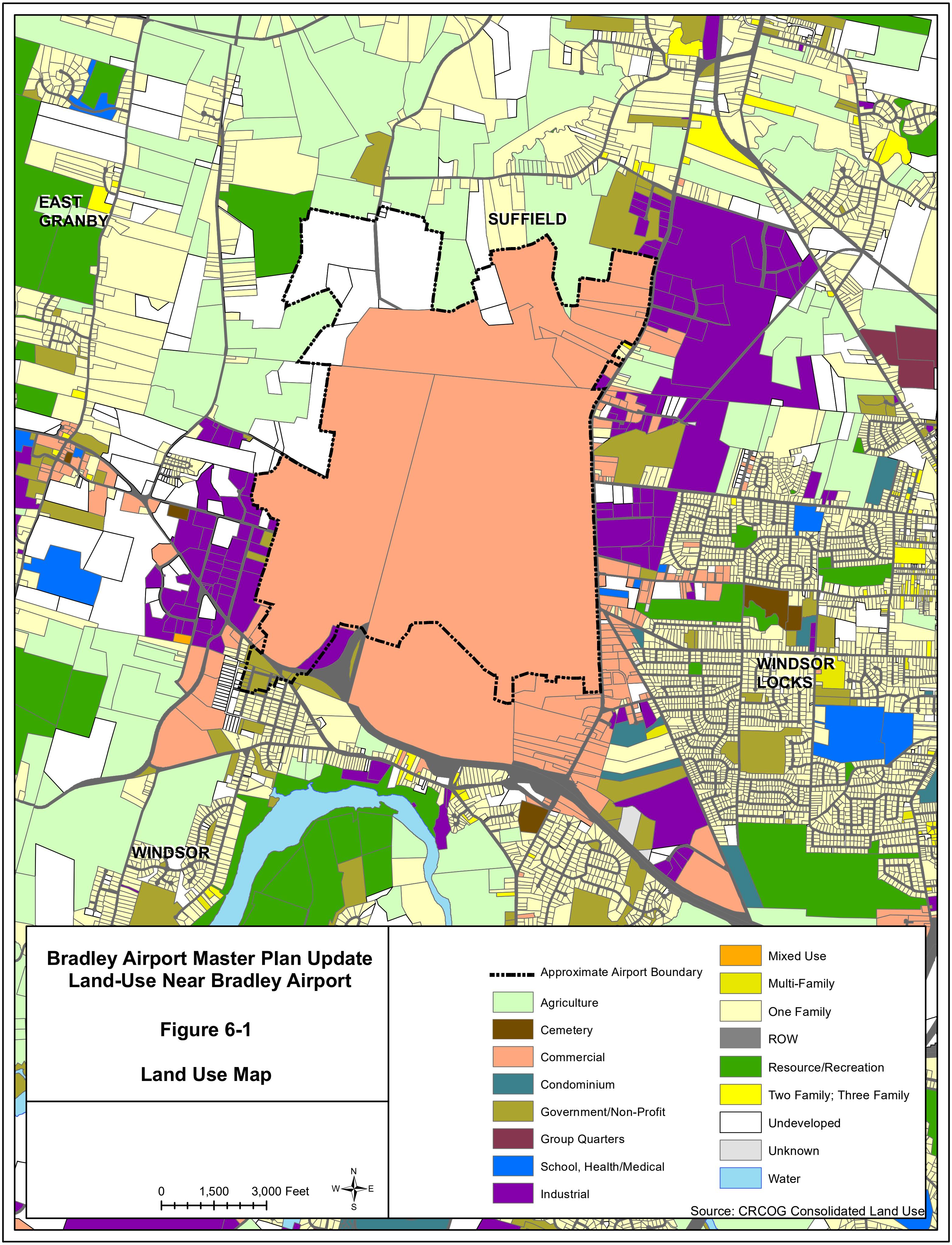
> *"is consistent with current on-airport land use and land use clustering identified in the [2005 AMPU] since it would continue to improve existing passenger facilities in proximity to access roads, and other travel amenities. As such, the Proposed Action is not expected to result in any on-airport land use impacts."*

The Terminal B EA further states:

> *"Addressing off-airport impacts associated with noise or surface transportation issues are related to the presence of the airport and aviation activity, and are not specific to the Proposed*

> *Action, which is a response to forecast increases in passenger enplanements/deplanements and aircraft operations."*

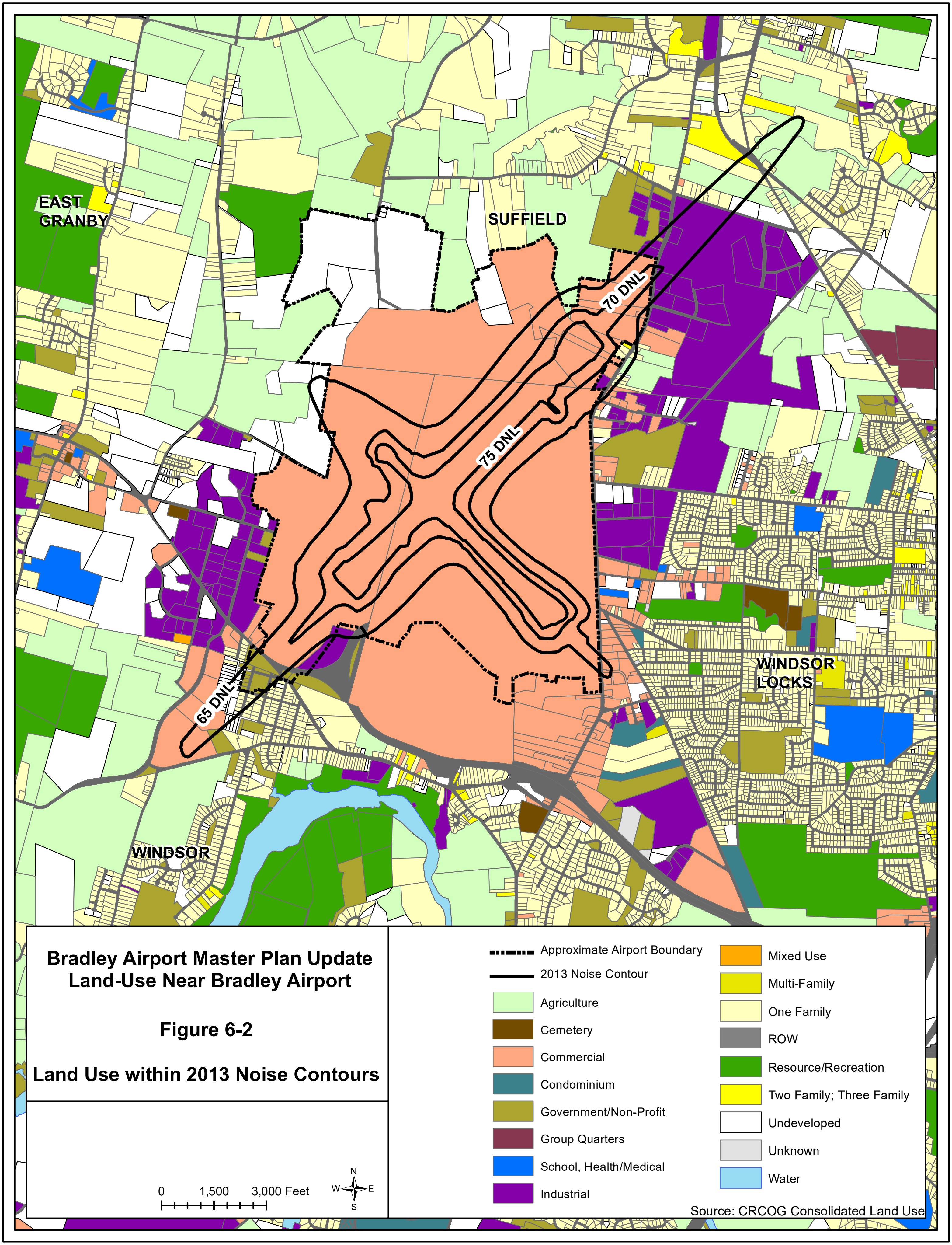
Based on the foregoing, the construction of the new passenger terminal is a response to forecast increases which are included in projected noise contours. Therefore, it is not anticipated that the recommendations to the master plan would impact compatible land use. However, after 2018, updated noise contours should be considered to address any anticipated changes since the 2013 study.



Bradley Airport Master Plan Update
Land-Use Near Bradley Airport

Figure 6-1

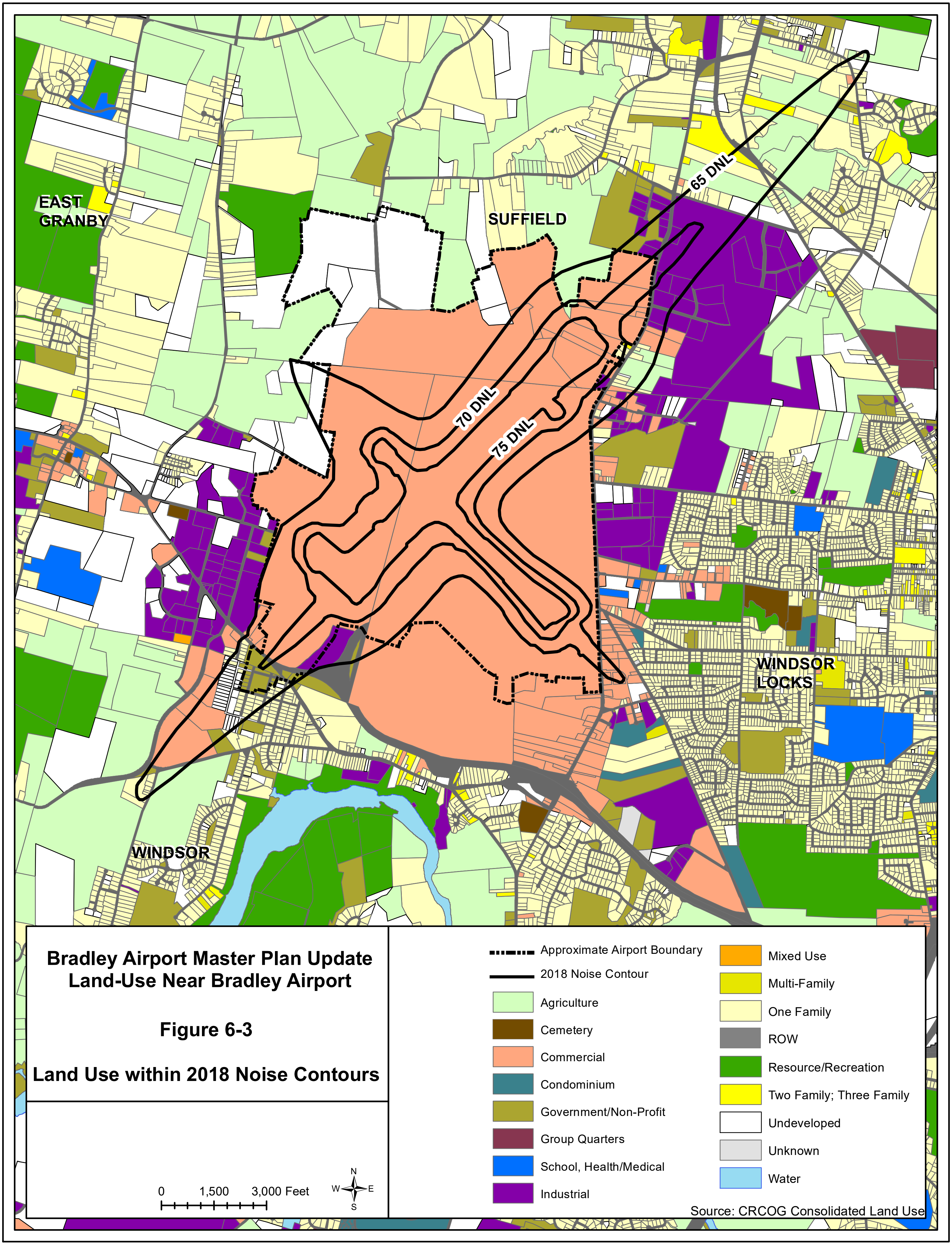
Land Use Map



Bradley Airport Master Plan Update
Land-Use Near Bradley Airport

Figure 6-2

Land Use within 2013 Noise Contours



Bradley Airport Master Plan Update
Land-Use Near Bradley Airport

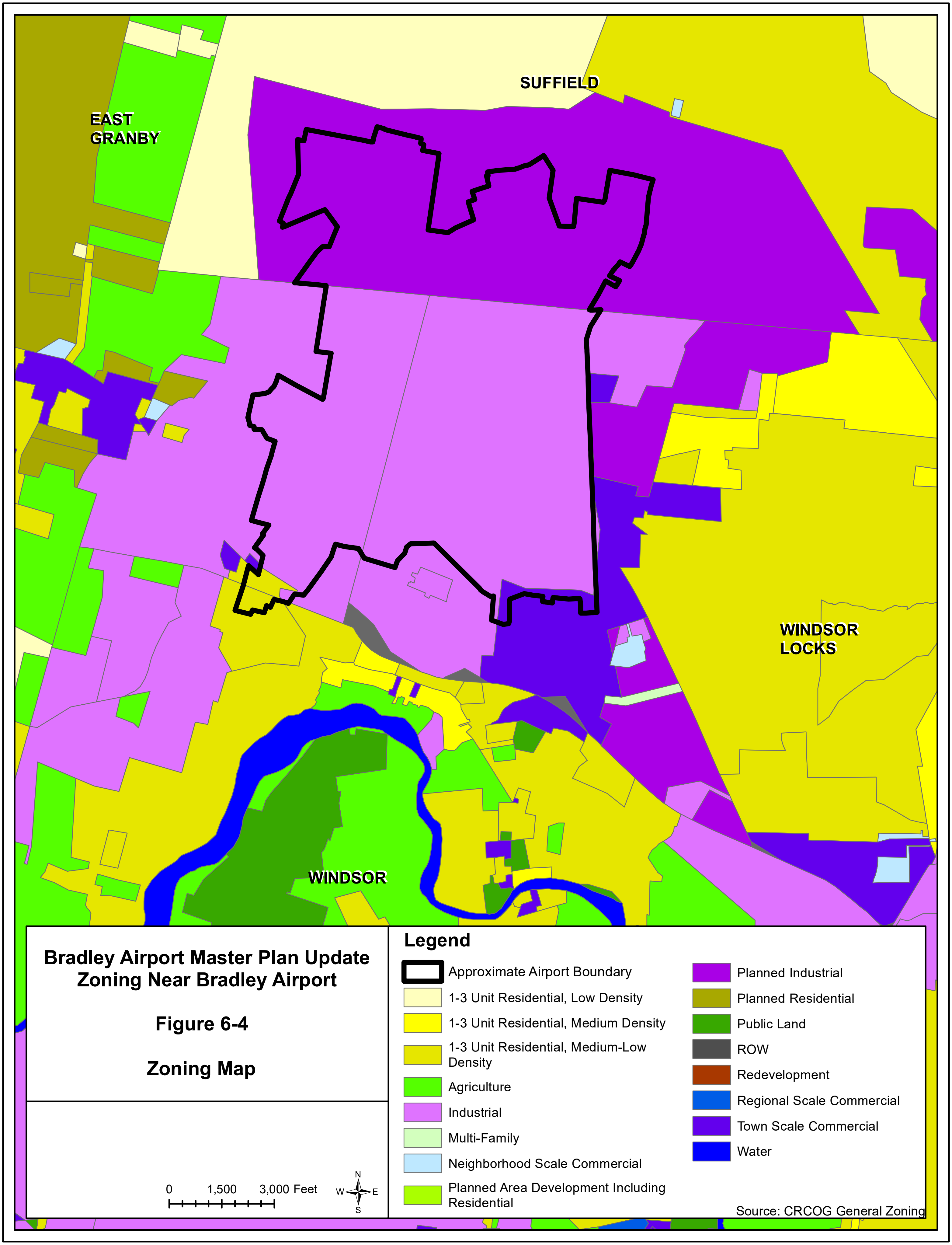
Figure 6-3

Land Use within 2018 Noise Contours

6.2.2 Zoning

As shown on Figure 6-3, zoning at the Airport is primarily industrial, but also includes planned industrial, in the northern portion of the Airport, near and north of the Runway 24 end. Zoning in the immediate vicinity of the Airport includes planned industrial to the north, beyond which is residential and planned residential; commercial, industrial, and planned industrial to the east, beyond which is mostly residential; industrial and commercial to the south, with residential, agricultural, and public land beyond; and industrial to the west, with mostly residential, planned residential, and commercial beyond.

Since the study recommendations would occur on Airport property and are consistent with the current Airport use and existing facilities, there would be no impact on zoning.



Bradley Airport Master Plan Update
Zoning Near Bradley Airport

Figure 6-4

Zoning Map

6.3 SOCIAL AND ECONOMIC ENVIRONMENT

6.3.1 Socioeconomic Resources

The Airport is situated within four municipalities: East Granby, Suffield, Windsor, and Windsor Locks. In general, the project area is limited to the Airport and the immediately surrounding area, however, for the purposes of characterizing the socioeconomic environment, the study area includes all four municipalities. Socioeconomic data, including population and housing data, based on information available through the U.S. Census Bureau and Connecticut Economic Resource Center (CERC), is provided below for each of the towns within the socioeconomics study area.

Table 6-1– Socioeconomic Study Area, Population and Median Household Income

Municipality	2011-2015 ACS Population	Population Density (population per square mile)	Population Change 2010-2015 (percent)	Population Change 2015-2020 (percent)	2011-2015 ACS Median House Income
East Granby	5,123	292	-0.5	0.7	$72,684
Suffield	15,657	370	-0.5	1.1	$99,707
Windsor	29,095	986	0.2	-0.4	$81,982
Windsor Locks	12,556	1,393	0.5	0.0	$68,944
Hartford County	896,943	1,220	0.3	0.6	$66,395
Connecticut	3,593,222	742	0.5	0.1	$70,331

Source: Connecticut Economic Resource Center, 2017, Accessed October 2017.

Based on the information listed in the table above, and American Community Survey (ACS) population data, 2011-2015 estimates of population in the study area are 62,431. Population in the study area has changed minimally since 2010, with minor decreases experienced in both East Granby and Suffield. Population growth rates for the four study area municipalities are generally consistent with those associated with both Hartford County and the State of Connecticut. The largest growth rate among the municipalities in the study area is projected for Suffield between 2015 and 2020, at 1.1 percent. For comparison, between 2010 and 2015, Suffield experienced a 0.5 percent decrease in population. For all other municipalities, as well as the county and the state, population change was (between 2010 and 2015) and is expected to be (between 2015 and 2020) less than 1 percent. Windsor is projected to experience a 0.4 percent decrease in population between 2015 and 2020.

Population densities vary among the four towns, with the lowest densities in East Granby and Suffield, as expected for more rural areas, and the highest density in Windsor Locks. The population densities in both Windsor and Windsor Locks are higher than that for the state, but similar to overall densities within Hartford County.

Between 2011 and 2015, it is estimated that there were 22,535 households in the four-town area, the highest concentration of which were in Windsor (10,746), comprising nearly ½ of the study area population. As shown in Table 6-1, the median household income during this time period was estimated to range from $68,944 in Windsor Locks to $99,707 in Suffield, compared to $66,395 in Hartford County and $70,331 for the state.

The Airport plays a significant role in the local, regional, and state-wide economies as both an economic generator and economic facilitator, stimulating economic growth for regional businesses. This is achieved through direct employment, including jobs for airlines, vendors, contractors, suppliers, and cargo handlers, as well as indirect off-Airport economic activity such as area hotels, rental car facilities, restaurants, etc. Wages directly or indirectly earned by local residents who are employed at or in connection with the Airport, are circulated back into the local economy through the purchase of goods and services such as housing, food, and clothing.

The master plan recommendations would have no impact on demographics. Further, displacement of residences or residential land is not contemplated in connection with implementation of the recommendations.

Most elements of this study would have no long-term negative impact on socioeconomic resources as they (airfield and terminal improvements) would not negatively affect capacity or alter employment opportunities on or off the Airport. Further, implementation of the recommendations would not require relocation of businesses or residents. The proposed roadway access improvements would only impact surface transportation patterns immediately adjacent to and within the Airport, and would have no long-term impact on socioeconomic resources. In the short-term, the proposed improvements would create additional jobs (during construction) and traffic patterns adjacent to the Airport could be temporarily modified. It is anticipated that any short-term impacts associated with these projects would be minor.

As detailed in the Terminal B EA, construction of a new passenger terminal facility and ground transportation center (GTC) (i.e., consolidated rental car facility), would have both short-term (during construction) and long-term beneficial impacts on socioeconomic resources due to the creation of new jobs. In the long term, jobs would be created in support of operating the new terminal, including retail and food and beverage services, ticketing, and security positions. The Terminal B EA further concludes that construction of a new passenger terminal facility would have no adverse impact on employment or the economy.

6.3.2 Environmental Justice

The U.S. Environmental Protection Agency (EPA) defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies. Title VI of the Civil Rights Act of 1964 was enacted to protect against discrimination based on race, color, and national origin in programs and activities receiving federal financial assistance.

Executive Order 12989, “General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” enacted in 1994, requires all federal agencies to identify and address the disproportionately high and/or adverse human health environmental impacts of their programs and policies on minorities and low-income populations and communities. The guidance provides six principles for consideration of environmental justice, which are: 1) composition of affected area and whether there are low-income populations, minorities, or Indian tribes, 2) public health and industry data for assessment of environmental hazards, 3) recognition of interrelated cultural, social, occupational, historical, or economic factors that could amplify environmental effects, 4) encouragement of public participation and accommodations to overcome linguistic, cultural, institutional, geographic, and other barriers, 5) meaningful community representation with awareness of diverse constituencies, and 6) solicitating tribal representation.

The Council on Environmental Quality's (CEQ) "Environmental Justice Guidance Under the National Environmental Policy Act" provides guidance to federal agencies on how to determine the presence of low-income and minority populations within an appropriate unit of geographic analysis. The guidance defines the identification of a minority population where either "(a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis."

Based on 2011-2015 ACS data for U.S. Census block groups surrounding the Airport, the minority population is approximately 40 percent, below the CEQ threshold of 50 percent, but above the state average for Connecticut of 31 percent.

The CEQ guidance does not provide a specific threshold to identify low-income populations, therefore, thresholds/criteria established by the Connecticut Department of Economic and Community Development (CT DECD) for Distressed Communities were used. According to the CT DECD 2016 list of Distressed Communities, the Towns of Windsor, Windsor Locks, East Granby, and Suffield do not meet the criteria for a distressed community for the purposes of Environmental Justice. However, census block groups meeting the criteria for low-income (30 percent of their population are living below 200 percent of the federal poverty level) are present in both Windsor and Windsor Locks. These communities however, are not in the vicinity of the Airport and are well outside the project area. Further, based on 2011-2015 ACS data for U.S. Census block groups surrounding the Airport, the low-income population is approximately 12 percent, well below the state average of 24 percent.

The recommendations would not have a disproportionately high and adverse impact on minority or low-income populations. The recommended projects are on Airport property, so would not result in direct physical impacts. Prior to implementation of the recommended projects, more detailed analysis may be required to fully assess environmental impacts, including those to environmental justice populations.

6.3.3 Children's Health and Safety

Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks" requires that federal agencies make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children. Such disproportionate impacts would be likely to occur at schools, day care centers, or similar facilities with higher concentrations of children. Such facilities near the Airport include the Poquonock Elementary

School and Windsor Locks High School, located approximately 1.5 miles south and south/southeast of the Airport in Windsor, respectively; the North Street School, approximately 1 mile east of the Airport in Windsor Locks; and the Carl Allgrove School located approximately 1.5 miles west of the Airport in East Granby.

The master plan recommendations have no anticipated impact on children's health and safety. The proposed projects would occur on Airport property and, as identified above, away from areas where children are likely to be present on a consistent basis. As discussed in Section 6.1 and 6.2 above, none of the schools near the Airport are within the 65 DNL noise contours, and homes exposed to high aviation levels were address through the airport's noise insulation program.

6.4 AIR QUALITY

The Clean Air Act Amendments (CAAA) of 1990 requires the EPA to set National Ambient Air Quality Standards (NAAQS) for six "criteria" pollutants considered harmful to public health and the environment. The NAAQS identify two types of air quality standards: primary and secondary. Primary standards provide public health protection, including protecting the health of "sensitive" populations, such as asthmatics, children, and the elderly. Secondary standards were established to provide public welfare protection, including protection against impaired visibility and damage to animals, soils, crops, vegetation, and buildings. The six "criteria air pollutants" that have been established by EPA to protect public health and welfare include:

- Ozone (O_3)
- Carbon monoxide (CO)
- Particulates (PM10 and PM2.5)
- Sulfur dioxide (SO2)
- Nitrogen dioxide (NO2)
- Lead (Pb)

Connecticut has adopted the national standards and has developed a State Implementation Plan (SIP) to attain and maintain the standards. The state is divided into two air quality districts: The Greater Connecticut District (Hartford, New London, Tolland, Windham, and Litchfield counties) and the New York-Northern New Jersey-Long Island (NY-NJ-CT) District. Hartford County, where the Airport is located, as part of the Greater Connecticut Nonattainment Area, is subject to planning and emissions reduction requirements of the Clean Air Act. Nonattainment for an air pollutant is assigned when one or more of the standards have been violated in at least one region in Connecticut. The Connecticut Department of Energy & Environmental Protection (CTDEEP) has identified that the Airport is within the Hartford-New Britain-Middletown, CT moderate maintenance area for CO, meaning that it is currently in attainment, but has a history of nonattainment. The entire State of Connecticut is currently designated as nonattainment for O_3, based on the 2008 8-hour Ozone standard of 0.075 parts per million (ppm).

Section 176(c) of the CAAA requires that Federal actions conform to applicable Federal and state air quality plans and, ensure that the actions will not:

- Cause or contribute to any new violation of any standard in any area

- Increase the frequency or severity of any existing violation of any standard in any area
- Delay timely attainment of any standard of any required interim emission reductions or other milestones in any area.

No air quality modeling was conducted as part of this study. If proposed developments require air quality modeling, it would be conducted during preparation of additional environmental documentation (and before construction). The results of the air quality modeling will establish whether the above requirements are met and/or if additional actions are required by the Airport to ensure compliance.

In the short-term, construction of the proposed projects could result in minor impacts on air quality at and in the immediate vicinity of the Airport related to the use of construction vehicles and equipment. It is anticipated that pollutants from the use of such vehicles and equipment would include volatile organic compounds (VOCs), nitrogen oxide (NOx), and CO.

In the long-term, improvements such as the new passenger terminal and GTC could result in minor adverse impacts to air quality from associated components such as new boilers, chillers, and/or emergency generators. These are two of the larger recommendations and have the greatest potential to adversely impact air quality. However, the Terminal B EA, which considers both projects, concludes that:

> "*the Proposed Action will not cause a significant air quality impact, since the projected increases in ozone-forming precursor emissions due to the Proposed Action are well below de minimis levels and it is unlikely that the pollutant concentrations would exceed a NAAQS. In addition, the maximum annual emissions during construction would not exceed the de minimis levels.*"

Some of the master plan recommendations could also result in minor improvements in air quality in the future. Specifically, the roadway improvements and the GTC would eliminate rental car shuttle buses. Other study improvements would be assessed in more detail in environmental documentation closer to the time of implementation, including a general conformity assessment to determine whether the proposed project(s) conforms to the relevant SIP.

6.5 WATER QUALITY

Water quality standards applicable to the Airport are established under the federal Clean Water Act (CWA) and the Connecticut General Statutes (CGS). Together, these regulations include requirements for controlling discharges into surface water and groundwater, develop waste treatment management plans and practices, and establish federal permitting requirements for discharges (Section 402) and dredged and fill materials (Section 404). Existing surface water and groundwater quality at the Airport are described below.

6.5.1 Surface Water

Surface water features on and in the immediate vicinity of the Airport include a network of streams, wetlands, and floodplains that contribute to the Connecticut River Drainage basin. Existing wetlands (see Section 6.10 and Figures 6.4a-6.4e) and floodplains (see Section 6.11 and Figures 6.6a-6.6d) are described in subsequent sections. Surface waters on the southern portion of the Airport flow into the Farmington River via Rainbow Brook and Seymour Hollow Brook. Streams on the northern portion of the Airport generally flow into the Spencer Brook, DeGrayes Brook, and Stony Brook systems. Surface waters occurring within the project area, are shown on Figures 6-4a through 6-4e. As shown on these graphics, the southern ends of Spencer Brook and Stony Brook are proximal to the proposed extensions of Taxiways “W” and “J” in the northern portion of the Airport. A branch of DeGrayes Brook extends east to the vicinity of the Runway 15 end, near areas of both pavement removal and landside and airside pavement additions, including the relocation of the access road, EMAS at the Runway 15 end, apron expansion near the Embraer facility, extension of Taxiway S, and removal of Taxiway U. Rainbow Brook and a pond (Watts Pond) are present in the vicinity of the proposed future GTC and surrounding access improvements. Watts Pond, which is fed by Rainbow Brook is on the opposite side of the Bradley International Airport Connector road. Both Rainbow Brook and Watts Pond are subject to an EPA consent order issued to UTC Aerospace Systems (formerly Hamilton Sundstrand) for remediation clean-up. Seymour Hollow Brook also extends into part of the proposed roadway access improvement area, south of existing Terminal A.

In general, surface waters on and in the area surrounding the Airport are classified by CTDEEP as Class A, indicating these waters can support habitat for fish, other aquatic life and wildlife, as well as potential drinking water supplies, recreation, navigation, and serve as a water supply for industry and agriculture. According to the 2014 State of Connecticut Integrated Water Quality Report, both Rainbow Brook and Seymour Hollow Brook were listed as not supporting aquatic life with an “Impaired” designation for use as habitat for fish, other aquatic life and wildlife. The cause for this impairment was identified as Ethylene Glycol and Propylene Glycol. Glycol compounds are found in deicing products used on airplanes to remove snow and ice prior to takeoff during winter months (or whenever temperatures are cold enough to necessitate deicing). As a result of past contamination at BDL and other airports, a formal consent order was developed and implemented between the Airport, EPA, and CTDEEP requiring measures to reduce the amount of deicing chemicals in runoff. The consent order requires the use products that contain Propylene Glycol, which is less toxic than Ethylene Glycol, constructing remote deicing facilities, and implementing improvements to drainage systems to separate stormwater and glycol. The Stormwater Pollution Prevention Plan (SWPPP) discussed below in Section 6.5.3 was also developed as part of the consent order.

The Farmington River, located south of the Airport, is designated by CTDEEP as a Class B surface water body. Similar to Class A, it supports habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. This River is also listed as impaired, but this designation is not related to Airport activities and is considered a non-pollutant impairment.

If all projects are implemented, the recommendations in the master plan would result in a net increase in pavement at the Airport from construction of new/extended/relocated taxiways and apron areas. Some pavement would also be added in connection with construction of the proposed future terminal area facilities; however, the vast majority of the area to be occupied be these landside improvements is already paved. Approximately 25 percent of the pavement added would be offset by recommendations in the MPU that involve the removal of pavement.

The additional impervious surface would increase the potential for runoff from the Airport into nearby surface water. Prior to implementation of these improvements, more detailed documentation would be required to more specifically quantify the additional impervious surface area and assess resulting impacts to surface water. Drainage improvements would be required to minimize stormwater runoff and associated potential for adverse impacts to surface waters. These improvements should be included in the project design and fully evaluated in the project-specific environmental documentation to be conducted closer to the time of construction. If such elements are incorporated, it is not anticipated that the proposed projects would result in adverse impacts to surface water quality. Given the current condition of water bodies south of the Airport (Seymour Hollow Brook, Rainbow Brook, and the Farmington River), drainage improvements associated with recommended projects could result in an overall benefit on surface water quality.

6.5.2 Groundwater

Based on previous studies, topography, and known watersheds on and in the immediate vicinity of the Airport, groundwater beneath the Airport flows generally in a southeasterly direction. The exception is the northernmost portion of the Airport, where groundwater has been documented to flow to the north.

According to information available through the CTDEEP, there are no known Aquifer Protection Areas in the immediate vicinity of the Airport.

Groundwater beneath the Airport is primarily classified by CTDEEP as GA-Impaired. The GA groundwater classification is generally defined by CTDEEP as existing water supplies that are "suitable for drinking without treatment." Despite this classification, it appears there is an impairment source impacting groundwater beneath the Airport, due both to its classification (as GA-Impaired) and previous environmental analyses for the Airport, which have indicated that groundwater does not meet GA standards for drinking water quality. In addition to the GA-Impaired classification, there are two areas of the Airport mapped as GB: an area south of Schoephoester Road near Hamilton Pond that extends to the southern side of Route 20, and an area along the central eastern boundary of the Airport, extending east of Ella Grasso Turnpike (just north of the intersection of Route 40 and Route 75/Ella Grasso Turnpike). Class GB groundwater is defined by CTDEEP as "presumed not suitable for human consumption without treatment." The GB classification generally occur in areas that have historically been highly urbanized where public water supply services are available. The reason for the degradation of groundwater quality could be the result of existing land use impacts, waste discharges, or other spills or leaks. Discharge requirements to Class GB groundwater are less restrictive than those associated with Class GA groundwater.

Potential impacts to groundwater associated with the recommended projects would be evaluated closer to implementation, when more details are available, in a project-specific environmental document.

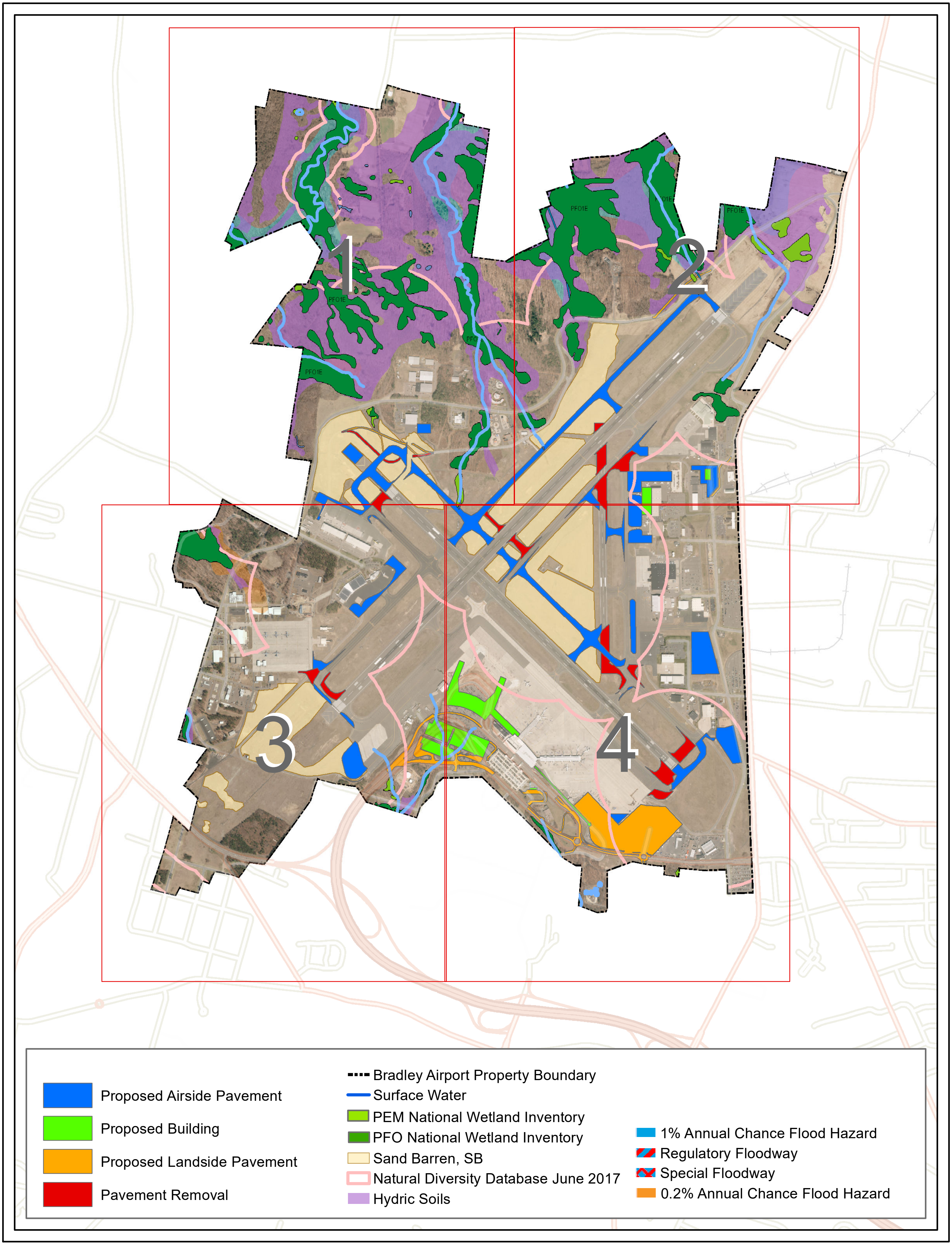
6.5.3 Stormwater

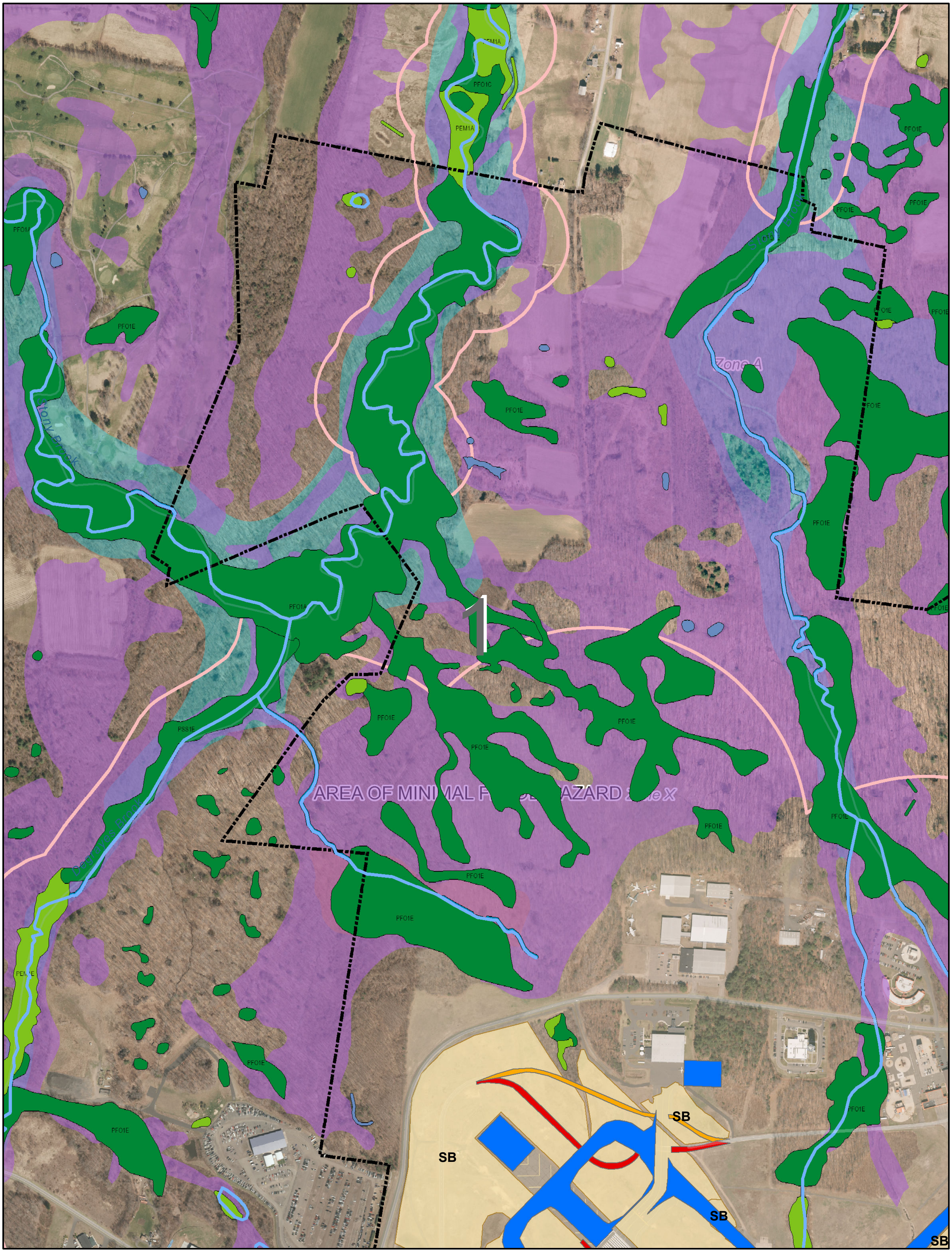
A SWPPP for the Airport was approved in 2010 and updated in 2011. This SWPPP describes existing stormwater drainage systems, non-stormwater discharges, and potential pollution sources on the Airport, and then identifies a variety of short- and long-term controls and measures to minimize stormwater pollution from Airport operations. Measures proposed in the SWPPP include best management practices, stormwater treatment, materials storage and loading/unloading practices, deicing procedures, erosion controls, and aircraft, vehicle, and equipment storage, and maintenance protocols. Procedures for training, inspection, spill control and response, and preventative maintenance are also included in the SWPPP.

As noted above, the recommended airport developments will result in additional paved areas on the airport, particularly for airside improvements. Prior to implementation, more detailed environmental documentation would be required to specifically quantify the additional impervious surface area and assess resulting stormwater impacts. Drainage improvements would be required to minimize stormwater runoff. These improvements should be included in the project design and fully evaluated in the project-specific environmental documentation to be conducted closer to the time of construction. As an example, the Terminal B EA states that:

> "*the new Terminal B would include separated glycol and stormwater runoff collection systems…ensuring no discharge of glycol consistent with the TMDL. Additionally, the Proposed Action is anticipated to result in improvements in the quality of stormwater discharge from the project area since the stormwater management design for the new terminal complex would be consistent with the requirements of applicable standards.*"

Any modifications to the drainage system at the Airport should be incorporated into a revised SWPPP.


1
2
3
4
PFO1E
Bradley Airport Property Boundary
Surface Water
PEM National Wetland Inventory
PFO National Wetland Inventory
Sand Barren, SB
Natural Diversity Database June 2017
Hydric Soils
Proposed Airside Pavement
Proposed Building
Proposed Landside Pavement
Pavement Removal
1% Annual Chance Flood Hazard
Regulatory Floodway
Special Floodway
0.2% Annual Chance Flood Hazard



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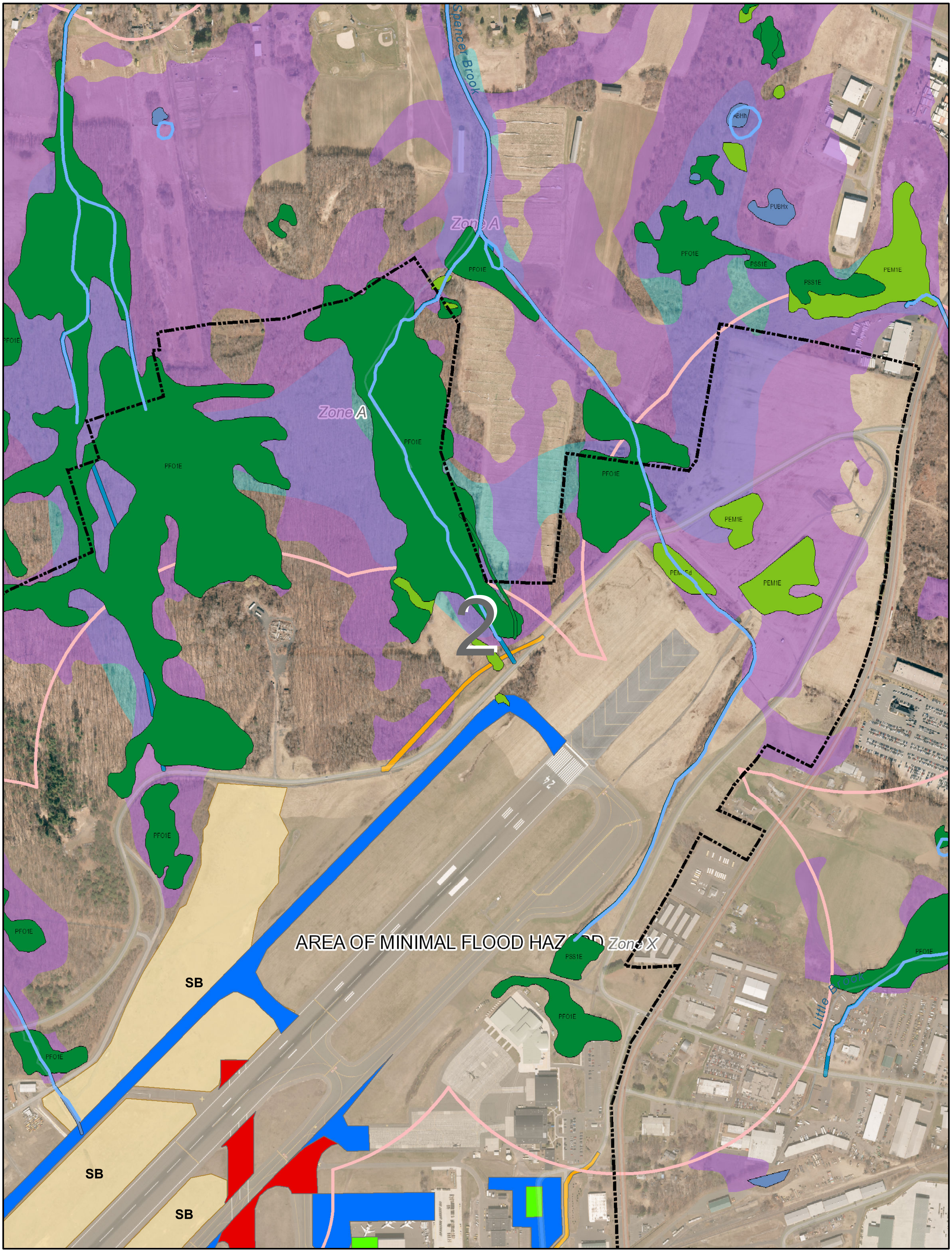
PFO1C
PFO1A
PFO1E
PSS1E
PEM1E
SB



Spencer Brook
Zone A
PFO1E
PSS1E
PEM1E
PUBHx
ABHh
Zone A
PEM1Ed
2
24
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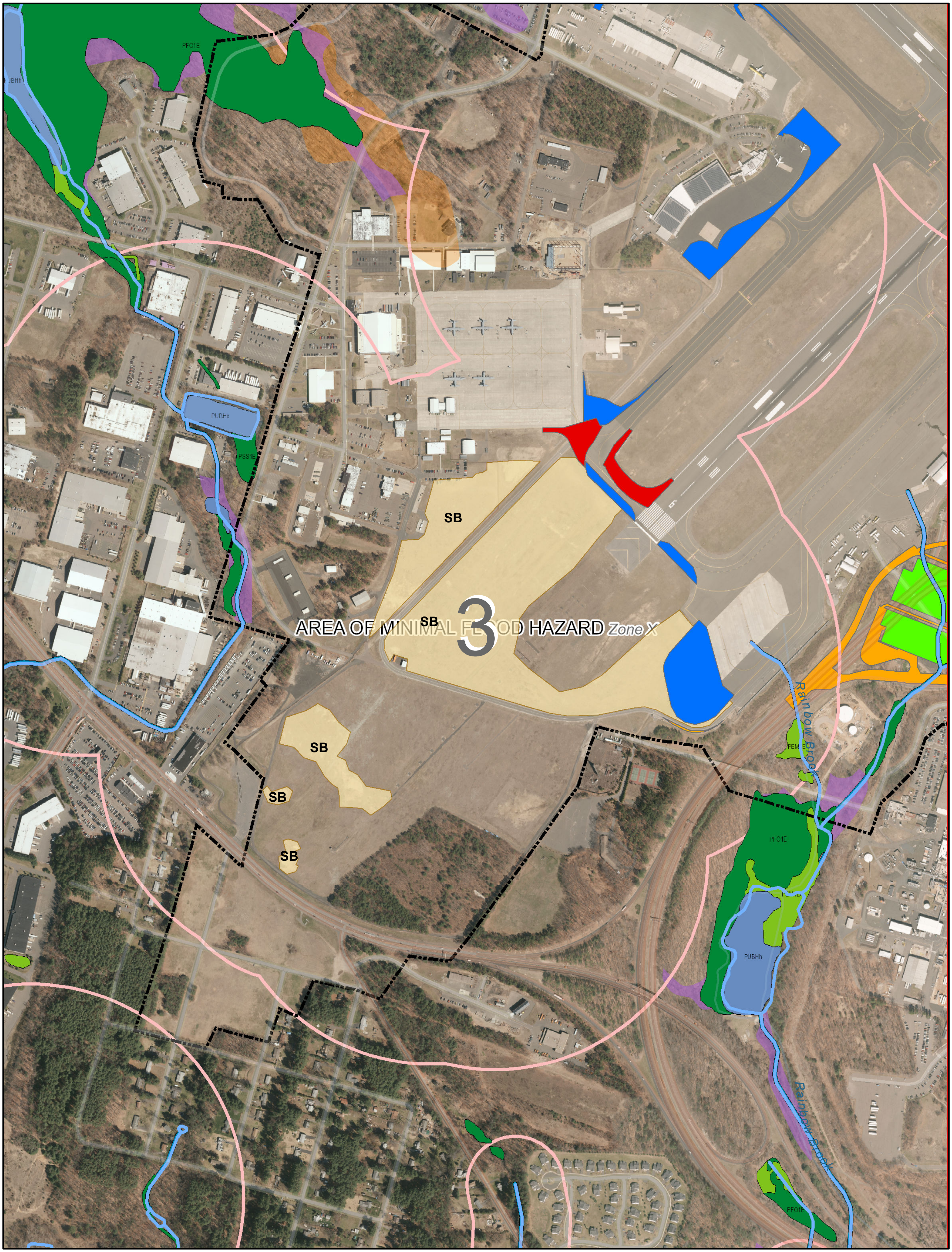
SB
SB
SB
Little Brook



PFO1E
PUBHh
PUBHx
PSS1E
SB
SB
3
AREA OF MINIMAL FLOOD HAZARD Zone X
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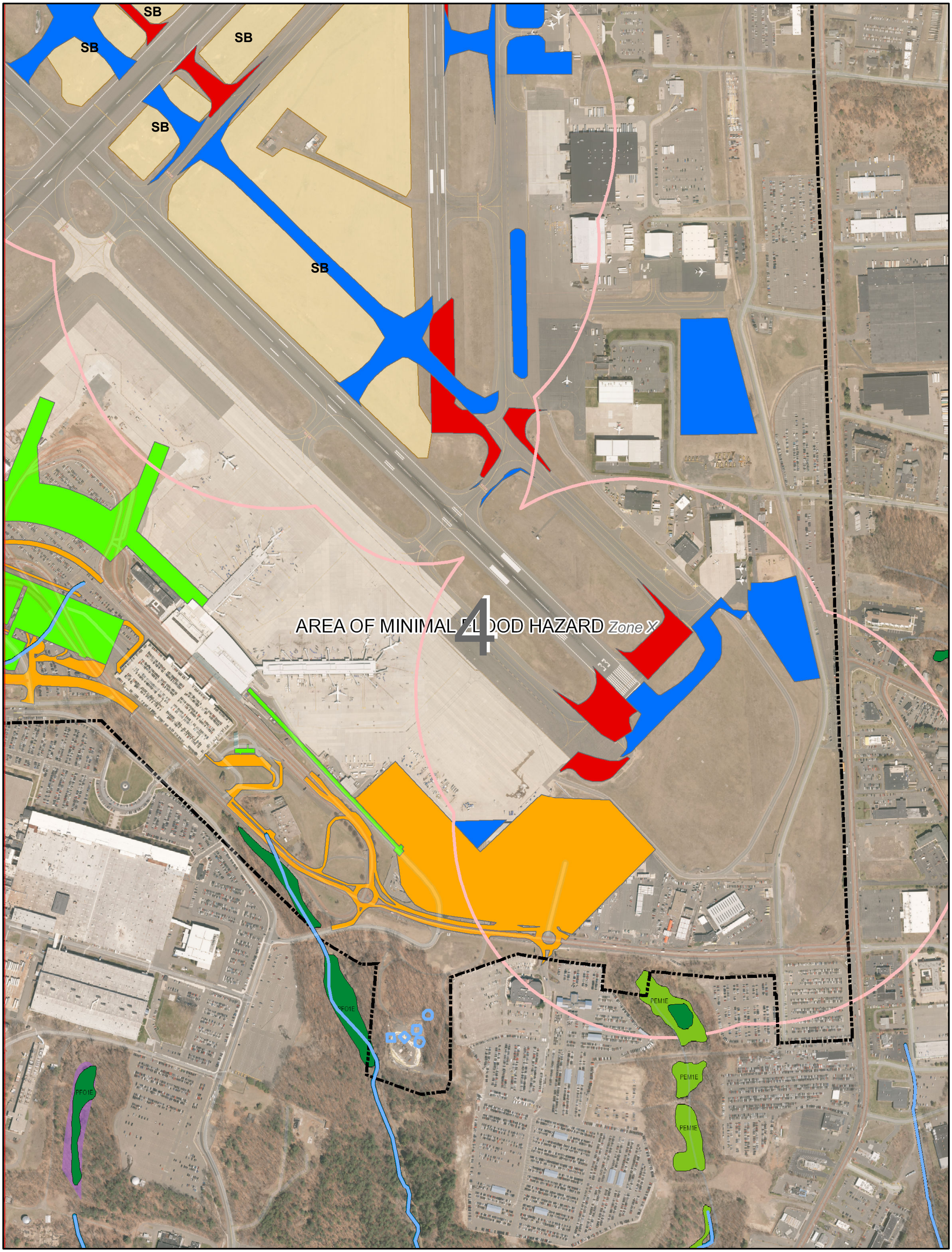
Rainbow Brook
PEM1E
PFO1E
PUBHh
Rainbow Brook
PFO1E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AREA OF MINIMAL FLOOD HAZARD Zone X
4
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6.6 DEPARTMENT OF TRANSPORTATION ACT, SECTION 303

Pursuant to Section 303 of the U.S. Department of Transportation (formerly Section 4(f)), programs or projects requiring the use of any publicly-owned land, including public parks, recreation areas, wildlife or waterfowl refuge areas, and historic sites (including traditional cultural properties) of national, state, or local significance shall not be approved by the Secretary of Transportation unless there is no feasible and prudent alternative to the use of such land, and such program includes all possible planning to minimize harm.

Based on a review of the surrounding area, there are no Section 303 properties in the immediate vicinity of the Airport. Northwest Park and the Airways Golf Course, both public recreational areas, are the two closest Section 303 resources to the Airport. Northwest Park is approximately two miles south and southwest of the Airport, in Windsor, and the Airways Golf Course, at its nearest point, is approximately 0.7-mile northwest of the Airport.

Based on the foregoing, no impacts to Section 303 resources are anticipated in connection with the projects proposed in the master plan.

6.7 HISTORIC, ARCHITECTURAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Under the National Historic Preservation Act of 1966 and the Archaeological and Historic Preservation Act of 1974, federal undertakings, such as the actions included in the Master Plan Update, are subject to Section 106 review to ensure that properties or data having historic, scientific, prehistoric, archaeological or paleontological significance are surveyed, recovered or preserved.

In order to identify federally and state-listed resources in the project area, a record review was conducted at the Connecticut State Historic Preservation Office (CTSHPO) in October 2017. The file and GIS review identified three archaeological sites in or near the project area. Two of the sites are described as Bradley plane scraps and the third is a German prisoner-of-war (POW) camp. According to available information, the German POW camp was closed in 1945 and dismantled. No diagnostic artifacts characteristic of World War II assemblages, such as uniform buttons, foreign currency, or other military emblems, were identified during investigation of this site and relevant cultural landscapes have been heavily altered. The project area has been heavily disturbed in connection with development of the existing runways, taxiways, hangars, and other airport facilities.

In addition, the file review revealed two National Register-listed properties in the vicinity of the Airport, as noted below:

- Benomi Case house, 436 Rainbow Road in Windsor Locks – approximately 0.2 mile south/southwest of the Airport; and
- East Granby Historic District – less than 0.5 mile west of the Airport

The Benomi Case House, constructed circa 1834, is a two-story masonry dwelling located southwest of the Airport. The property is part of a larger collection of brick buildings in the Town of Windsor, which are listed in the National Register of Historic Places as the 18th and 19th Century Brick Architecture of Windsor Thematic Resource. The National Register of Historic Places nomination identifies the Benomi Case House as one of the finest Greek Revival-era dwellings in the Town of Windsor Locks, and notes that it retains much of its original detail. The Master Plan improvements would not directly or indirectly affect the Benomi Case House, or other resources within the 18th and 19th Century Brick Architecture of Windsor Thematic Resource.

Located west of the Airport, the East Granby Historic District is a collection of buildings that illustrates the broad patterns of agrarian history and rural town formation in the State of Connecticut in the 18th and 19th centuries. The improvements included in the Master Plan Update are not likely to be visible from the East Granby Historic District.

Neither of these historic resources are within DNL 65 dB noise contours for the Airport. As follow-up to the records review, a letter was sent to the CTSHPO in February 2018 to identify potential concerns. Prior to implementation of specific airfield recommendations, a more detailed environmental review, including CTSHPO consultation, would be conducted to confirm existing resources and assess potential effects.

In 2012, FAA corresponded with the Tribal Historic Preservation Offices (THPOs) of federally recognized tribes with known interest in the vicinity of the Airport – the Mohegan and Mashantucket Pequot Tribes. This consultation was directly related to the development of a new Terminal B passenger facility and associated improvements at the Airport. During these consultations, both tribes indicated that no properties of historical, religious or cultural significance would be affected, though the Mohegan Tribe requested consultation in the event of an inadvertent discovery of human remains during construction. During the environmental compliance process for individual components of the Master Plan Update, FAA may undertake additional consultation with the appropriate THPOs.

6.8 BIOTIC COMMUNITIES

Information regarding biotic communities at the Airport was obtained through a review of previous reports, and associated coordination with the CTDEEP ’s Natural Diversity Database (NDDB), screening through the U.S. Fish & Wildlife Service’s (USFWS) Information Planning and Conservation (IPaC) System, GIS screenings, and field investigations.

The majority of the project area is within the existing Airport footprint and much consists of impervious surfaces such as asphalt, concrete, or buildings. The project area provides minimal ecological diversity, and those habitats that are present on the Airport (see Figure 6.4a through Figure 6.4e) have been extensively altered over time and have become fragmented by development. Biotic communities that remain include wetlands (see Section 6.10), turf grass/mowed fields, disturbed open fields, riparian woodland, sand barren, and urban woodland. Woodland areas are characterized as temperate deciduous forest. Existing small stands of mixed hardwood trees, occurring primarily on the northern portion of the Airport, comprise native species such as red maple (*Acer rubrum*), black cherry (*Prunus serotine*), pitch pine (*Pinus rigida*), gray birch (*Betula populifolia*), red oak (*Quercus rubra*), black oak (*Quercus velutino*), white oak (*Quercus alba*), highbush blueberry (*Vaccinium corymbosum*), and northern arrowwood

(*Viburnum dentatum*). Additional species that have been observed along the edges of existing woodlands include multiflora rose (*Rose multiflora*) and sumac (*Rhus sp*.). Forested habitat occurs in the project area near or within some of the proposed recommendations. Most notably, small areas of forested habitat occur within the project areas for the potential expansion to the West Air Cargo apron, potential expansion to the Embraer apron, the northern end of the Taxiway 'J' expansion, the roadway access improvements, and the tree removal areas for obstructions and line-of-sight. Vegetation occurring along intermittent watercourses in the northern portion of the Airport is characterized by red maple and eastern cottonwood (*Populus deltoids*), and herbaceous species such as common reed (*Phragmites australis*), broad-leaved cattail (*Typha latifolia*) and jewelweed (*Impatiens capensis*). This vegetation is found near the Runway 24 end and Runway 15 end, near the location of the proposed Taxiway 'W' and Taxiway 'J' extensions. Palustrine forested wetlands are characterized by shrub species such as silky dogwood (*Cornus amomum*) and black elderberry (*Sambucus canadensis*) and herbaceous species such as skunk cabbage (*Symplocarpus feotidus*), sensitive fern (*Onoclea sensibilis*), and cinnamon fern (*Osmunda cinnamomea*). Multiflora rose and tartarian honeysuckle (*Lonicera tartaria*) are characteristic shrubs found in upland areas adjacent to existing wetlands.

These habitats support a range of wildlife, including some identified as species of "Greatest Conservation Need" by the CTDEEP. Such species are described in Section 6.9 below. The most abundant mammal species present within the project area include gray squirrel (*Sciurus carolinensis*), red squirrel (*Sciurus vulgaris*), and eastern chipmunk (*Tamias stratus*). Signs of white-tailed deer (*Odocoileus virginianus*), woodchuck (*Marmota monax*), and coyote (*Canis latrans*) have also been observed at the Airport. Other mammals commonly observed at the Airport include raccoon (*Procyon lotor*), opossum (*Didelphimorphia*), eastern cottontail (*Sylvilagus floridanus*), a variety of rodents and arboreal-roosting bats. The Airport also provides abundant suitable habitat for amphibians, song birds, wading birds and other mammals. For both security purposes and to prevent large mammals, such as deer and coyote, from traversing the runways, the Airport maintains fencing around the airfield.

Grasslands and pine barrens, both sensitive biotic communities, are present at the Airport in or near areas planned for development. Both have been identified as critical habitats due to their uniqueness and potential to harbor state Species of Special Concern and threatened and endangered species. Critical habitat in the project area is limited to sand barrens, which occur within and in the immediate vicinity of the proposed taxiway extensions and apron expansions (see Figure 6.4a-6.4e). The sand barrens, defined in CTDEEP's *2015 Connecticut Wildlife Action Plan* as "unconsolidated stable or actively moving sands and/or gravels with sparse vegetation," are habitat for state threatened species and state Species of Special Concern, as discussed in Section 6.10, *Wetlands*. Sand barrens are characterized by eroding sandy bluffs and escarpments, active inland dunes, and other open sandy sites.

For implementation of the airfield recommendations, a more detailed environmental analysis would be conducted to assess potential impacts to biotic communities, including quantifying acreages of sand barren habitat to be disturbed and identifying mitigation measures to address that loss.

6.9 THREATENED AND ENDANGERED SPECIES

The Endangered Species Act of 1973 (ESA) provides for listing, conservation, and recovery of endangered and threatened species of plants and wildlife. Section 7(a)(2) of the ESA states that federal agencies shall ensure the actions it authorizes, funds, or carries out are not likely to jeopardize the continued existence of a listed species or result in a destruction or adverse modification of designated critical habitat. Section 9 of the ESA prohibits the take of listed species. "Take" is defined in the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect." The definition of harm also includes adverse habitat modifications. Federal actions that could result in a take must be coordinated under Section 7.

Similar to the biotic communities discussed in Section 6.8, threatened and endangered species that may or are known to occur within the project area were identified through a review of previous reports and studies conducted at the airport. As proposed AMPU development projects are funded and are advanced, coordination with CTDEEP NDDB and screening through the USFWS IPaC system will be undertaken as part of the NEPA process to identify potential for project specific impacts to threatened and endangered species.

6.9.1 Federally Listed Species

As part of consultations associated with previous studies, the USFWS stated that there were no known occurrences of federally-listed or proposed threatened or endangered species or critical habitat within the project area. These findings were confirmed as part of the environmental analysis conducted for the EA for the *New Terminal B Passenger Facility* released in 2012. However, the IPaC report prepared in 2015, in connection with the EA for Obstruction Removal, identified two species as potentially occurring at the Airport: a clam species, the Dwarf Wedgemussel (*Alasmidonta heterodon*), and the Northern Long-eared Bat (*Myotis septentrionalis*). The dwarf wedgemussel, although identified as potentially occurring at the airport, is not known to occur on or near airport property but has been reported downstream within the watershed of a stream that traverses airport property.

With respect to the Northern Long-eared Bat, the Final 4(d) rule, issued on January 14, 2016, prohibits an incidental take that may occur from tree removal activities within 150 feet of known occupied maternity roost tree(s) during the "pup season" (generally June 1 to July 31). The 4(d) rule also prohibits an incidental take that may occur from tree removal activities within ¼ mile of a hibernation site, year-round. There are no known maternity roost trees in CT and the nearest known hibernacula to the Airport is in East Granby, more than two miles northwest of the Airport.

The 2015 USFWS IPaC report that was generated for the Obstruction Removal EA also identified 15 migratory birds that have distributional ranges that overlap the Airport. These 15 migratory birds include:

- American Bittern (*Botaurus lentiginosus*)
- Bald Eagle (*Haliaeetus leucocephalus*)
- Black-billed Cuckoo (*Coccyzus erythropthalmus*)
- Blue-winged Warbler (*Vermivora canadensis*)
- Canada Warbler (*Wilsonia canadensis*)
- Fox Sparrow (*Passerella iliaca*)

- Least Bittern (*Ixobrychus exilis*)
- Peregrine Falcon (*Falco peregrinus*)
- Pied-billed Grebe (*Podilymbus podiceps*)
- Prairie Warbler (*Dendroica discolor*)
- Purple Sandpiper (*Calidris maritima*)
- Short-eared Owl (*Asio flammeus*)
- Upland Sandpiper (*Bartramia longicauda*)
- Wood Thrush (*Hylocichla mustelina*)
- Worm Easting Warbler (*Helmitheros vermivorum*)

Of these 15 migratory birds, only the Canada Warbler and the Prairie Warbler are listed as federal Birds of Conservation Concern.

Closer to implementation of specific airfield recommendations, more detailed environmental analysis would be conducted, including consultation with USFWS, confirmation of existing species within the project area, an evaluation of potential impacts to those species and habitat areas, and, if appropriate, mitigation measures to address adverse impacts.

6.9.2 State-Listed Species

The Airport contains various habitat suitable for breeding species listed as Species of Special Concern, Threatened, or Endangered on Connecticut's Endangered Species Act pursuant to Chapter 495 of the Connecticut General Statutes Sections 26-306-4. These habitats include tracts of grasslands, sand barrens, and shrublands. The grasslands include areas that support breeding by the state endangered Upland Sandpiper (*Bartramia longicauda*), the state endangered Grasshopper Sparrow (*Ammodramus savannarum*), the state endangered Vesper Sparrow (*Pooecetes gramineus*), the state threatened Eastern Meadowlark (*Sturnella magna*), the state Species of Special Concern American Kestrel (*Falco sparverius*), the state Species of Special Concern Savannah Sparrow (*Passerculus sandwichensis*) and the state Species of Special Concern Bobolink (*Dolichonyx oryzivorus*). The sand barrens provide breeding habitat for the state endangered Horned Lark (*Eremophilia alpestris*), while the shrubland areas provide habitat for the state Species of Special Concern Brown Thrasher (*Toxostoma rufum*).

Grassland management protocols have been established for the Airport, and are carried out by CAA, under agreement with the CTDEEP to ensure protection of state-listed endangered and threatened bird species that use the grasslands for breeding. As part of the management approach, an off-Airport mitigation area was established to provide additional habitat area to attract birds away from the Airport (i.e., reduce the risk for bird strikes). Prior to implementation of the airfield recommendations, CAA should review the existing grassland management protocols and revise as appropriate to accommodate future development.

According to information provided by CTDEEP NDDB in an October 2016 correspondence related to the Obstruction Removal EA, several invertebrate species are known to inhabit sand barrens that are present at the airport, such as those occurring in the project area. According to that correspondence, the state threatened zanclognatha (*Zanclognatha martha*), a moth that occurs only in sand/pitch pine barrens, has been observed near the Runway 6 end, and possibly in other locations of sand barren habitat at the Airport. As discussed in Section 6.8 above, sand barren habitat has been documented in the immediate vicinity of the proposed runway and taxiway extensions/relocations and aprons expansions (see Figure 6.4a-6.4e). The CTDEEP NDDB letter specifically notes, “while this moth may tolerate the cutting of trees, it would be negatively impacted by the complete removal of woody vegetation, stump grinding, amending soils with topsoil, lime, fertilizers and subsequent seeding.” CTDEEP further states that “[t]hese activities would not only destroy the habitat for this species on airport property, it would negatively impact sand barren habitat, one of Connecticut’s Critical Habitats.”

The state Species of Special Concern, the big sand tiger beetle (*Cicindela formosa generosa*), has also been documented using sand barrens in some portions of the Airport and could be negatively impacted by the addition of top soil, wood chips, lime, or fertilizers or seeding the existing sandy soils with turf grasses.

In addition to the invertebrate species identified above, other state-listed species that have been identified in past studies and projects on or near the airport that could be affected by planned development include the following:

- Plants
  - Virginia Copperleaf (*Acalypha virginica*) – Species of Special Concern
  - Yellow Lady’s-slipper (*Cypripedium parviflorum*) – Species of Special Concern
  - Low Frostweed (*Crocanthemum propinquum*) – Species of Special Concern
  - Long-bracted Green Orchid (*Coeloglossum viride*) – State Endangered

- Invertebrates
  - Brook floater (*Alasmidonta varicosa*) – State Endangered
  - Eastern pondmussel (*Ligumia nasuta*) – Species of Special Concern
  - Bombardier beetle (*Brachinus cyanipennis*) – Species of Special Concern
  - Brown-bordered geometer (*Eumacaria latiferrugata*) – State Threatened
  - Violet dart moth (*Euxoa violaris*) – Species of Special Concern
  - A ground beetle (*Harpalus eraticus*) – Species of Special Concern
  - A noctuid moth (*Zanclognatha martha*) – State Threatened
  - Scrub euchlaena (*Euchlaena madusaria*) – State Threatened
  - Phyllira tiger moth (*Grammia phyllaria*) – State Endangered
  - Sand plain flower moth (*Schinia spinosae*) – Species of Special Concern
  - American rubyspot (*Hetaerina Americana*) – State Threatened
  - Spinose flower moth (*Shinia spinosae*) – Species of Special Concern

- Reptiles
  - Spotted turtle (*Clemmys gutatta*) – Species of Special Concern
  - Eastern box turtle (*Terrapene carolina carolina*) – Species of Special Concern
  - Eastern hognose snake (*Hererodon platirhinos*) – Species of Special Concern

As discussed previously, more detailed environmental analysis would be conducted prior to implementation of development recommendations, including formal consultations with CTDEEP NDDB and other state agencies, confirmation of existing species within the project area, and an evaluation of potential impacts to those species and habitat areas. If appropriate, mitigation measures to address adverse impacts would be pursued.

6.10 WETLANDS AND WATERCOURSES

Wetlands and watercourses at the Airport are regulated and protected under both federal and state regulatory programs. U.S. Department of Transportation Order 5660.1A, *Preservation of the Nation's Wetlands*, implements Executive Order 11990, *Protection of Wetlands*. The U.S. Army Corps of Engineers (USACE) administers Section 404 of the Clean Water Act (CWA) (33 CFR 320-332) which regulates discharges of fill into federal wetlands and waters of the United States. Federally regulated wetlands, as defined in 33 CFR Part 328, are "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

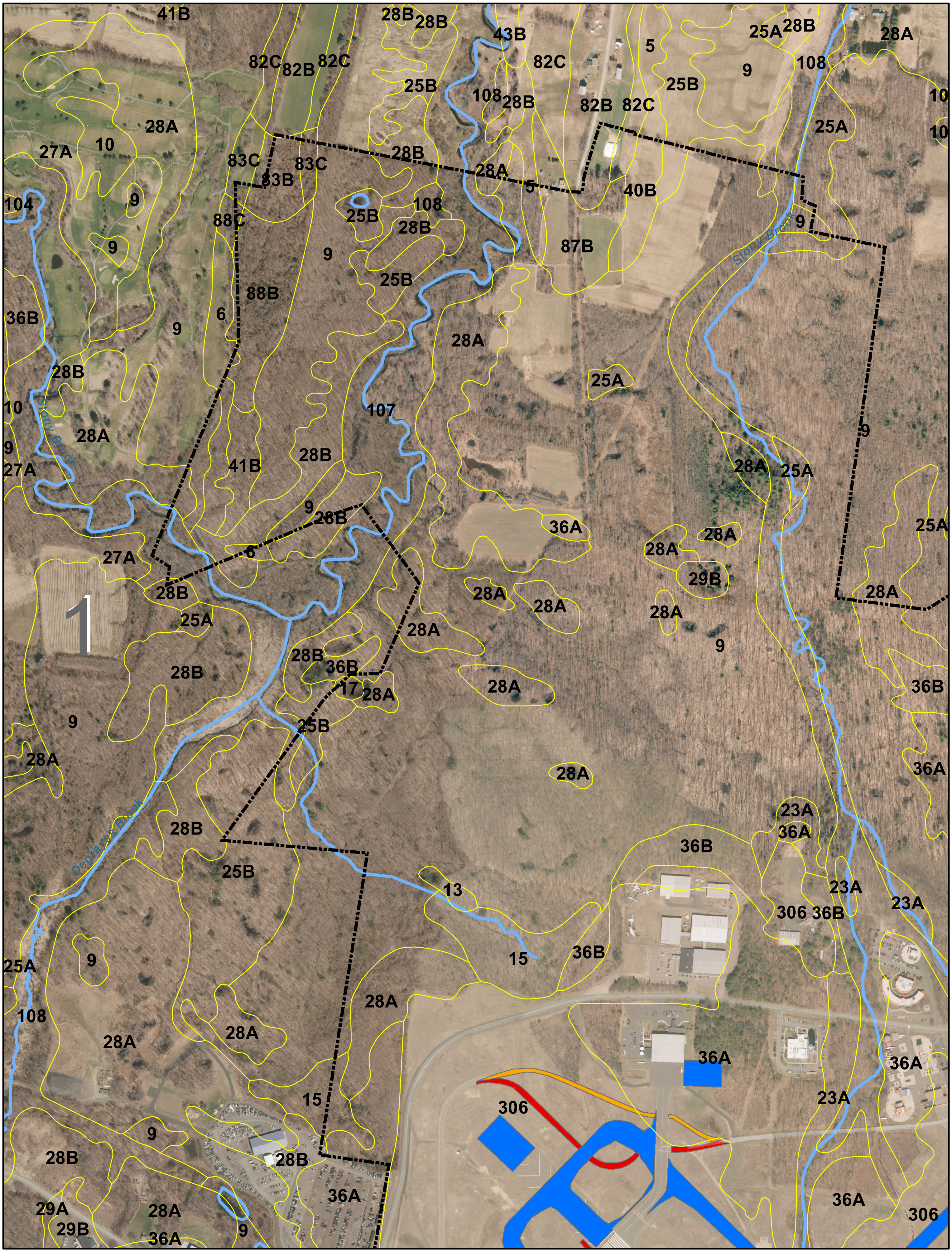
State regulated wetlands are defined in Section 22a-38(15) of the Connecticut General Statutes (CGS) according to soil types. Specifically, Connecticut inland wetland boundaries are determined by the limit of any soil types designated as poorly drained, very poorly drained, alluvial, and floodplain by the U.S. Department of Agriculture, Natural Resources Conservation Service's (NRCS) National Cooperative Soils Survey. State watercourses are defined in CGS Section 22a-38(16) as "…rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs, and all other bodies of water, natural or artificial, vernal or intermittent, public or private, which are contained within, flow through or border upon this state or any portion thereof, not regulated pursuant to CGS Sections 22a-28 to 22a-35 inclusive."

Work occurring within designated federal or state wetlands or watercourse will require securing the appropriate permits from the USACE or Connecticut Department of Energy and Environmental Protection (CTDEEP), as applicable. Soil types in the project area include the following (and see Figures 6.5a-6.5d):

- Udorthents-Urban land complex
- Urban land
- Udorthents, smoothed
- Windsor loamy sand (0-3 percent slopes)
- Hinckley gravelly sandy loam (15-45 percent slopes)

In order to identify wetlands and watercourses occurring within the project area, previous reports and studies at the Airport were reviewed, as well as data available online through the National Wetlands Inventory (NWI) mapper. Wetlands and watercourses were not formally delineated as part of this study. It is anticipated that prior to initiating specific projects, a current wetland delineation would be required to determine federal and state regulated wetland and watercourse boundaries.

A number of wetlands occur on the Airport, comprising over 400 acres and mostly occurring away from the airfield operational area. Based on information obtained, these wetlands are primarily forested and dominated by red maples and northern spice bush. The largest contiguous wetlands occur on the western and northern sides of the Airport and are associated with intermittent and small perennial streams such as Stony Brook, Spencer Brook, and DeGrayes Brook. Wetlands occurring within the project area (see Figures 6-4a through 6-4e) include freshwater emergent wetlands and freshwater forested/shrub wetlands.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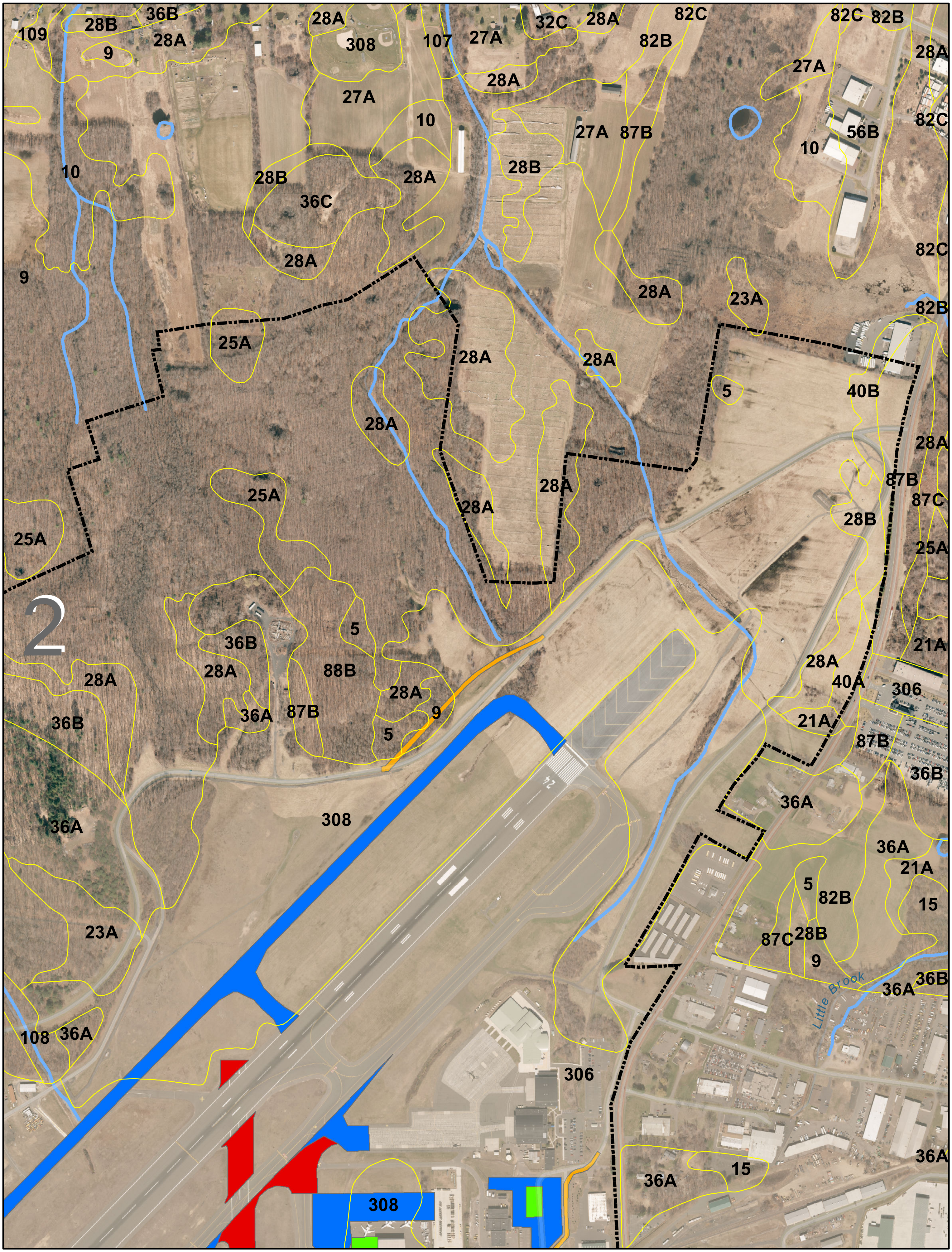
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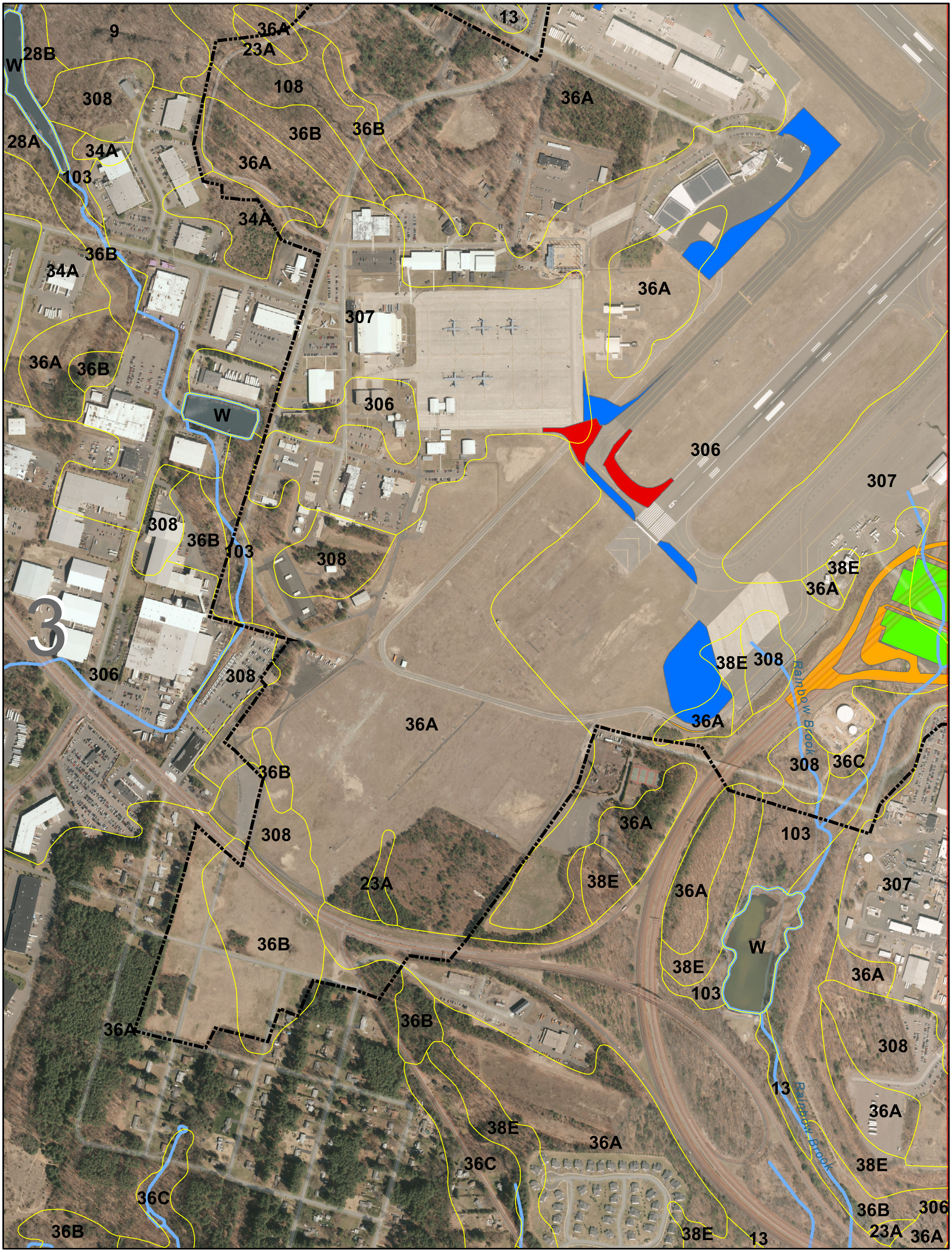

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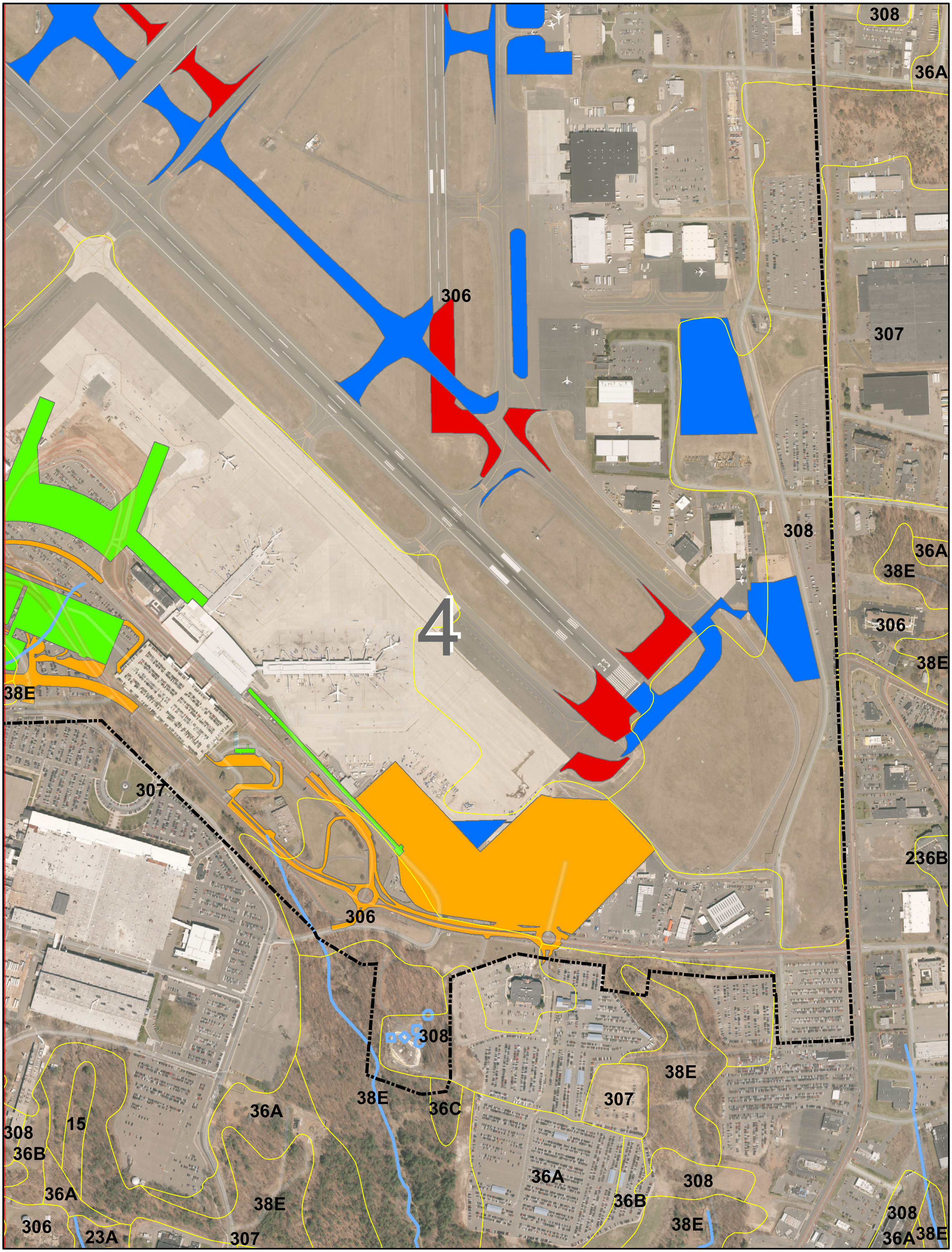
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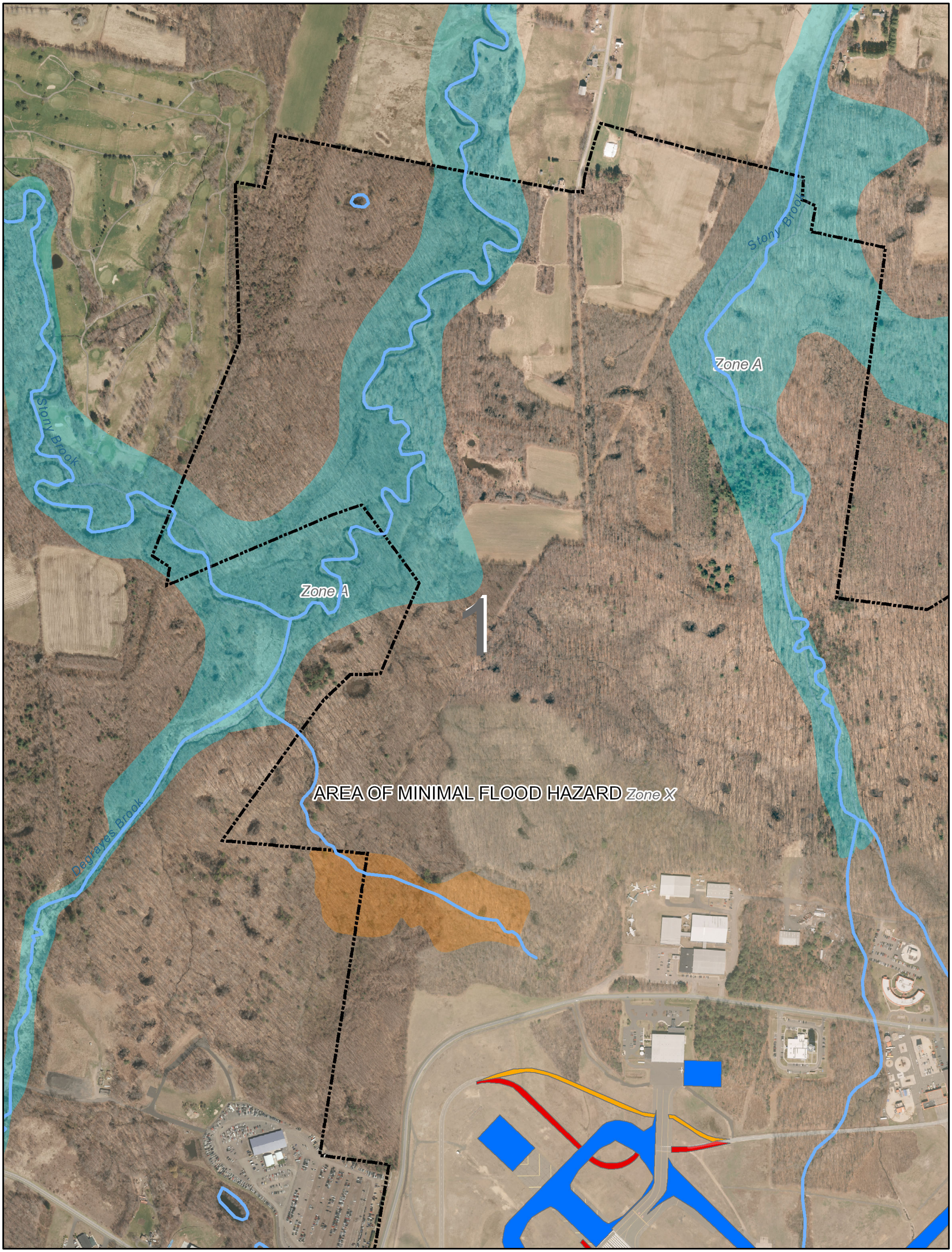
6.11 FLOODPLAINS

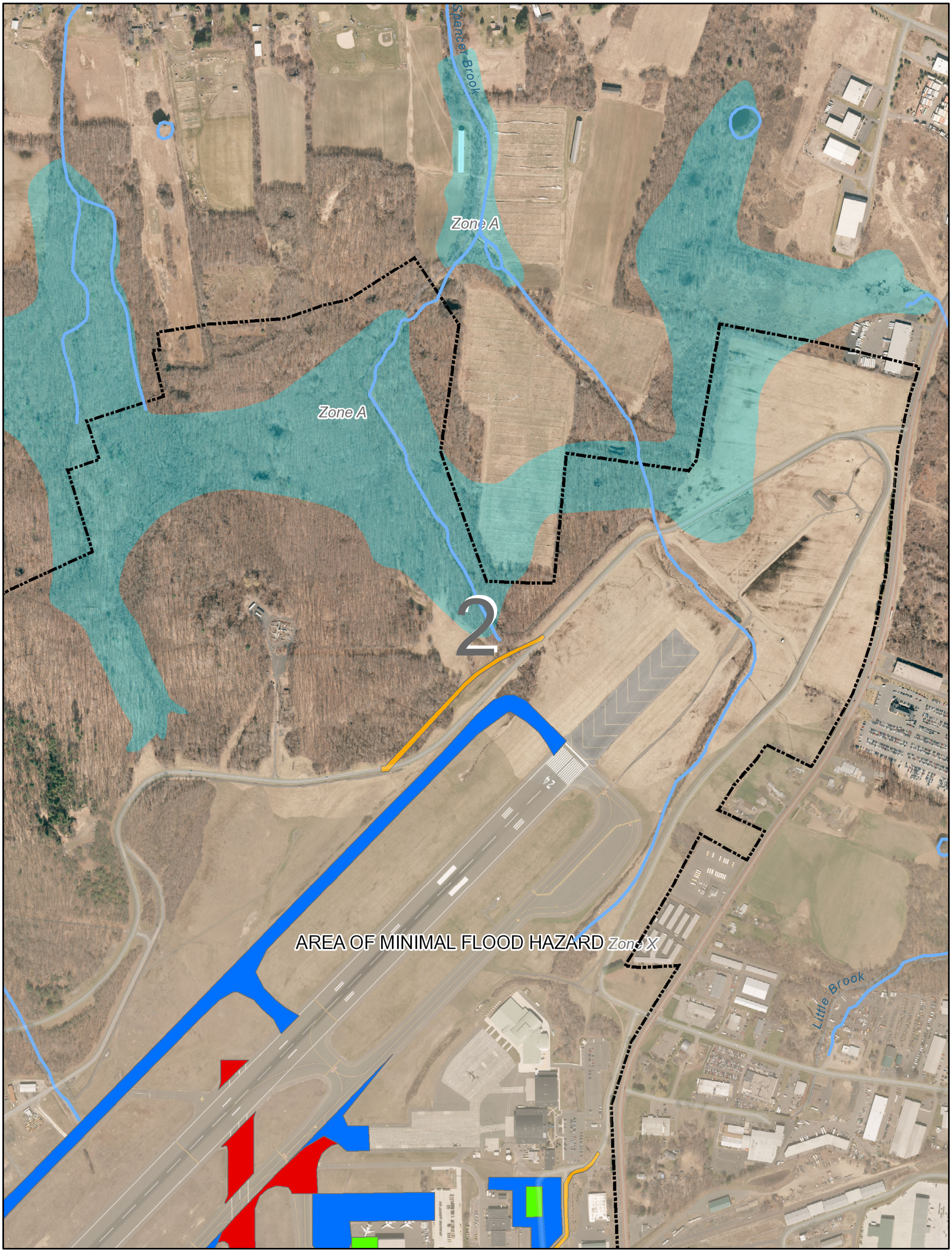
Executive Order 11988, *Floodplain Management*, defines floodplains as “the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands”, including the area that would be inundated by a 100-year flood. 100-year floodplain is an area that has a 1% chance of being flooded in any given year (Zone A). A 500-year floodplain is an area that has a 0.2% chance of being flooded in any given year (Zone X).

Both 100- and 500-year floodplains are present on the Airport in connection with DeGrayes Brook, Stony Brook, and Spencer Brook to the north of the project area, north of Perimeter Road, and off-Airport in connection with the Farmington River to the south of the project area; however, no 100- or 500-year floodplains occur within proposed project areas. Flood zones on the Airport, and in the immediate area, are shown on Figures 6.6a through 6.6d.

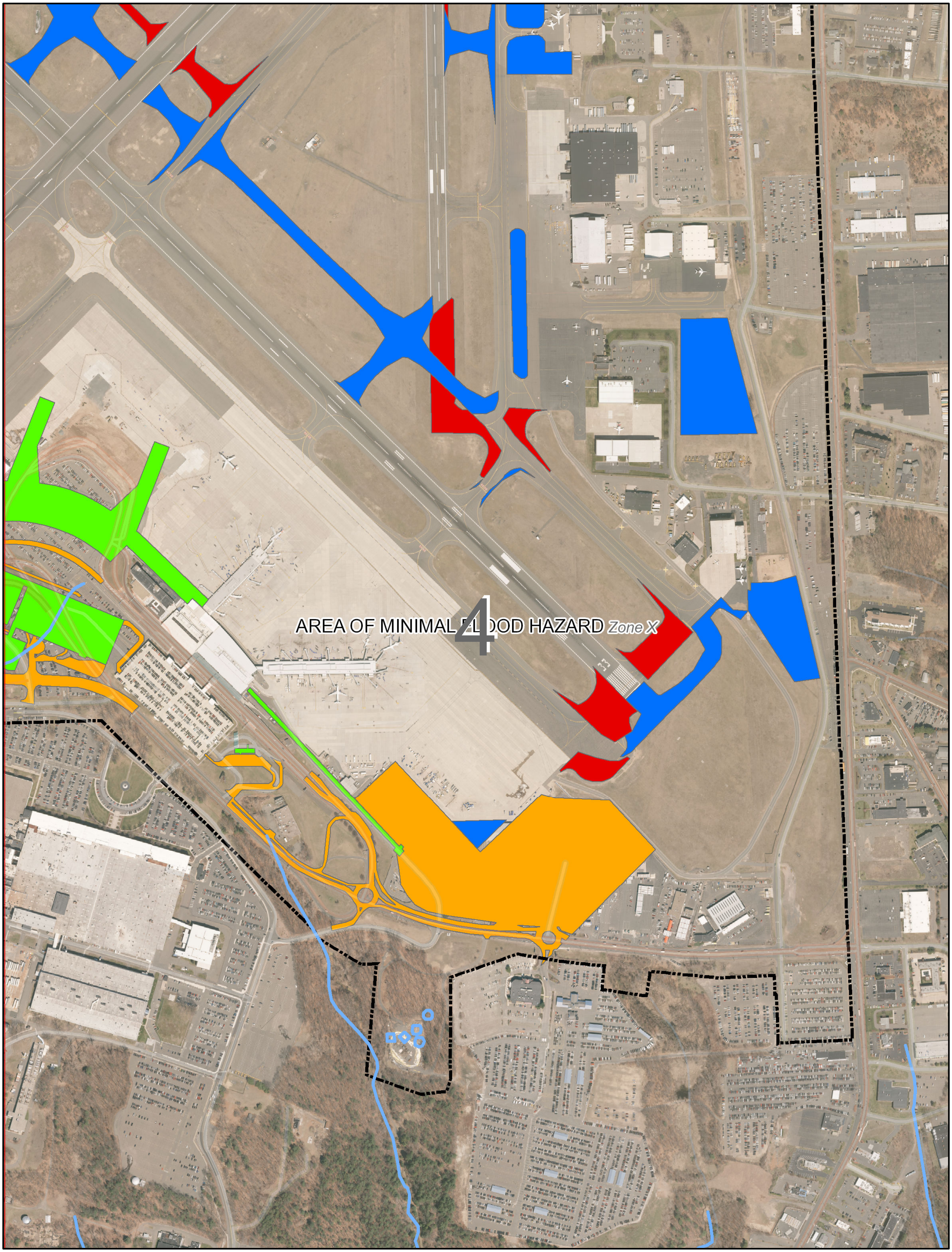
Based on the foregoing, the projects recommended in the master plan are not anticipated to impact floodplains. However, prior to implementation, project-specific environmental documentation would be prepared to document existing floodplains in the area and evaluate potential for impacts. If it is determined that a proposed action would occur within the 100-year floodplain, compliance with applicable state and federal flood and stormwater management standards must be demonstrated, including adherence to Section 25-68d of the Connecticut General Statutes.



Stony Brook
Stony Brook
Zone A
Zone A
1
AREA OF MINIMAL FLOOD HAZARD Zone X
Degrayes Brook


Spencer Brook
Zone A
Zone A
2
24
AREA OF MINIMAL FLOOD HAZARD Zone X
Little Brook

3
AREA OF MINIMAL FLOOD HAZARD Zone X
Rainbow Brook
Rainbow Brook


AREA OF MINIMAL FLOOD HAZARD Zone X
4

6.12 COASTAL ZONE MANAGEMENT PROGRAM

The National Oceanic and Atmospheric Administration (NOAA) regulations (15 CFR Part 930) require an analysis of any action affecting the coastal areas along the Atlantic and Gulf Coasts. The CTDEEP administers the Connecticut Coastal Management Program, enacted in 1980 to protect coastal resources, including the restoration of coastal habitat, improve public access, promote harbor management, and regulate work within the tidal, coastal and navigable waters. The Airport is not within a designated Coastal Zone; therefore, it is not regulated by a Coastal Zone Management Program.

6.13 PRIME AND UNIQUE FARMLAND

The Farmland Protection Policy Act (FPPA) limits the conversion of significant agricultural lands to non-agricultural uses as a result of federal actions (7 USC § 4201, et seq.). The determination of whether farmlands are subject to FPPA requirements is based on soil type; the land does not have to be actively used for agriculture. Farmland subject to FPPA requirements can be pastureland, forested, or other land types, but not open water or developed urban or transportation areas. The FPPA regulates four types of farmland soils:

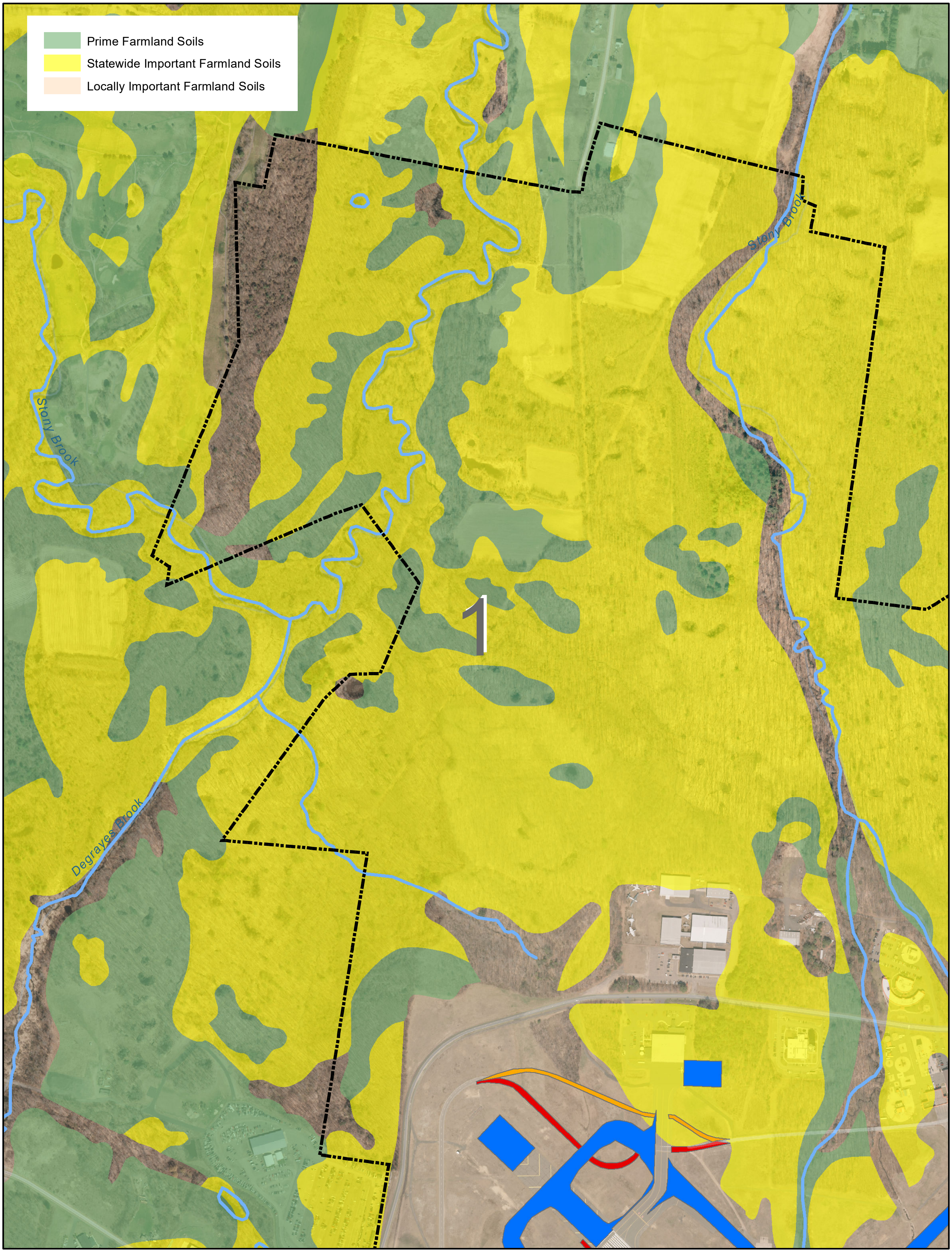
- Prime Farmland;
- Unique Farmland;
- Farmland of Statewide Importance; and
- Farmland of Local Importance.

The evaluation is based upon soils identified by the NRCS. Prime farmland is defined by the NRCS as “land that has the best combination of physical and chemical characteristics” for agriculture. This includes land with these characteristics used for livestock or timber production but not land that is already urbanized or used for water storage. Unique farmland is defined as “land other than prime farmland that is used for production of specific high-value food and fiber crops,” with such crops defined by the Secretary of Agriculture. Farmland of statewide or local importance is farmland other than prime or unique farmland that “is used for the production of food, feed, fiber, forage or oilseed crops.”

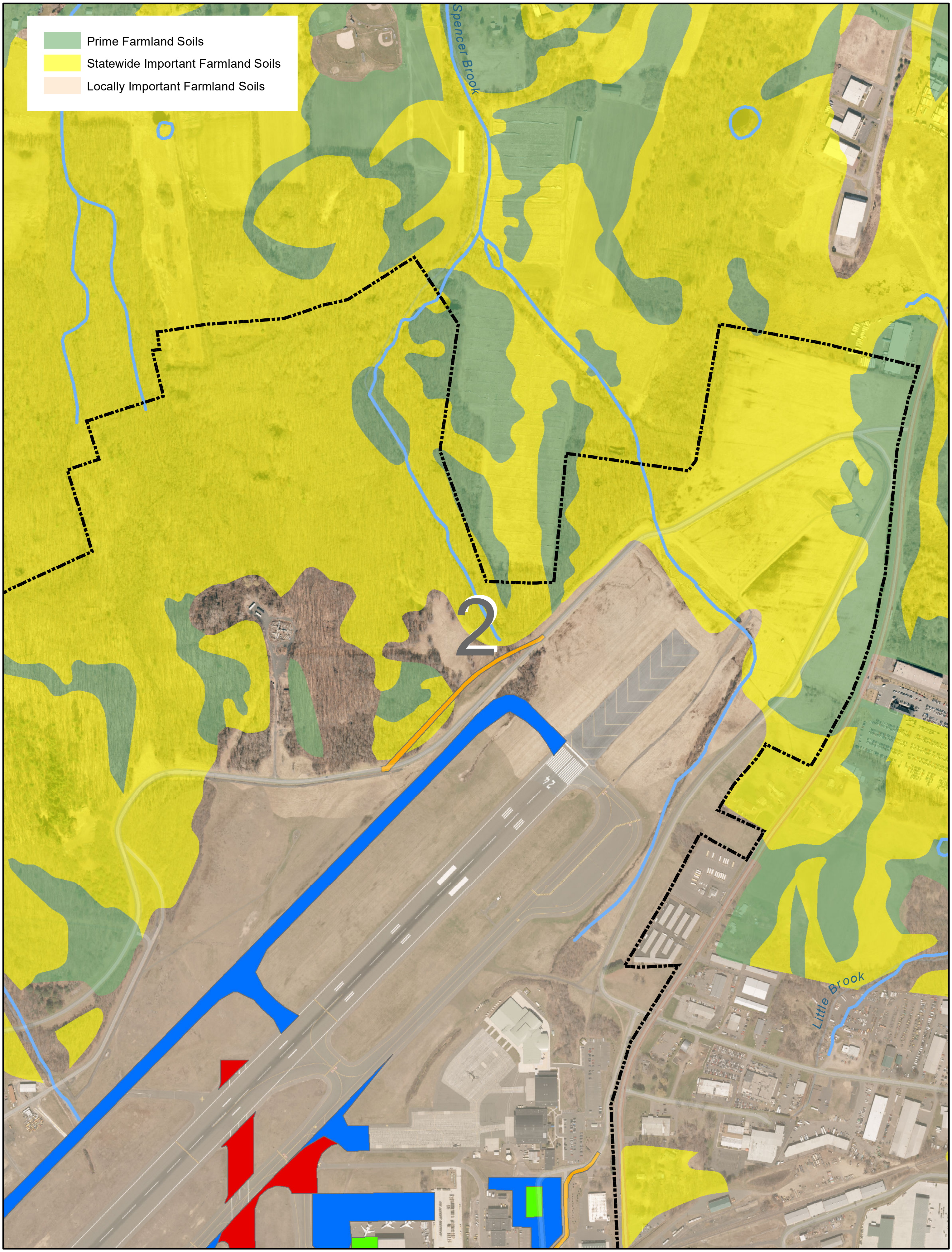
Most of the Airport is designated as Urban/Built land; however, several areas along the perimeter of the Airport, including portions of the project area, have been identified as having prime farmland or farmland of statewide importance (see Figures 6.7a through 6.7d). According to the Web Soil Survey from the NRCS, there are no prime farmland soils within the project area; however, the Windsor loamy sands, 0-3 percent slopes soil type, which is identified as farmland of statewide importance is mapped in the project area.

Based on soil types discussed in Section 6.10, *Wetlands and Watercourses*, and as shown on Figures 6-7a through 6.7d, prime farmland and statewide important farmland soils are most heavily concentrated on the north and west side of the Airport, near the Runway 15 end and Runway 24. As currently proposed, none of the recommended projects would occur over prime farmlands; the nearest would be a small portion of the Taxiway ‘W’ extension, near the intersection with the Taxiway ‘J’ extension. Statewide important farmland soils are more prevalent at the Airport, though would be only minimally impacted by the proposed improvements. Specifically, Statewide important farmland soils occur beneath the potential Signature apron expansion, potential expansion to the West Air Cargo apron, and the potential expansion to the Embraer apron, all of which would be developed near the Runway 15 end.

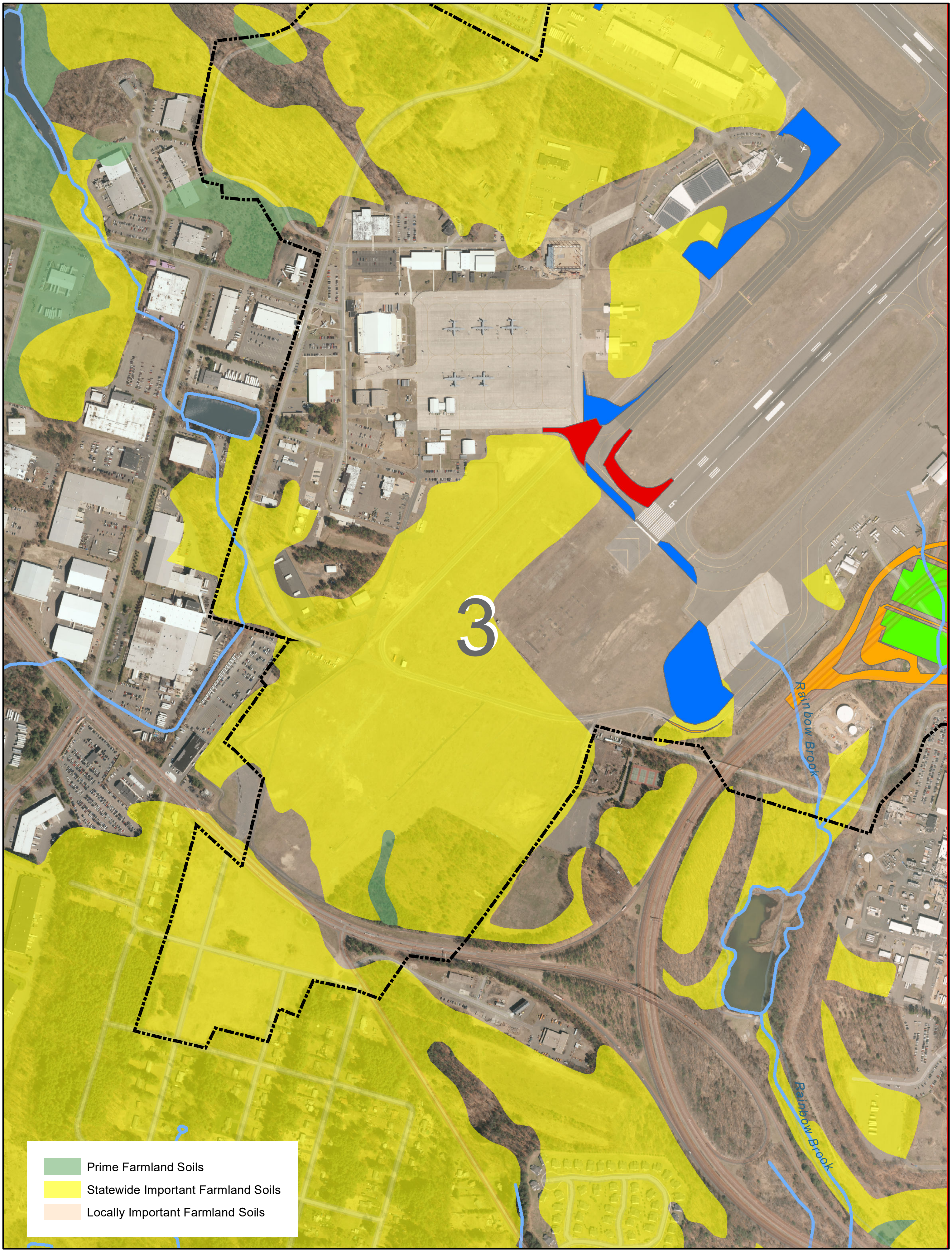
Prior to implementation of the airfield recommendations, a project-specific environmental analysis would be conducted to confirm the location of the improvements relative to farmland soils, quantify potential impacts, and, if appropriate, recommend mitigation measures to address adverse impacts.

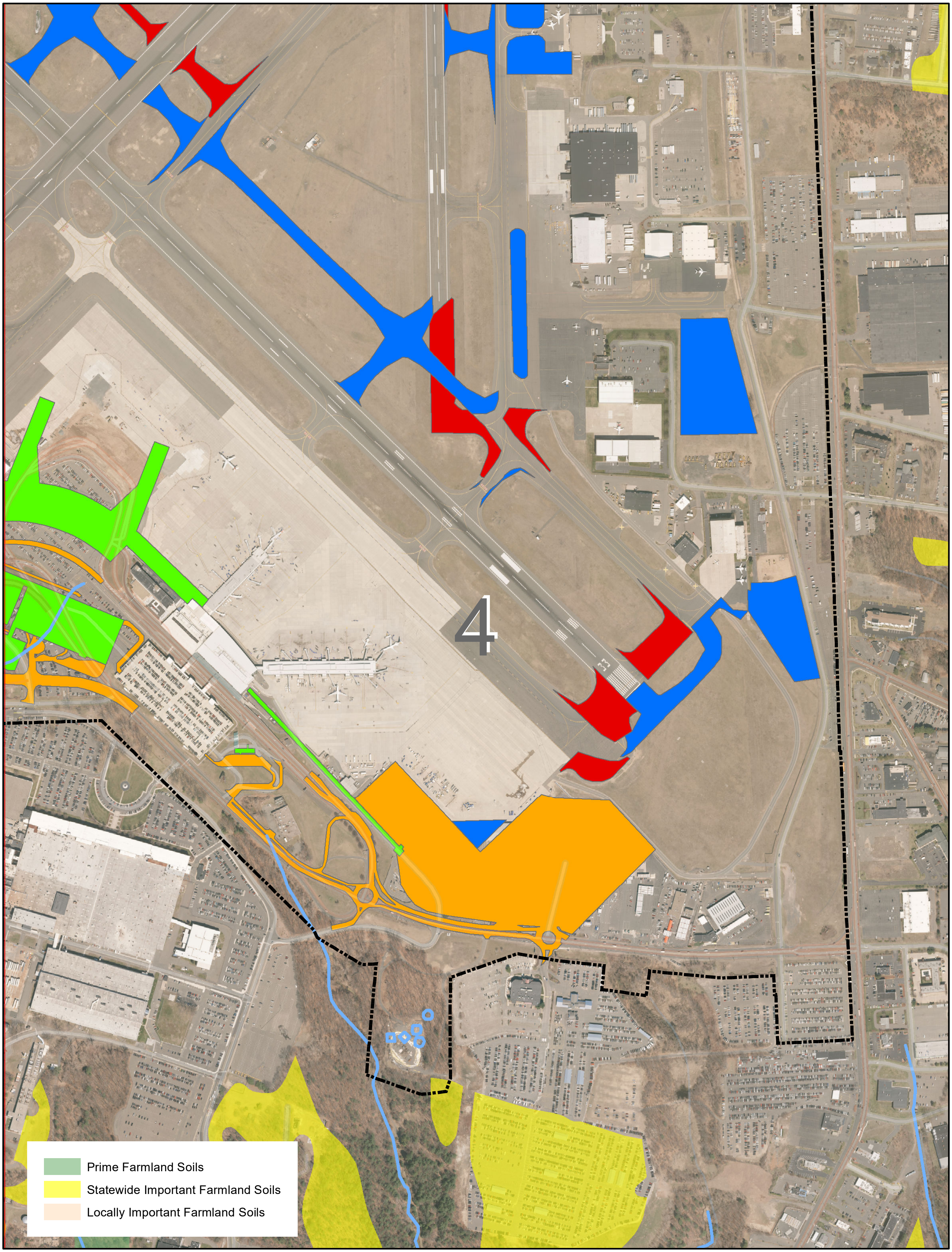


Prime Farmland Soils
Statewide Important Farmland Soils
Locally Important Farmland Soils
Stony Brook
Stony Brook
Degrayes Brook
1



Prime Farmland Soils
Statewide Important Farmland Soils
Locally Important Farmland Soils
Spencer Brook
Little Brook
2
24


3
Rainbow Brook
Rainbow Brook
Prime Farmland Soils
Statewide Important Farmland Soils
Locally Important Farmland Soils


4
Prime Farmland Soils
Statewide Important Farmland Soils
Locally Important Farmland Soils

6.14 WILD AND SCENIC RIVERS

Through the National Wild and Scenic Rivers Act of 1968 (16 U.S.C 1271), rivers can be federally designated as wild and scenic if they contain remarkable scenic, recreational, or fish and wildlife related values. Such rivers, as well as rivers or river segments currently under study for potential designation as a federal National Wild and Scenic River are granted protection under the Act and must be evaluated as part of the NEPA process. For this reason, such rivers (including rivers currently under study) were considered in this Master Plan document.

There are two rivers in Connecticut that are designated as Wild and Scenic Rivers: the Eightmile River and the West Branch of the Farmington River. Neither of these rivers is near the Airport. There are no river segments on or near the airport presently under study for potential federal National Wild and Scenic River designation.

6.15 ENERGY SUPPLY AND NATURAL RESOURCES

Projects recommended would increase energy demand due to new airfield lighting, heating, and air conditioning of the new passenger terminal and GTC; however, it is anticipated that this increase would be minimal in comparison to the total system usage. Efficient energy management could also be employed to further reduce energy use and overall consumption.

As described in the Terminal B EA:

> *"[t]he combination of passive and active energy efficiency measures that are proposed as part of the Proposed Action would improve energy use and conservation compared to the existing structure, and the cogeneration plant would provide increased energy efficiency compared to current grid-generated power. As such, a beneficial impact is anticipated."*

It should be noted that this beneficial impact is in comparison to operation of the former Terminal B, which has since been demolished. Therefore, compared to current overall energy use, there would be a net increase, but the systems would be notably more efficient.

Prior to implementation of the proposed improvements, coordination with the applicable utility companies would confirm the projected demands can be accommodated by existing or planned source facilities. It is not anticipated that there would be a need for unusual natural resources or materials in short supply during construction activities.

6.16 LIGHT EMISSIONS

It is not anticipated that the recommended projects would create a noticeable light emissions impact. It is anticipated that lighting would be installed along the new taxiway areas but would be consistent with existing airfield lighting and in compliance with FAA requirements. Similarly, the future passenger terminal and GTC would require lighting but would be consistent with that currently present on the Airport and surrounding area.

The existing approach lights to Runway 33 are recommended to be extended with the addition of Runway Alignment Identification Lights (RAIL). If implemented, the RAILs would consist of five white strobe lights, spaced 200 feet apart, and extending over Ella Grasso Boulevard. The lights would be located on commercial property and can may be shielded to avoid distractions to drivers. Lighting details would be documented and evaluated in a project-specific environmental analysis to assess potential for visual impacts.

6.17 VISUAL RESOURCES

It is not anticipated that the recommended projects would have a visual impact on the surrounding area and/or sensitive resources, other than as discussed in Section 6.16, *Light Emission*. Both airside and landside improvements would require additional lighting but would be consistent with existing conditions and FAA requirements. Similarly, the future passenger terminal and GTC would be similar in character to existing development on and surrounding the Airport and would be constructed in areas that are currently/have previously been developed.

6.18 SOLID WASTE

Solid waste generated at the Airport is collected in various receptacles throughout the Airport emptied into dumpsters by Airport staff and removed from the Airport by a private contractor. According to information provided in the Terminal B EA, this contractor is responsible for collection, transfer, and disposal (either at its own facility or other private facilities, depending on the type of material). Within public areas of the terminal building, recycling containers are single-stream and not segregated into separate bins for paper or plastic. Recyclables are collected by Airport staff and transported to dumpsters for removal by a private contractor; similar to the non-recyclable materials. In addition, solid waste generated on international flights is collected and disposed of at the on-site incinerator, located just southeast of the Terminal A along Cargo Road.

While solid waste would be generated during operation of the proposed new passenger terminal, the development of these facilities is not anticipated to substantially increase solid waste generation at the Airport or impact the ability or capacity for proper disposal.

6.19 HAZARDOUS WASTE

According to the 2016 EA for Obstruction Removal, which included a database review of relevant state and federal regulatory agency records, spills have occurred near Runways 6, 24, and 33 on generally residential, off-Airport properties. In addition to the database review, in July 2015, a visual site investigation was conducted to determine if hazardous materials were present in the area of tree removals. The investigation was focused on-Airport in areas south of Runway 6, northwest of Runway 15, and north of Runway 24; and off-Airport in areas northeast of Runway 24, southeast of Runway 33, and southwest of Runway 6. No hazardous materials were observed in these areas during the 2015 site inspection.

An analysis conducted as part of the Terminal B EA was more comprehensive, identifying that the Airport generates between 100-1,000 kilograms of hazardous waste per month (approximately 220-2,205 pounds per month). In August of 2011 the Airport was classified as a Conditionally Exempt Small Quantity Generator (CESQG) of hazardous waste. Previously, the Airport was classified as a Small Quantity Generator (SQG) from 2006-2011 and a Large Quantity Generator (prior to 2006). As reported in the 2012 EA for the new passenger facility, potential sources of hazardous materials generated at the Airport are typical of airport facilities and include:

- Above-ground storage tanks (ASTs)
- Underground storage tanks (USTs)
- Transformers
- Propylene glycol aircraft deicer and anti-icer fluid
- Buckeye jet fuel line
- Sewage pump areas
- Indoor and outdoor floor/ground drains
- Elevators
- Spills on taxiways, roadways, and parking lots
- Waste storage

Of the study recommendations, the development of the proposed passenger terminal and GTC could involve additional hazardous materials. Operation of these facilities will require adherence to federal and state regulations to prevent potential impacts.

6.20 TRANSPORTATION

Both the future GTC and roadway access improvements would affect transportation at the Airport; however, any noticeable impacts would likely be beneficial. Specifically, construction of the GTC, which includes a consolidated rental car facility, would reduce the need for shuttle buses to transport passengers to the Airport (from more distant rental car locations), and the roadway access improvements would be designed to enhance circulation patterns. The future remote parking lot would also likely affect circulation patterns.

6.21 SUMMARY

Projects recommended in the master plan are anticipated to have some impacts on the environment, with concerns generally focused on water quality, biotic communities, threatened and endangered species, and wetlands. As noted under each of the resource-specific sections, before implementation of some of the proposed development projects, further environmental documentation would be required to document existing conditions at that time, determine impacts on each resource, and if appropriate, identity mitigation measures to address adverse impacts. Once project details are available, if appropriate under NEPA, Categorical Exclusion(s) or Environmental Assessment(s) will be prepared in accordance with FAA guidance. Based on past studies and the types of projects recommended in the master plan, it is anticipated that impacts can be successfully mitigated allowing implementation of the recommended plan.

7 AIRPORT LAYOUT PLAN

This chapter presents the Airport Layout Plan (ALP) for the recommended developments at BDL. The ALP illustrates the recommended future airport facilities, airspace, and serves as the official development plan for the Airport. A number of additional drawings that illustrate surrounding airspace and land use support the ALP. The combined set of drawings is termed the ALP Drawing Set. This chapter contains the Summary of the Recommended Plan, the 20-year Airport Capital Improvement Plan (ACIP), and a description of the ALP drawing set.

7.1 SUMMARY OF RECOMMENDATION PLAN

Figures 5-33 and 5-34 in Chapter 5 presented the overall recommended airport developments for BDL. The plan includes recommendations for airfield, passenger terminal, landside, general aviation (GA), and air cargo development, which have been organized into three implementation phases: short-term, mid-term, and long-term.

It should be noted that potential avigation easements, tree clearings, and property acquisitions are not shown in the Chapter 5 figures as they occur beyond the property of the Airport. However, these potential projects are included in the recommendations.

Short-Term (0-5 years, 2017-2022)

- On Airport Obstruction Removal
- Easement Acquisitions
- Taxiway “W” Extension
- Taxiway “E” Realignment
- Passenger Circulation Terminal Renovation
- Ground Transportation Center Construction
- Terminal Restroom Renovation

Mid-Term (5-10 years, 2023-2027)

- Deicing Apron Expansion
- RON Apron Expansion
- Light Lane Realignment
- Taxiway “H” Reconfiguration
- Runway 33/Taxiway S & W Extension
- Runway 15/Parallel Taxiway S Extension
- Service Road Relocation
- Remote Parking Lot Expansion
- Relocation the Runway 24 ILS Glide Scope
- FIS Facility & Inline Baggage Construction
- Terminal A Expansion (ticketing, bag claim, concourse)

Long-Term (10-20 years, 2028-2037)

- Taxiway “J” Extension
- EMAS Installation (stop end of Runway 33)
- Taxiway “G” Reconfiguration
- Taxiway “E” Connector
- Taxiway “P” Extension
- Runway 33 RAILS (MALSR)
- Property Acquisition
- CT ANG Taxiway Relocation
- Walkway from Lot 3 to Terminal
- Schoephoester Road Improvements
- Airport Maintenance/Repair Facility
- Terminal B, Phase 1, Construction
- Terminal A Renovations
- Terminal B Construction – Phase 2 & 3

The projects listed above include new facilities and property acquisition. Throughout the planning period, numerous rehabilitation projects and facility upgrades, both airside and landside, will also be pursued by BDL, but are not listed above. However, they are included in the ACIP.

7.2 AIRPORT CAPITAL IMPROVEMENT PLAN

The Airport Capital Improvement Plan (ACIP) is intended to include a comprehensive list of potential projects. The ACIP is used to present annual development goals, identify anticipated costs for each project, and potential funding source. The ACIP must be continuously refined during the planning period to address any change in time frames. The short-term ACIP (5-year) is required by FAA to be updated every year.

Airport Management will use a revised ACIP each year to identify its annual project requests and other short-term projects to the FAA New England Region. The short-term ACIP includes additional details and often separates projects into individual components. The overall ACIP serves as a planning tool for the Airport and reference guide for long-range development.

The tables below provide the short, mid, and long-term ACIP for BDL. Note that these tables are based on planning-level estimates.

Table 7-1 - Short Term ACIP (2017-2022)

Type	Year	Projects	FAA SHARE	BDL SHARE	PFC	TOTAL
A	2017	On Airport Obstruction Removal	$ 911,078	$ 303,693		$ 1,214,771
A	2018	Easement Acquisition - Runway 6-24	$ 562,500		$ 187,500	$ 750,000
A	2019	Easement Acquisition - Runway 15-33	$ 1,125,000	$ 375,000		$ 1,500,000
A	2019	Obstruction Removal - Runway 6-24	$ 750,000		$ 250,000	$ 1,000,000
A	2020	Extend Taxiway W - Planning	$ 187,500	$ 62,500		$ 250,000
A	2020	Obstruction Removal - Runway 15-33	$ 750,000	$ 250,000		$ 1,000,000
A	2021	Extend Taxiway W - Permit & Design	$ 562,500	$ 187,500		$ 750,000
A	2021	Runway 1-19/Taxiway E - Design	$ 562,500	$ 187,500		$ 750,000
A	2022	Runway 1-19/Taxiway E - Construction	$ 11,250,000	$ 1,500,000	$ 3,750,000	$ 16,500,000
A	2022	Extend Taxiway W - Construction	$ 16,875,000	$ 2,250,000	$ 5,625,000	$ 24,750,000
		Subtotal	**$ 33,536,078**	**$ 5,116,193**	**$ 9,812,500**	**$ 48,464,771**
T	2017	Passenger Circulation Terminal Renovations		$ 100,000	$ 700,000	$ 800,000
T	2018	HVAC Equipment Replacement		$ 2,000,000	$ 1,500,000	$ 3,500,000
T	2018	Terminal Restroom Renovations-Phase 1			$ 2,700,000	$ 2,700,000
T	2019	Terminal Restroom Renovations-Phase 2			$ 2,700,000	$ 2,700,000
T	2020	Ground Transportation Center	-	$ 200,000,000	-	$ 200,000,000
T	2022	FIS Facility & Inline Baggage - Design		$ 13,780,000		$ 13,780,000
		Subtotal	**$ -**	**$ 225,880,000**	**$ 7,600,000**	**$ 223,480,000**
R	2017	Rehabilitate Taxiway S - Design		$ 500,000		$ 500,000
R	2017	Replace In-pavement Light Fixtures			$ 250,000	$ 250,000
R	2018	Rehabilitate Taxiway C South & R - Construction	$ 12,750,000	$ 2,250,000	$ 4,250,000	$ 19,250,000
R	2019	Rehabilitate Taxiway S - Design	$ 375,000	$ 125,000		$ 500,000
R	2020	Rehabilitate Taxiway S - Construction	$ 7,875,000	$ 1,050,000	$ 2,625,000	$ 11,550,000
R	2020	Airfield Signage Replacement and Circuitry Study	$ 1,425,000		$ 475,000	$ 1,900,000
		Subtotal	**$ 22,425,000**	**$ 3,925,000**	**$ 7,600,000**	**$ 33,950,000**
S	2018	Prepare PFC Application			$ 50,000	$ 50,000
S	2021	Pavement Condition Study Update	$ 112,500	$ 37,500		$ 150,000
		Subtotal	**$ 112,500**	**$ 37,500**	**$ 50,000**	**$ 200,000**
E	2017	Purchase Two 9-Ton Dump Truck w/Plows			$ 550,000	$ 550,000
E	2017	Replace 2 Plow Truck			$ 600,000	$ 600,000
E	2018	Purchase 1 Loader for SRE			$ 600,000	$ 600,000
E	2018	Purchase 2 Plow Trucks			$ 600,000	$ 600,000
E	2019	Purchase 1 Loader for SRE			$ 600,000	$ 600,000
		Subtotal	$ -	$ -	$ 2,950,000	$ 2,950,000
		TOTAL	**$ 56,073,578**	**$ 224,958,693**	**$ 28,012,500**	**$ 309,044,771**

A = Airfield T = Terminal R = Rehabilitation S = Studies E = Equipment

Table 7-2 - Mid-Term ACIP (2023-2027)

Type	Year	Projects	FAA SHARE	BDL SHARE	PFC	TOTAL
A	TBD	Deicing Apron Expansion	$ 3,600,000	$ 1,200,000		$ 4,800,000
A	TBD	RON Apron Expansion	$ 2,550,000	$ 850,000		$ 3,400,000
A	TBD	Light Lane Realignment			$ 700,000	$ 700,000
A	TBD	Taxiway H Reconfiguration	$ 412,575	$ 137,525		$ 550,100
A	TBD	Runway 33 Extension/Taxiway S & T Extension and Service Road Relocation	$ 4,575,000	$ 1,525,000		$ 6,100,000
A	TBD	Runway 15 Extension/Parallel Taxiway S Extension and Service Road Relocation	$ 4,800,000	$ 1,600,000		$ 6,400,000
A	TBD	Remote Parking Lot Expansion (Lot 3), Building Demolition		$ 27,000,000		$ 27,000,000
A	TBD	Runway 24 Glidescope*	$ 600,000			$ 600,000
		Subtotal	**$ 16,537,575**	**$ 32,312,525**	**$ 700,000**	**$ 49,550,100**
T	2020	FIS Facility & Inline Baggage - Construction		$ 121,320,000		$ 121,320,000
T	2021	Terminal Expansion (Ticketing, Bag Claim, Concourse) - Design & Construction		$ 110,700,000		$ 110,700,000
T	2022	International Gates - Phase 2 - Gates & Sterile Corridor - Design & Construction		$ 49,709,000		$ 49,709,000
		Subtotal	**$ -**	**$ 281,729,000**	**$ -**	**$ 281,729,000**
R	TBD	Rehabilitation Projects	$ 25,462,500		$ 8,487,500	$ 33,950,000
S	TBD	Studies	$ 375,000	$ 125,000		$ 500,000
E	TBD	Equipment Purchases and Maintenance			$ 2,950,000	$ 2,950,000
		TOTAL	**$ 42,375,075**	**$ 314,166,525**	**$ 12,137,500**	**$ 368,679,100**

A = Airfield   T = Terminal   R = Rehabilitation   S = Studies   E = Equipment
* = Potential FAA Facilities & Equipment Project

Table 7-3 - Long Term ACIP (2028-2037)

Type	Year	Projects	FAA SHARE	BDL SHARE	PFC	TOTAL
A	TBD	Taxiway J Extension	$ 15,300,000	$ 5,100,000		$ 20,400,000
A	TBD	EMAS Installation - Stop End of Runway 33	$ 6,375,000	$ 2,125,000		$ 8,500,000
A	TBD	Taxiway G Reconfiguration	$ 1,500,000	$ 500,000		$ 2,000,000
A	TBD	New Taxiway E1 Connector	$ 1,500,000	$ 500,000		$ 2,000,000
A	TBD	Taxiway P Extension	$ 1,575,000	$ 525,000		$ 2,100,000
A	TBD	Runway 33 RAILS (MALSR)*	$ 750,000			$ 750,000
A	TBD	Property Acquisition (RPZ Private Property)	$ 7,500,000	$ 2,500,000		$ 10,000,000
A	TBD	CT ANG Taxiway Relocation	$ 975,000	$ 325,000		$ 1,300,000
A	TBD	Elevated/Enclosed Walkway from Lot 3 to Terminal		$ 38,600,000		$ 38,600,000
A	TBD	Schoephoester Road Improvements	$ 11,475,000		$ 3,825,000	$ 15,300,000
A	TBD	Airport Maintenance/Repair Facility	$ 3,750,000		$ 1,250,000	$ 5,000,000
		Subtotal	**$ 50,700,000**	**$ 50,175,000**	**$ 5,075,000**	**$ 105,950,000**
T	2027	Terminal B - Phase 1 - Processor & Central Gates		$ 392,099,961		$ 392,099,961
T	2027	Terminal A Renovations - Phase 2 - Bag Claim		$ 5,190,852		$ 5,190,852
T	2032	Terminal B - Phase 2 - North Gates		$ 25,221,090		$ 25,221,090
T	2037	Terminal B - Phase 3 - West Gates		$ 92,232,938		$ 92,232,938
		Subtotal	**$ -**	**$ 514,744,841**	**$ -**	**$ 514,744,841**
R	TBD	Rehabilitation Projects	$ 50,925,000	$ 16,975,000		$ 67,900,000
S	TBD	Studies	$ 1,125,000	$ 375,000		$ 1,500,000
E	TBD	Equipment Purchases and Maintenance			$ 5,900,000	$ 5,900,000
		TOTAL	**$ 102,750,000**	**$ 582,269,841**	**$ 10,975,000**	**$ 695,994,841**

A = Airfield T = Terminal R = Rehabilitation S = Studies E = Equipment
* = Potential FAA Facilities & Equipment Project

7.3 AIRPORT LAYOUT PLAN

The ALP drawings illustrate all development projects identified for BDL throughout the 20-year planning horizon. Upon approval by the FAA, the ALP becomes the official planning document for the Airport. The FAA requires that all new airport facilities be consistent with the ALP. As such, keeping the drawings accurate and up to date is a high priority. FAA policy now requires that the ALP be updated at least every five years.

Although the ALP is the only drawing that is signed by the FAA, it is part of a larger drawing set that includes the sheets listed below. BDL and the FAA maintain full size copies of the final approved ALP Set. Each of the drawings is described below.

7.3.1 Existing and Proposed Airport Layout Plan

Table 7-4 – ALP Drawing Index

DRAWING INDEX		
Sheet No.	Sheet Title	DWG. No
1	Title Sheet	ALP-1
2	Airport Data Sheet Summary	ALP-2
3	Existing Airport Layout	ALP-3
4	Future Airport Layout Plan	ALP-4
5	Airport Airspace Plan	ALP-5
6	Airport Airspace Plan (continued)	ALP-6
7	Inner Approach Surface Drawing, Runway 6	ALP-7
8	Inner Approach Surface Drawing, Runway 24	ALP-8
9	Inner Approach Surface Drawing, Runway 15	ALP-9
10	Inner Approach Surface Drawing, Runway 33	ALP-10
11	Obstruction Tables	ALP-11
12	Obstruction Tables (continued)	ALP-12
13	Terminal Area Plan	ALP-13
14	Land Use Plan	ALP-14
15	Airport Property Map	ALP-15

The first drawing sheet of the drawing set is the Existing Airport Layout. This sheet depicts the Airport as it exists today. The drawing identifies all key FAA airfield design standards (e.g. Runway Safety Areas, Object Free Areas, Runway Protection Zones, etc.) and illustrates all landside facilities.

Next, the future or proposed ALP, includes all features of the Existing ALP, plus all proposed facilities, airfield improvements, and recommendations. This drawing is reviewed by several offices within the FAA for consistency with airport design standards, flight procedures, airspace, and environmental requirements. Approval indicates the FAA's endorsement of the proposed project types and locations, but development may still be predicated upon environmental approvals and demand/capacity justification.

It should be noted that projects illustrated on the ALP do not commit the CAA or FAA to pursue their development nor does it ensure that funding will be available. The projects are intended to depict the maximum build-out of the Airport within the planning period. Also note that FAA considers ALP approval to 'condition', pending environmental review under the National Environmental Policy Act (NEPA).

The ALP drawings were prepared in accordance with the FAA design standards for Airport Reference Code (ARC) D-V, which includes commercial jet aircraft such as the Boeing 787. Primary Runway 6-24 currently satisfies FAA design standards for ARC D-V. Secondary or crosswind Runway 15-33 also serves commercial jets, such as Airbus A300 and Boeing 757 in ARC D-IV. General aviation Runway 1-19 is not in use and will be permanently closed.

The following publications were used during the drawing preparation:

- FAA Advisory Circular 150/5300-13A, Airport Design
- FAA Advisory Circular 150/5070-6B, Airport Master Plans
- Federal Aviation Regulations, Part 77, Objects Affecting Navigable Airspace

As a large amount of information is contained on the ALP drawing, additional charts and tables relating to the ALP were placed on a preceding sheet, Airport Data Summary, in order to reduce clutter.

Runway Protection Zone (RPZ): A trapezoidal ground area that underlies the final approach area to each runway end. Its purpose is to control future development beneath the inner portion of the approach surface, and thus enhance the protection of people and property on the ground. The dimensions of the RPZs for BDL are listed below.

The master plan recommendations include a project that would increase the size of the Runway 33 RPZ. Specifically, the approach lights on Runway 33 are recommended for an upgrade from a MALSF to a MALSR (as discussed in Chapter 5). This upgrade may enable a reduction in the instrument visibility minimums from ¾ to ½ mile, which then increases the size of the RPZ.

Table 7-5 – RPZ Dimensions

Runway End	Inner Width	Outer Width	Length
Runway 6 (Precision ½ mi.)	1,000'	1,750'	2,500'
Runway 24 (Precision ½ mi.)	1,000'	1,750'	2,500'
Runway 15 (Non-Precision ¾-mi.)	500'	1,010'	1,700'
Runway 33 (Precision ¾-mi.) – Existing	500'	1,010'	1,700'
Runway 33* (Precision ½ mi.) – Future	1,000'	1,750'	2,500'

**Addition of a RAIL system may reduce visibility minimum to ½ mile.*

As shown in the ALP drawing, the existing airport property extends out beyond the runway ends to include the majority of RPZs. However, Runway ends 15, 24, and 33 each have a small area of the RPZ that is off-airport. Ideally, these locations should be considered for acquisition by the airport in the event they become available for sale in order to protect these location from development.

The Runway 33 RPZ is the only location that contains development currently, and expansion of the RPZ in the future would result in 32 additional acres for private commercial property to the RPZ. Again, CAA should review these locations and consider acquisition if such parcels become available for sale.

Building Restriction Line (BRL): The BRL is a FAA designated reference line that surround both runways and is based upon FAR Part 77 obstruction criteria (see Section 7.3.3 below). For the precision instrument runways at BDL, a 745-foot runway offset is used for the BRL to represent the required runway clearance for a sample 35-foot tall building. This offset prevents Transitional Surface penetrations. The Existing Airport Layout Sheet, the ALP Sheet, and Terminal Area Plan illustrate the BRL. The BRL offsets are determined as follows:

Offset from Runway Centerline = (Primary Surface width / 2) + (7 x 35 feet)
-or-
(1,000’/2) + (7 x 35’) = 745 feet

7.3.2 Terminal Area Plan

The Airport Terminal Area Plan illustrate the existing and future terminal building(s), parking, access, and apron area. The facilities depicted are identical to that depicted on the ALP, but at a larger scale and in greater detail. Highlights of the proposed new facilities on the Terminal Area Plan include:

- The Ground Transportation Center (GTC), with Consolidated Rental Car facilities
- Expansion of Existing Terminal A
- Proposed Terminal B
- Terminal apron parking and gate layout
- Expanded Remain Overnight (RON) airline parking apron
- Potential improvements to Schoephoester Road
- Expanded passenger parking (Lot 3)

It is anticipated that these planned facilities will comment in 2019 with the GTC and continue as needed to accommodate activity growth thorough the Planning period. These terminal facilities are the most costly items in the ACIP. Thus, financial planning and financing would be required and will also affect the timing and ultimate level of development.

7.3.3 Airport Airspace Plan

The next several sheets of the ALP drawing set illustrate the airspace requirements described in Federal Aviation Regulations (FAR) Part 77, Objects Affecting Navigable Airspace. Part 77.23 identifies a series of geometric planes (i.e., imaginary surfaces) that extend outward and upward from the Airport’s runways and define the obstruction clearing requirements. These surfaces identify the maximum acceptable height of objects by defining three-dimensional areas surrounding all sides of the airfield. When an object penetrates an imaginary surface, it is considered an airspace obstruction and all obstructions are treated as potential hazards to air navigation (unless a FAA aeronautical study determines otherwise).

The height and dimensions of the imaginary surfaces are determined by the airfield and runway end elevations, the type of aircraft using the facilities, and the availability of instrument approaches to the runway ends (approach type and visibility minimums). For BDL, the specific surfaces are described below.

Primary Surface: A surface longitudinally centered on each runway and extending 200 feet beyond the runway ends. Based on the precision instrument approaches, the width of the primary surface for both Runways 6-24 and Runway 15-33 is 1,000 feet. The elevation of the primary surface is equal to the elevation of the nearest point of a runway centerline. Note that the highest point of the primary surface determines the official airport elevation (i.e., for BDL - 173 feet above mean sea level).

Horizontal Surface: A horizontal plane 150 feet above the airport elevation of 173 feet mean sea level (MSL). Therefore, the horizontal surface at BDL is situated 323 feet above MSL. The shape of the surface is created using radial arcs of 10,000 feet from the ends of the primary surface of Runways 6, 23, 15, and 33, connected by lines tangent to the arcs.

Conical Surface: A surface extending outward and upward from the periphery of the horizontal surface at a slope of 20 to 1, for a horizontal distance of 4,000 feet. At BDL, the elevation of the outer edge of the conical surface is 523 feet above MSL.

Approach Surface: Surfaces that are longitudinally centered on the runway centerlines and extend outward and upward from the ends of the primary surfaces. For BDL, the dimensions and slopes of the approach surfaces are listed below.

Table 7-6 – Approach Surface Dimensions

Runway End	Inner Width	Outer Width	Length	Slope
Runway 6 (Precision)	1,000	16,000	50,000	50:1 & 40:1*
Runway 24 (Precision)	1,000	16,000	50,000	50:1 & 40:1*
Runway 15 (Non-Precision)	1,000	4,000	10,000	34:1
Runway 33 (Precision)	1,000	16,000	50,000	50:1 & 40:1*

*50:1 for the first 10,000 ft., then 40:1 thereafter

Transitional Surface: Surfaces extending outward and upward at right angles from the sides of the primary and approach surfaces at a slope of 7 to 1. The transitional surfaces terminate at the overlying horizontal surface.

The overall Airport Airspace Plan, illustrates the full dimensions of the Part 77 surfaces and obstructions located within the outer portions of the approach, horizontal, and conical surfaces. These drawings use a small scale as they depict a large area extending nearly 10 miles from the runway ends.

The Approach Surface is illustrated in greater detailed at the ends of each runway in a set of drawings entitled the Inner Approach Surface Drawings. By definition the inner portion of the surface extend outward to the point with the Approach has reach 100 feet above the runway end elevation. These sheets illustrate approach obstructions in a level of detail to identify specific objects, such tree, poles, and building penetrations. As common to most airports, the drawings identify several penetrations to the surrounding airspace. At BDL, the CAA has recently completed a tree obstruction removal project, which as substantially mitigated the worst approach surface obstructions.

7.3.4 Land Use Plan

Airport development has the potential to impact sensitive areas such as residences, schools, churches, etc. Conversely, airports are typically considered to be compatible with commercial, industrial, and agricultural activities. As discussed in Chapter 6, the land use surrounding the airport contains a diverse mix of commercial, industrial and residential activities, as well as substantial undeveloped locations. The Land Use Plan sheet depicts the surrounding land use and associated zoning for the four surrounding towns: East Granby, Windsor, Windsor Locks, and Suffield.

7.3.5 Airport Property Map

The final sheet of the ALP set is the Airport Property Map. This drawing is often called the “Exhibit A” because the property map is a required attachment for FAA grant applications, and is attached as Exhibit A.

The primary purpose of this drawing is to provide information indicating how various tracts of airport property were acquired (i.e., federal programs, local funds only, etc.). The maps identify for the FAA the current and future aeronautical use of properties acquired with federal funds. They also identify each location that is proposed or planned for ultimate acquisition. An “Exhibit A” is for illustration purposes and does not constitute a property boundary survey or other legal document.

APPENDICES

LIST OF APPENDICES

APPENDIX A

COMMERICAL FORECAST BY YEAR

A. COMMERCIAL FORECAST BY YEAR

Commercial Forecast by Year

Year	Enplanements	Operations	Average Aircraft Size	Percentage Seats Filled
2017	3,187,046	67,482	110.6	85.7%
2018	3,276,184	69,104	109.8	86.4%
2019	3,464,001	71,800	111.1	86.8%
2020	3,595,967	73,339	112.3	87.3%
2021	3,621,511	73,366	112.4	87.8%
2022	3,640,759	73,366	112.4	88.3%
2023	3,713,574	74,354	112.9	88.5%
2024	3,785,988	75,479	113.4	88.5%
2025	3,858,679	76,599	113.8	88.5%
2026	3,931,609	77,713	114.3	88.5%
2027	4,003,164	78,788	114.8	88.5%
2028	4,073,619	79,832	115.3	88.5%
2029	4,143,686	80,857	115.8	88.5%
2030	4,212,471	81,847	116.3	88.5%
2031	4,278,185	82,768	116.8	88.5%
2032	4,341,075	83,625	117.3	88.5%
2033	4,403,152	84,458	117.8	88.5%
2034	4,464,796	85,274	118.3	88.5%
2035	4,527,750	86,106	118.8	88.5%
2036	4,591,591	86,946	119.3	88.5%
2037	4,653,118	87,734	119.9	88.5%

Source: Forecast

APPENDIX B

LEAKAGE BY MARKET

B. LEAKAGE BY MARKET

BDL's Largest Markets Without Nonstop Service

Rank	Domestic O&D Market Without BDL Nonstop	YEQ3 2016 O&D Passengers	Total O&D Plus YEQ3 2016 Core Area Leakage	PDEW Incl. YEQ3 2016 Core Area Leakage
1	San Francisco (SFO)	98,050	168,153	230
2	Phoenix (PHX)	87,167	118,832	163
3	San Diego (SAN)	68,608	95,212	130
4	Seattle (SEA)	57,890	92,687	127
5	Nashville (BNA)	58,698	78,036	107
6	Jacksonville (JAX)	50,784	64,561	88
7	Austin (AUS)	47,171	61,563	84
8	Charleston (CHS)	41,026	56,940	78
9	New Orleans (MSY)	41,500	55,574	76
10	Salt Lake City (SLC)	37,883	50,986	70

Source: U.S. DOT, Origin-Destination Passenger Survey, year ended Q3 2016;

Adjusted ARC, year ended Q3 2016; Innovata schedules for summer 2017.

BDL's Largest Markets Under 2,000 Miles Without Nonstop Service

Domestic O&D Market Without BDL Nonstop	YE Q3 2016 O&D Passengers	Total O&D Plus Core Area Leakage	PDEW Incl. Core Area Leakage	Total O&D Plus Svc. Area Leakage	PDEW Incl. Full Area Leakage
Nashville (BNA)	58,698	78,036	107	111,100	152
Jacksonville (JAX)	50,784	64,561	88	87,326	120
Austin (AUS)	47,171	61,563	84	82,597	113
New Orleans (MSY)	41,026	56,940	78	81,373	111
Charleston (CHS)	41,500	55,574	76	78,083	107

Source: U.S. DOT, Origin-Destination Passenger Survey, year ended Q3 2016;

Adjusted ARC, year ended Q3 2016; Innovata schedules for summer 2017.

APPENDIX C

INTERNATIONAL CARGO DEMAND

C. INTERNATIONAL CARGO DEMAND

BDL does not currently have direct international all-cargo service or any services expected or anticipated during the forecast period.[1] International O&D traffic is handled on the integrated flights via their hubs and gateways but that traffic is not specifically identified in the traffic data so is handled as part of the domestic all-cargo forecasts. The BDL local market does generate a significant amount of air exports and imports that are flown or trucked to/from international flights at other U.S. airports. While international air trade does not affect these forecasts, this section provides a profile of air trade that is generated within BDL's international cargo service area with a particular focus on a primary region that could be the catalyst for direct international flights in the future.

BDL International Air Cargo Service Area

The selection of particular air cargo services is driven by a trade-off between cost and service factors relative to the particular characteristics of each shipment (e.g., shipment value and size). A major consideration for both shippers and air cargo service providers is the location of origin/destination "demand" relative to an airport's "supply" of services. While it is possible to use almost any airport for a shipment originating or terminating within a wide distance range (up to 500 road miles or a one-day drive time), the definition of a service area for an airport must reasonably consider the location of services at competing airports and the likelihood that current and potential services could attract a significant share of traffic for the region.

BDL is located within two-and-a-half hours of New York - JFK (JFK) which is the primary U.S. gateway airport to Europe and also has significant cargo capacity to other world regions. EWR is an international gateway for FedEx and also has direct cargo capacity on passenger airlines to international points. BDL's international cargo service area was therefore defined[2] as follows (see figure below):

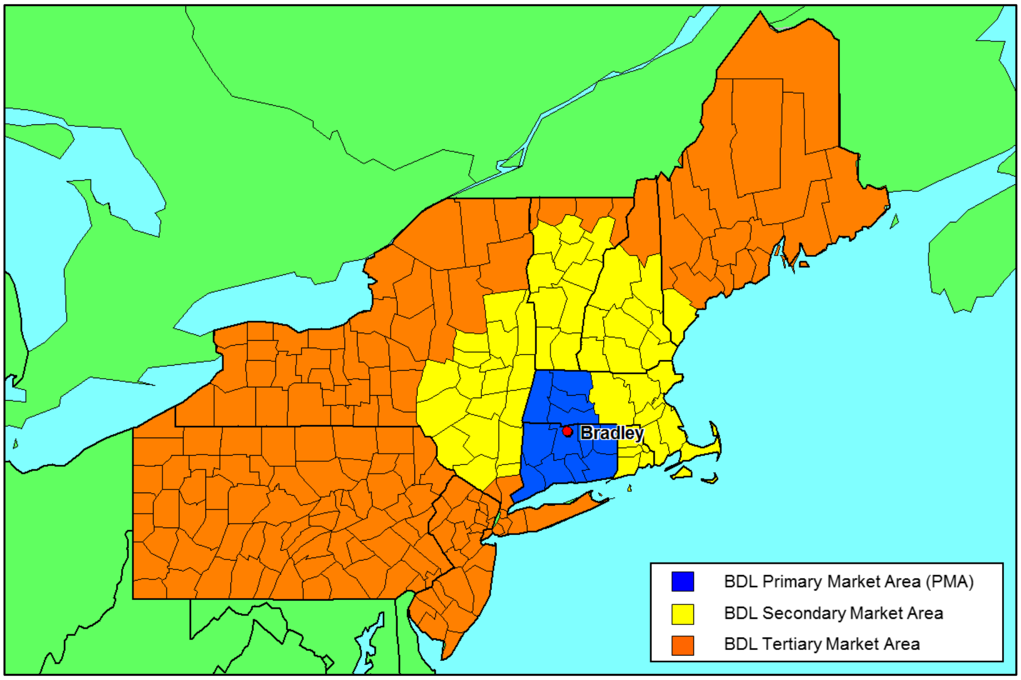
- Primary: A primary air trade area for an airport represents the region where shippers and consignees can receive same-day pickup or delivery for an international flight, and therefore is a key determinant in attracting direct cargo flights and supporting services. The Primary Region includes Connecticut and the four Western Massachusetts counties.
- Secondary: This is an area where BDL could compete with JFK and BOS with the ability for same pickup and delivery services.
- Tertiary: This area is within a reasonable truck-haul of BDL, but a BDL service would have to have a superior advantage in price or service to divert from closer airports or JFK.

The following analysis focuses on the primary and secondary areas that are critical to the future for direct international all-cargo services.

[1] From 2004 to 2006, there were scheduled international all-cargo flights, but no consistent service since then with only minor international charter traffic.

[2] This definition was developed as part of earlier internal air cargo studies conducted by the airport.

BDL International Air Cargo Service Area



Source: Campbell-Hill.

Air Trade Volumes for BDL International Air Cargo Service Area

The combined primary and secondary areas produced $34 billion of air exports and $35 billion of air imports in 2015 (see table below) accounting for 7% of total U.S. air trade (excluding Puerto Rico and the Virgin Islands). The region's air trade value increased 5% from 2013 to 2015 with export value down 4% and import value up 15%. The region produced over 213,000 tonnes of import trade and 208,000 tonnes of export trade with the combined weight up 1% from 2013 to 2015 (with imports up 12% and exports down 7%).

Air Trade for BDL Service Area (2015)

	Imports	Exports	Total
Trade Value (mil. $)			
Primary	$13,216	$10,994	$24,210
Secondary	$21,507	$23,065	$44,573
	$34,724	$34,059	$68,783
Trade Weight (MT)			
Primary	58,704	59,382	118,086
Secondary	154,801	149,139	303,940
	213,506	208,521	422,026

Source: Campbell-Hill State Air Trade Database[3]

The 12-county primary area produced $11 billion of air exports and $13 billion of air imports in 2015 with export value down 13% from 2013 to 2015 and import value up 42%. Trade weight

[3] These estimates are based on U.S. Bureau of the Census, State of Export/Import data series adjusted by Campbell-Hill and allocated to the county areas using a proprietary model.

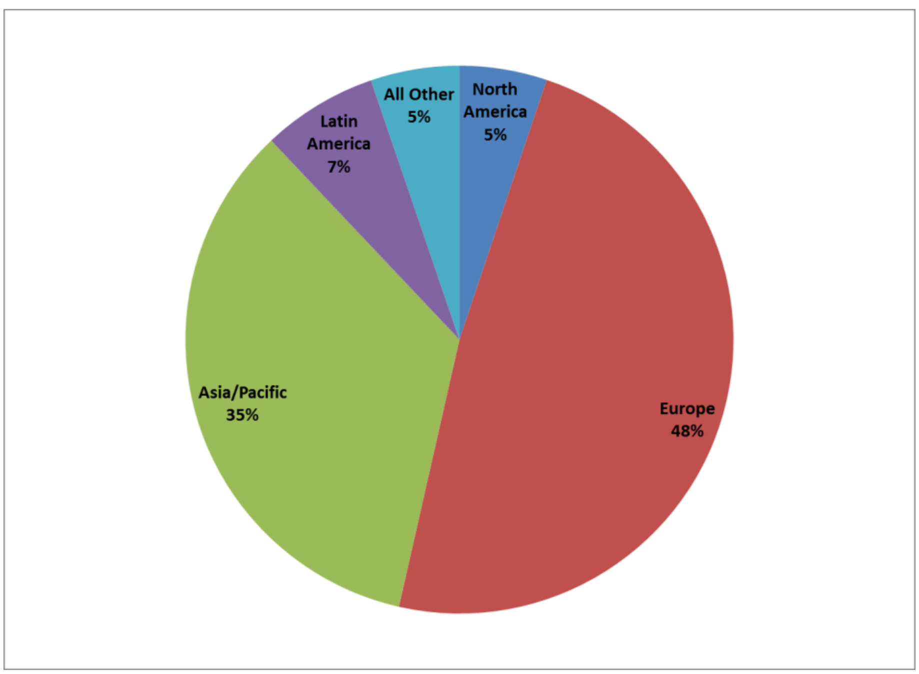
was over 118,000 tonnes including over 59,000 tonnes of exports and 58,000 tonnes of imports. Export trade weight declined 3% from 2013 to 2015 while import weight increased 9%. It is expected that demand in the primary service area would be the driving factor in future expansion of international air cargo activity at BDL. Typically, a secondary gateway will depend on the primary region for most of a direct service initial traffic (over 75%). Accordingly, the focus of the rest of the international demand analysis focuses on patterns in terms of weight flows for the primary region.

Top Foreign Markets for BDL's Primary International Service Area

European markets dominate the air trade for the primary region with nearly half of the total weight in 2015 (see figure below). Asia/Pacific accounted for 35% of the trade followed by Latin America with 7%, All Other (Africa and Middle East) with 5% and North America (Canada and Mexico) with 5%. Import trade is more heavily dependent on Europe with 57% of the total weight compared to 40% of the import trade.

In terms of growth patterns, the 3% decline in air export weight from 2013 to 2015 was based on a 5% decline for Europe and a 2% decline for Asia/Pacific. The 9% increase in air imports was based on an 11% increase for Asia/Pacific with a 9% increase for Europe and a 52% increase in the relatively small trade volume with Canada and Mexico.

BDL Primary Region Air Trade Weight by World Region (2015)

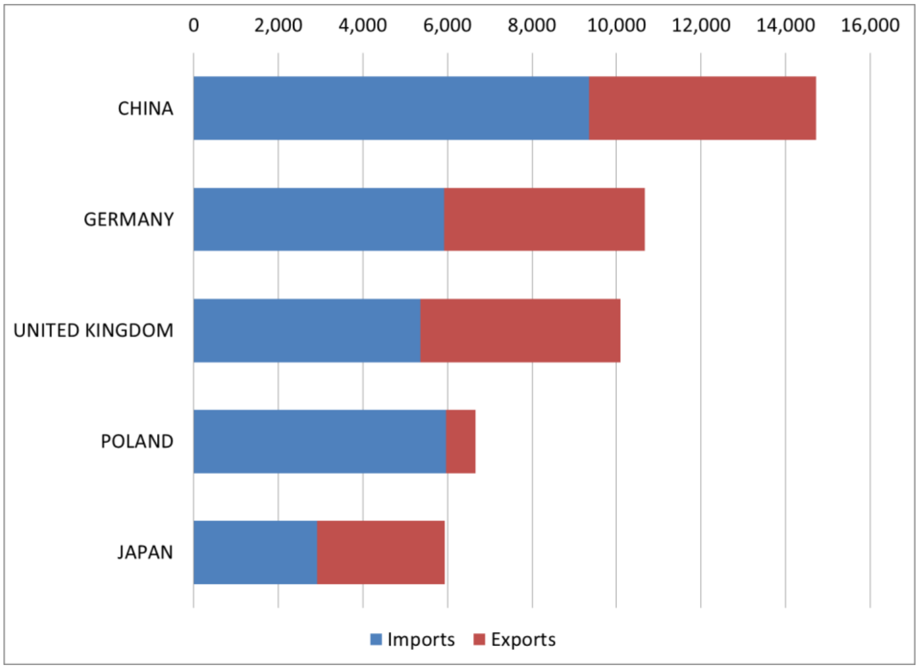


Source: Campbell-Hill State Air Trade Database

China is the top country market for the BDL primary market region by a wide margin based on being the top export and import market in 2015 (see figure below). China's trade increased by 2% from 2013 to 2015, with import volumes up 7% and export volumes down 6%. Germany is the second largest trade partner being third in import trade and second in export trade. United

Kingdom, Poland, Japan and France are also large sources of trade, with the Dominican Republic being the fastest growing export market (up 114% from 2013 to 2015) and Poland as the fastest growing import market (up 605%).

Top Trade Partners for BDL Primary Region (2015)



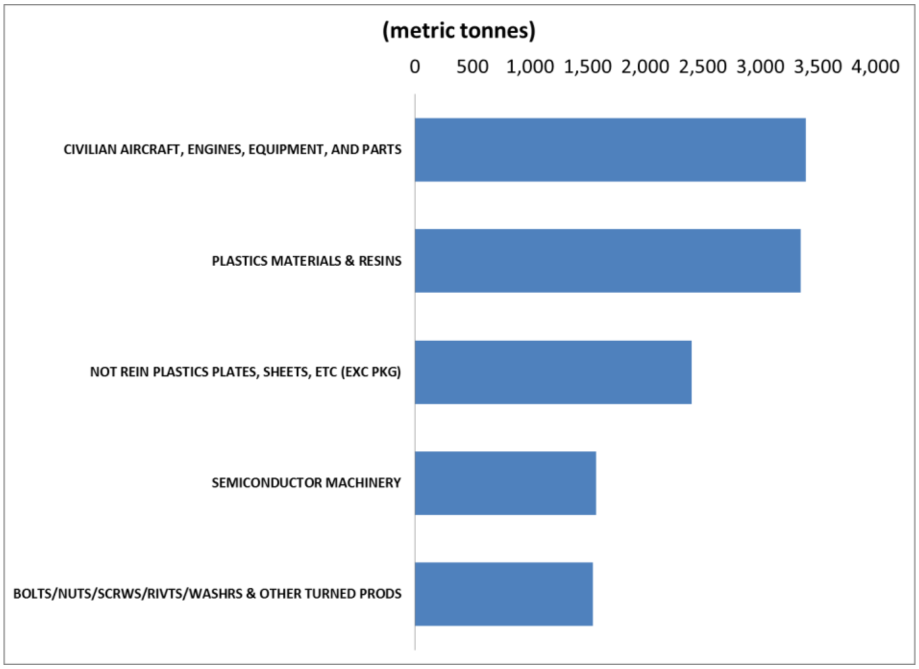
Source: Campbell-Hill State Air Trade Database

Top Commodities for BDL's Primary International Service Area

In general, the composition of international air trade for an airport's service area reflects the concentration of industrial production in the region that produces and consumer air trade, as well as the demand for high value consumer goods shipped by air. The top three export groups (at the 3-digit North American Industry Classification System (NAICS) level) for the primary region are fabricated metal products (18% of total weight in 2015), non-electrical machinery (15%), and chemicals (9%) which combined accounted for 47% of total weight. For imports, the top three categories were fabricated metal products (20% of weight), non-electrical machinery (16%), and computer and electronic products (14%) which combined for 50% of the total weight).

The top export commodities (at the six-digit NAICS level) were a combination of industrial materials such as aviation products and plastics materials and resin, and high tech commodities such as semiconductor machinery (see figure below).

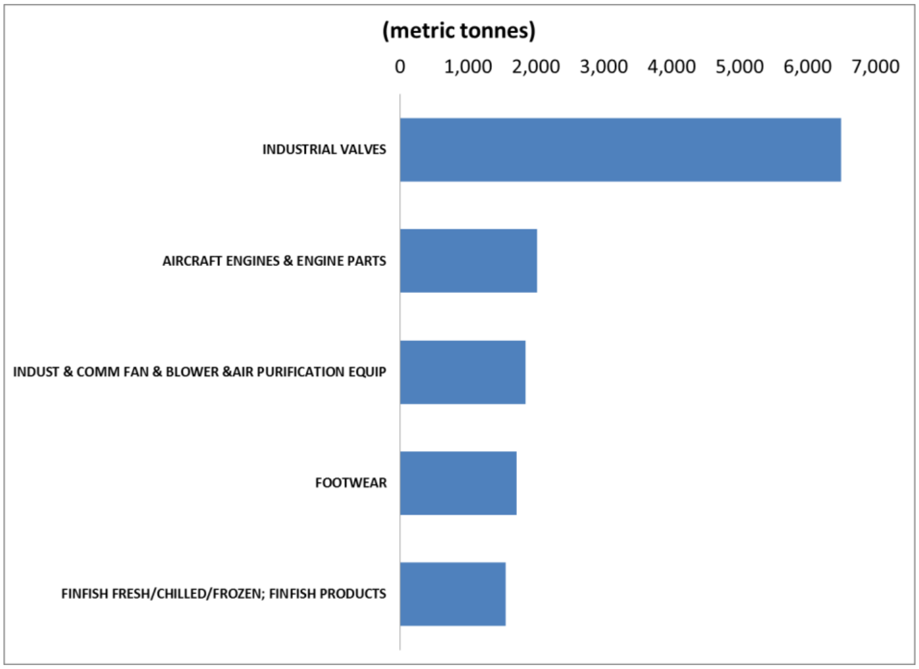
Top Export Commodities for BDL Primary Region (2015)



Source: Campbell-Hill State Air Trade Database

The top import commodities were industrial materials including industrial valves, aircraft engines and parts, and industrial equipment and consumer goods such as footwear and fish (see figure belowError! Reference source not found.). The volatility of air trade flows are indicated by the 120% increase in industrial valve imports from 2014 to 2015 in comparison with declines of 28% for footwear and 29% for fish imports. On the export side, aviation products stayed stable from 2014 to 2015 while air export of plastics materials and resins nearly doubled.

Top Import Commodities for BDL Primary Region (2015)

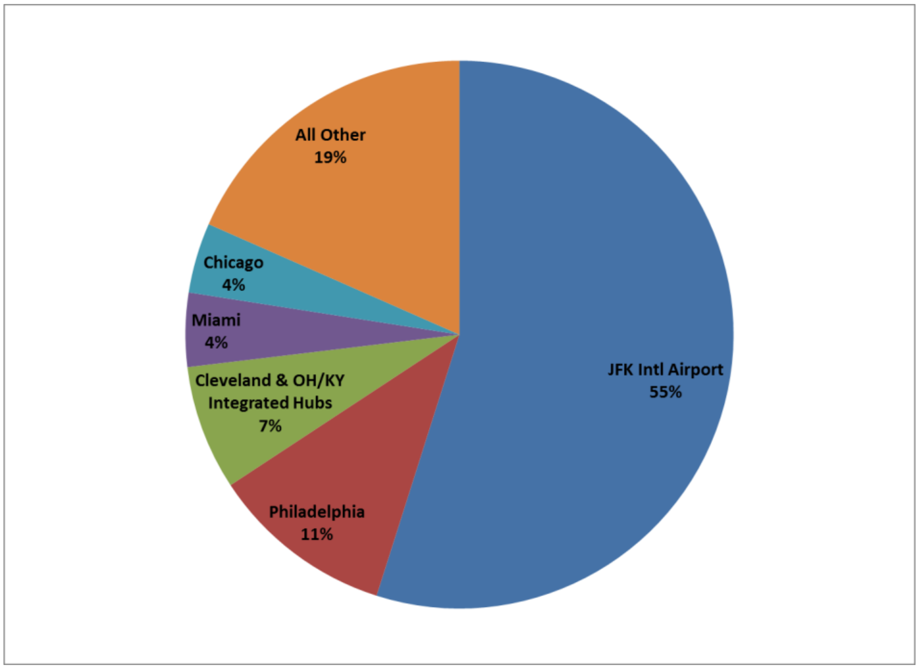


Source: Campbell-Hill State Air Trade Database

Current Airport Routing Patterns for Regional Air Trade

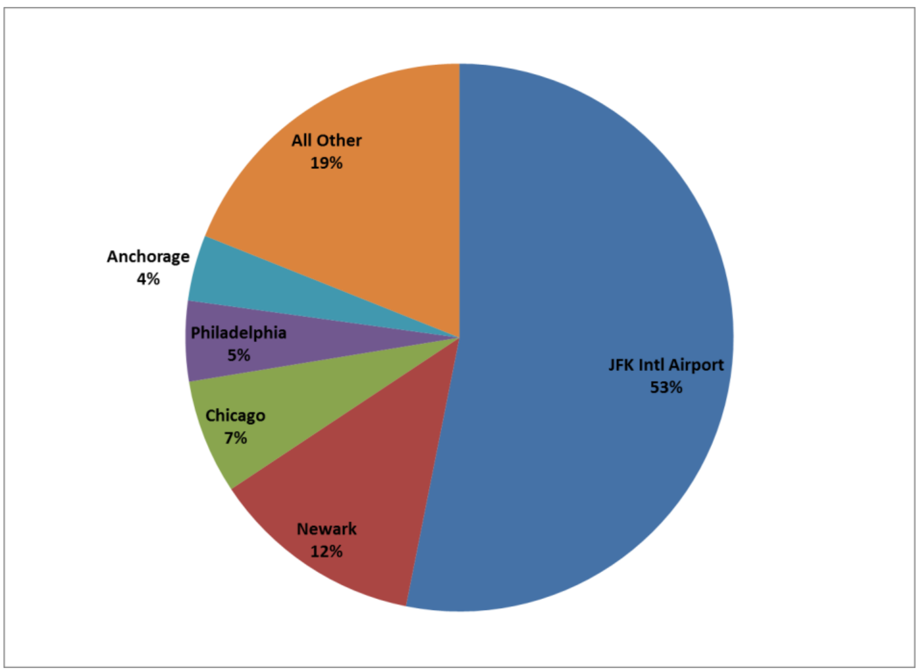
Without scheduled international services providing cargo capacity to primary world markets, the BDL regional market has substantial leakage of air export and import traffic to the primary cargo gateways. Routing patterns are not available for the local BDL primary market, but can be discerned by state-level patterns for Connecticut (see figure below). In terms of total international cargo, 55% of Connecticut's air exports are routed via JFK while the integrated carriers (FedEx's EWR gateway and MEM hub and UPS's PHL gateway and SDF hub) handled 23% of export trade. JFK is slightly less dominant for import trade with 53% of the weight while the integrated carrier gateways and hubs handled 21% of the trade (see figure below Note that while BOS is a significant international cargo gateway, the airport is not among the top ten routings for Connecticut's air trade in either direction.

State of Connecticut Air Export Weight by Airport of Exit



Source: Campbell-Hill State Air Trade Database

State of Connecticut Air Import Weight by Airport of Unlading

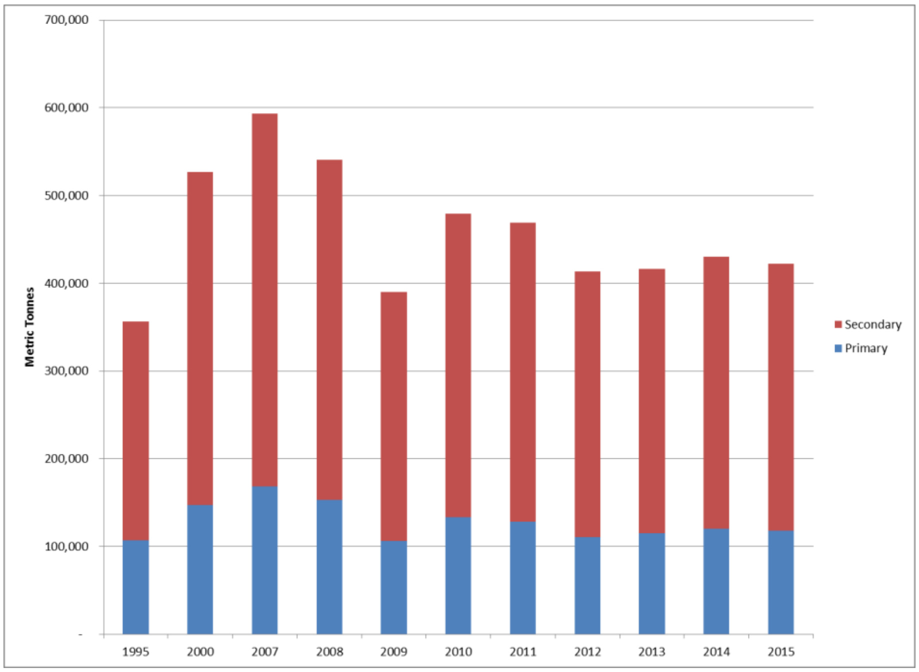


Source: Campbell-Hill State Air Trade Database

Historical Patterns for Regional Air Trade

As shown in see figure below, the air trade generated by the combined primary and secondary areas has not grown significantly over the last 20 years, has declined since 2007, and remained relatively stable since 2012. Between 1995 and 2015, air trade weight for the combined region increased 18% as the primary region increased 10% and the secondary region increased 22%. Between 2010 and 2015, overall weight has declined 12% based on relatively proportional drops for both regions.

BDL International Air Cargo Traffic (2001-2016)



Source: Campbell-Hill State Air Trade Database and previous BDL studies

Potential for Direct International All-Cargo Service

While the BDL International Service Area does generate a significant amount of air exports and imports, BDL handles very little on direct international flights. The vast majority of this air trade is routed by air or truck to other U.S. international airports including major cargo/passenger airports such as JFK and the gateway and hub airports for the integrated carriers. As discussed below, the current routing methods for regional air cargo are unlikely to change during the forecast period and therefore should have a minimal effect on the airport's facilities and infrastructure.

BDL currently handles a minimal amount of cargo on international flights and has not had significant traffic for almost a decade. According to T-100 statistics, a total of 171 tonnes was handled on 10 international flights at BDL in 2016.[4] There were only four international all-cargo flights carrying 96 tonnes of traffic to Toulouse, France. Six passenger flights combined for 75

[4] Less than one-tenth of a tonne of cargo was reported on 76 flights to/from Cunard and is excluded.

tonnes mostly on one round-trip charter to Puerto Vallerta, Mexico. This amount of traffic is insignificant compared to the 122,392 tonnes of domestic air cargo handled at the airport.

The international air trade handled at BDL (as measured by U.S. Bureau of the Census statistics) is also insignificant when compared to traffic handled at major Northeast U.S. airports. As shown below, a total of 775 tonnes of air exports and air imports for overseas markets was reported for the Customs Port of Hartford In CY 2016.[5] This level accounts for less than 0.1% of the trade routed via JFK and a fraction of that routed via Newark, Boston and Philadelphia.

New York (JFK)	970,310
Newark (EWR)	186,471
Boston - Logan (BOS)	109,160
Philadelphia (PHL)	31,774
Hartford (BDL)	775

There are three potential scenarios whereby an airport without some base of international air cargo operations can develop as an international gateway. One scenario would be to replicate the recent development of "secondary" gateways that have some geographical or efficiency advantage over the "primary" gateways (JFK, ORD, LAX, and MIA). For example, Seattle-Tacoma (SEA) has developed as a gateway for the Pacific Northwest based on both the long truck distances to the primary West Coast gateways to Asia (LAX and SFO) and growth in passenger flights with belly capacity. Between 2011 and 2016, SEA's overseas air trade increased by 38% while the U.S. total grew just 1%. This growth has been mostly based on new passenger flights while maintaining a significant number of all-cargo flights over the period.[6]

The potential for this type of expansion for BDL is low considering the close proximity of EWR, JFK and BOS that already are cargo gateways, and the lack of passenger belly capacity that could serve as a building block for all-cargo traffic. The key question is whether an all-cargo airline would consider serving a secondary airport such as BDL in order to reduce the costs and time delays for O&D traffic to/from the catchment region with the trade-offs of leaving the high density of freight forwarders and specialized handling capabilities of the existing gateways (particularly JFK).[7] As shown above, there are no Northeast airports that handle more air trade

[5] These statistics can include import trade that is landed at another airport and trucked to BDL for Customs clearance so may exceed traffic enplaned to or deplaned from international flights at BDL. Trade for Mexico and Canada is excluded.

[6] According to T-100 statistics, SEA's international cargo traffic increased 25% from YE 2011 Q2 to YE 2016 Q2 based on a 38% increase in total departures. The number of passenger flights increased 40% with traffic up 60%, while a 4% decline in all-cargo flights handled 1% less traffic.

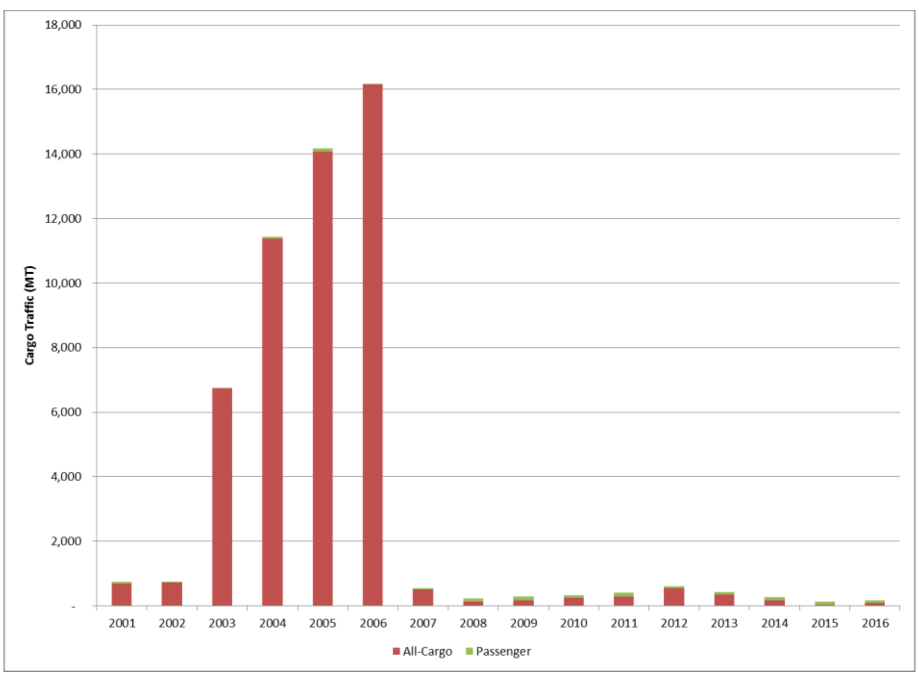
[7] Historically, there has been speculation that JFK's constrained freighter capacity and difficult ground access would induce cargo carriers to re-locate to secondary gateways. Recent trends have eased those pressures as freighter-based traffic declined by nearly two-thirds from 2003 to 2016 while overall traffic has been relatively stable (after declining 5% from 2003 to 2009). Belly capacity on international passenger flights has been adequate to handle current traffic levels and freighter capacity could be easily increased to handle any future growth.

than BDL and less than PHL which has significant passenger flight capacity and is the European gateway for UPS. Considering that BDL was not in the top 50 continental U.S. airports in terms of overseas trade for CY 2016, it is unlikely that the airport would develop as a general gateway as has SEA and other airports (e.g., Cincinnati).

A second scenario would be to develop as a specialty gateway dominated by a limited number of air carriers or shipper industries. For a number of years, Cargolux has operated a network of flights serving a combination of primary and secondary U.S. gateways tailored to high volume aerospace and high tech shippers using one-way flights that may carry third country trade (e.g., Mexico to Europe). During the 12 months ended June 2016, Cargolux connected the U.S. with Asia and Europe using over 3,300 one-way flights connecting 11 U.S. airports with 10 Asian and European airports (including its Luxembourg hub). While the primary gateways are included in these services, Cargolux also fly to medium cargo gateways such as Dallas-Fort Worth (DFW), Houston (IAH) and Atlanta (ATL) and smaller gateways such as Seattle, Huntsville (HSV), Indianapolis (IND), and Rickenbacker (LCK).

In fact, CargoLux formerly served BDL with all-cargo flights and was responsible for the relatively high volume of international cargo during the period 2003 to 2006 (see Figure 3-31). Since it has been a decade since that activity occurred and there being no interest expressed in direct flights by Cargolux or any other all-cargo operator, it must be concluded that the current pattern of minimal ad hoc international cargo activity will continue throughout the forecast period.

BDL International Air Cargo Traffic (2001-2016)



Source: T-100

A final scenario would be to become an international gateway for FedEx or UPS. Neither carrier has international flights at a Northeast airport other than its gateway (EWR for FedEx and PHL for UPS). The purpose of these gateways is to bypass the national hub for international shipments between Trans-Atlantic markets and the U.S. Northeast. Both PHL and EWR are well-located to cover the entire Northeast region and both have a network of supporting domestic flights. It is unlikely that BDL (or another New England airport) could better fulfill this role.

APPENDIX D

REGRESSION RESULTS

D. REGRESSION RESULTS

	Single Variable		Combined With Average Yield		
	Coefficient	R-Squared	Coefficient	Yield Coefficient	R-Squared
Domestic - Originating Passengers					
Yield	-0.13	0.01			
Population	-3.87	0.38	-3.86	-0.12	0.39
GDP	-0.40	0.05	-0.46	-0.20	0.08
Household Income	-0.78	0.24	-0.78	0.01	0.24
Domestic - Total Passengers					
Yield	-0.13	0.01			
Population	-3.87	0.38	-3.86	-0.12	0.39
GDP	-0.40	0.05	-0.46	-0.20	0.08
Household Income	-0.78	0.24	-0.78	0.01	0.24
Total - Originating Passengers					
Yield	0.44	0.10			
Population	-3.54	0.34	-3.49	0.02	0.34
GDP	-0.31	0.04	0.01	0.44	0.10
Household Income	-0.69	0.20	-0.59	0.21	0.22
Total - Total Passengers					
Yield	0.44	0.10			
Population	-3.54	0.34	-3.49	0.02	0.34
GDP	-0.31	0.04	0.01	0.44	0.10
Household Income	-0.69	0.20	-0.59	0.21	0.22

$\ln T_i = a + b \ln X_i + c \ln Y_i$ where
T_i = ONT domestic O&D passengers in year i.
X_i = value of socio-economic or demographic variable in year i.
Y_i = value of average yield in year i.

Source: U.S. DOT, O&D Survey, Woods & Poole CEDDS (2016)

APPENDIX E

FAA Airfield Design Standard Review

Design Critieria	AC 150/5300-13A Paragraph	Current Condition	Meets Standards? C-IV
Runway Safety Area Transverse Grades	Figure 3-23	1.0% to 4.5%	No
Runway Safety Area Width	Table 3-5	400' to 500'	No
Runway Object Free Area	Table 3-5	659' & 720'	No
Runway Protection Zone (RPZ) (15 End)	Table 3-5	1,510 x 1,000 x 1700	Yes
Runway Protection Zone (RPZ) (33 End)	Table 3-5	1,750 x 1,000 x 2500	Yes
Runway Centerline to Parallel Taxiway Centerline	Table 3-5	450' (North TWY) & 400' (South TWY)	Yes

Design Critieria	AC 150/5300-13A Paragraph	Current Condition	Meets Standards? C-IV
Runway Width	Table 3-5	150'	Yes
Shoulder Width	Table 3-5	25'	Yes
Longitudinal Grades	418 b (1-5)	0.0% to 0.2%	Yes
Transverse Grades	418 b (6)	1.0% to 1.5%	Yes

RSA TRANSVERSE GRADES

LT	RT
Sta. 108+00 to 118+00 (>3%)	132+50 to 134+00 (<1.5%)

Positive Grades and Drainage Structures in RSA

LT	RT
129+00 to 151+00	Sta. 122+00 to 124+00
155+00 to 166+00	135+00 to 141+00

Runway Alignment begins @ Sta. 100+00 at Runway 15 end

			Meets Standards?
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**D-V**
Runway Safety Area Transverse Grades	Figure 3-23	1.5% to 3.0%	Yes
Runway Safety Area Width	Table 3-5	500'	Yes
Runway Object Free Area	Table 3-5	800'	Yes
Runway Protection Zone (RPZ) (6 End)	Table 3-5	2,500 x 1,000 x 1700	Yes
Runway Protection Zone (RPZ) (33 End)	Table 3-5	2,500 x 1,000 x 1700	Yes
Runway Centerline to Parallel Taxiway Centerline	Table 3-5	550' (TWY C) & 570' (TWY J)	Yes

			Meets Standards?
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**D-V**
Runway Width	Table 3-5	200'	Yes
Shoulder Width	Table 3-5	25'	No (35')
Runway CL Longitudinal Grades	418 b (1-5)	0.2% to 0.6%	Yes
Pavement Transverse Grades	418 b (6)	1.0% to 1.5%	Yes

Runway Alignment begins @ Sta. 100+00 at Runway 24 end

			Meets Standards?
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**B-II**
Runway Safety Area Transverse Grades	Figure 3-23	0.6% to 4.9%	Yes*
Runway Safety Area Width	Table 3-5	150'	Yes
Runway Object Free Area	Table 3-5	500'	Yes
Runway Protection Zone (RPZ) (1 End)	Table 3-5	500 x 700 x 1,000	Yes
Runway Protection Zone (RPZ) (33 End)	Table 3-5	500 x 700 x 1,000	Yes
Runway Centerline to Parallel Taxiway Centerline	Table 3-5	400' (TWY E)	Yes

			Meets Standards?
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**B-II**
Runway Width	Table 3-5	100'	Yes
Shoulder Width	Table 3-5	20'	Yes
Runway CL Longitudinal Grades	418 b (1-5)	0.0% to 0.8%	Yes
Pavement Transverse Grades	418 b (6)	-0.2% to 1.9%	No

*RSA Transverse Grades < 1.5%

LT	RT
105+50 to 107+00	105+00 to 107+00
108+00 to 112+00	109+50 to 110+50

Runway Pavement Transverse Grades < 1.0%

LT	RT
114+00 to 119+00	115+50 to 122+00
121+50 to 124+50	124+00 to 127+50
127+00 to 142+00	128+50 to 133+00

Runway Alignment begins @ Sta. 100+00 at Runway 1 end

			Meets Standards?		
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**ADG IV**	**ADG V**	**ADG VI**
Taxiway Safety Area	404 c	259' & 320'	Yes	Yes	No
Taxiway Object Free Area	404 b	259' & 320'	Yes	Yes (Partial)	No
Taxiway Centerline to Runway Centerline	320	550'	Yes	Yes	Yes
Taxiway Centerline to Fixed/Moveable Object	404 a (2)	130' & 162'	Yes	No	No

			Meets Standards?		
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**TDG 4**	**TDG 5**	**TDG 6**
Taxiway Width	403	75'	Yes	Yes	Yes
Taxiway Shoulder Width	403	25'	Yes	No	No
Taxiway Fillet Dimensions	406 b	Striped Non-Standard	Yes	No	No
Longitudinal Grades	418 b (1-5)	0.0% to 1.5%	Yes	Yes	Yes
Transverse Grades	418 b (6)	0.0% to 1.5%	No	No	No

TRANSVERSE GRADES (Locations below are < 1.0%)

LT	RT
Sta. 11+00 to 13+50	11+00 to 14+00
Sta. 16+50 to 17+75	16+75 to 17+75
Sta. 19+00 to 20+50	19+50 to 20+50
Sta. 21+00 to 23+50	29+00 to 30+50
Sta. 34+25 to 38+00	36+25 to 38+00
Sta. 38+75 to 41+00	

Taxiway Alignment begins at 10+00 at Runway Hold Line for Runway 15/33

			Meets Standards?		
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**ADG IV**	**ADG V**	**ADG VI**
Taxiway Safety Area	404 c	245'	Yes	Yes	No
Taxiway Object Free Area	404 b	259' & 320'	Yes	Yes	No
Taxiway Centerline to Runway Centerline	320	400' & 450'	Yes	Yes	No
Taxiway Centerline to Fixed/Moveable Object	404 a (2)	160'	Yes	Yes	No

			Meets Standards?		
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**TDG 4**	**TDG 5**	**TDG 6**
Taxiway Width	403	75'	Yes	Yes	Yes
Taxiway Shoulder Width	403	25'	Yes	No	No
Taxiway Fillet Dimensions	406 b	Striped Non-Standard	Yes	No	No
Longitudinal Grades	418 b (1-5)	0.0% to 1.2%	Yes	Yes	Yes
Transverse Grades	418 b (6)	0.0% to 1.8%	No	No	No

SUPERELEVATED AREAS

109+50 to 140+00

Taxiway Alignment begins at 100+00 where Taxiway CL curve stripes meet at Runway 33 End

Design Critieria	AC 150/5300-13A Paragraph	Current Condition	Meets Standards? ADG IV	ADG V	ADG VI
Taxiway Safety Area	404 c	259' & 320'	Yes	88' LT, 122' RT = 222' Total width	No
Taxiway Object Free Area	404 b	259' & 320'	Yes	217' LT, 150' RT = 367' Total Width	No
Taxiway Centerline to Runway Centerline	320	570'	Yes	Yes	Yes
Taxiway Centerline to Fixed/Moveable Object	404 a (2)	130'	Yes	No	No

Design Critieria	AC 150/5300-13A Paragraph	Current Condition	Meets Standards? TDG 4	TDG 5	TDG 6
Taxiway Width	403	75'	Yes	Yes	Yes
Taxiway Shoulder Width	403	25'	Yes	No	No
Taxiway Fillet Dimensions	406 b	Striped Non-Standard	Yes	No	No
Longitudinal Grades	418 b (1-5)	0.0% to 0.9%	Yes	Yes	Yes
Transverse Grades	418 b (6)	0.0% to 3.1%	No	No	No

TRANSVERSE GRADES (Locations below are > 1.5%)

LT	RT
123+00 to 126+00	114+50 to 116+50
	121+00 to 128+00

Taxiway Alignment begins at 100+00 at Runway Hold Line for Runway 6/24

			Meets Standards?		
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**ADG IV**	**ADG V**	**ADG VI**
Taxiway Safety Area	404 c	171'	Yes	No	No
Taxiway Object Free Area	404 b	259'	Yes	No	No
Taxiway Centerline to Runway Centerline	320	400'	Yes	Yes	No
Taxiway Centerline to Fixed/Moveable Object	404 a (2)	130'	Yes	No	No

			Meets Standards?		
Design Critieria	**AC 150/5300-13A Paragraph**	**Current Condition**	**TDG 4**	**TDG 5**	**TDG 6**
Taxiway Width	403	75'	Yes	Yes	Yes
Taxiway Shoulder Width	403	30'	Yes	Yes	Yes
Taxiway Fillet Dimensions	406 b	Striped Non-Standard	Yes	No	No
Longitudinal Grades	418 b (1-5)	0.0% to 0.8%	Yes	Yes	Yes
Transverse Grades	418 b (6)	0.0% to 2.0%	No	No	No

TRANSVERSE GRADES (Locations below are < 1.0%)

LT RT

Taxiway Alignment begins at 10+00 at Runway Hold Line for Runway 15/33
Taxiway Alignment ends at 43+35 at Runway 6/24 Edge

Design Critieria	AC 150/5300-13A Paragraph	Current Condition	Meets Standards? ADG IV	ADG V	ADG VI
Taxiway Safety Area	404 c	214'	Yes	Yes	No
Taxiway Object Free Area	404 b	320'	Yes	Yes	No
Taxiway Centerline to Runway Centerline	320	570'	Yes	Yes	No
Taxiway Centerline to Fixed/Moveable Object	404 a (2)	130'	Yes	Yes	No

Design Critieria	AC 150/5300-13A Paragraph	Current Condition	Meets Standards? TDG 4	TDG 5	TDG 6
Taxiway Width	403	75'	Yes	Yes	Yes
Taxiway Shoulder Width	403	25'	Yes	No	No
Taxiway Fillet Dimensions	406 b	Striped Non-Standard	Yes	No	No
Longitudinal Grades	418 b (1-5)	0.0% to 0.7%	Yes	Yes	Yes
Transverse Grades	418 b (6)	1.0% to 1.5%	No	No	No

Taxiway Alignment begins at 10+00 at Runway Hold Line for Runway 15/33
Taxiway Alignment ends at 43+35 at Runway 6/24 Edge

APPENDIX F

TERMINAL PROGRAM DETAIL

Bradley International Airport

Windsor Locks

Passenger & Aircraft Forecasts

	Existing		2017		2022		2027		2032		2037	
Peak Hour Passengers												
Simultaneous Peak Hour Domestic Pax												
peak hour domestic enplaning (departing) pax		O&D PHEP	1,633	O&D PHEP	1,865	O&D PHEP	2,051	O&D PHEP	2,224	O&D PHEP	2,384	O&D PHEP
peak hour domestic deplaning (arriving) pax		O&D PHDP	1,027	O&D PHDP	1,061	O&D PHDP	1,167	O&D PHDP	1,265	O&D PHDP	1,356	O&D PHDP
Total	***0***	***O&D PHP***	***2,660***	***O&D PHP***	***2,926***	***O&D PHP***	***3,218***	***O&D PHP***	***3,489***	***O&D PHP***	***3,740***	***O&D PHP***
peak hour domestic enplaning (departing) transferring pax		Trans PHEP	0	Trans PHEP	0	Trans PHEP	0	Trans PHEP	0	Trans PHEP	0	Trans PHEP
peak hour domestic deplaning (arriving) transferring pax		Trans PHDP	0	Trans PHDP	0	Trans PHDP	0	Trans PHDP	0	Trans PHDP	0	Trans PHDP
Total	***0***	***Trans PHP***	***0***	***Trans PHP***	***0***	***Trans PHP***	***0***	***Trans PHP***	***0***	***Trans PHP***	***0***	***Trans PHP***
Simultaneous Peak Hour International Pax												
peak hour int'l enplaning (departing) pax		O&D PHEP	10	O&D PHEP	11	O&D PHEP	13	O&D PHEP	14	O&D PHEP	15	O&D PHEP
peak hour int'l deplaning (arriving) pax		O&D PHDP	0	O&D PHDP	112	O&D PHDP	123	O&D PHDP	134	O&D PHDP	144	O&D PHDP
Total	***0***	***O&D PHP***	***10***	***O&D PHP***	***123***	***O&D PHP***	***136***	***O&D PHP***	***148***	***O&D PHP***	***159***	***O&D PHP***
peak hour int'l enplaning (departing) transferring pax		Trans PHEP	0	Trans PHEP	0	Trans PHEP	0	Trans PHEP	0	Trans PHEP	0	Trans PHEP
peak hour int'l deplaning (arriving) transferring pax		Trans PHDP	0	Trans PHDP	0	Trans PHDP	0	Trans PHDP	0	Trans PHDP	0	Trans PHDP
Total	***0***	***Trans PHP***	***0***	***Trans PHP***	***0***	***Trans PHP***	***0***	***Trans PHP***	***0***	***Trans PHP***	***0***	***Trans PHP***

Gates

	Existing		2017		2022		2027		2032		2037	
Domestic Flight Schedule Contact Gates												
Group I		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group II		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group III (Narrowbody)		gates	19	gates	21	gates	22	gates	23	gates	25	gates
Group IIIa (Narrowbody)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group IV (Widebody)		gates	1	gates	0	gates	0	gates	0	gates	0	gates
Group V (B747/A340/B777)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group VI (A380)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Total Departures and Arrivals	***23***	***gates***	***20***	***gates***	***21***	***gates***	***22***	***gates***	***23***	***gates***	***25***	***gates***
Domestic Flight Schedule Hardstand Gates												
Group I		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group II		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group III (Narrowbody)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group IIIa (Narrowbody)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group IV (Widebody)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group V (B747/A340/B777)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group VI (A380)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Total Departures and Arrivals	***0***	***gates***	***0***	***gates***	***0***	***gates***	***0***	***gates***	***0***	***gates***	***0***	***gates***
International Flight Schedule Contact Gates												
Group I		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group II		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group III (Narrowbody)		gates	2	gates	0	gates	0	gates	0	gates	0	gates
Group IIIa (Narrowbody)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group IV (Widebody)		gates	0	gates	2	gates	2	gates	2	gates	2	gates
Group V (B747/A340/B777)		gates	0	gates	1	gates	2	gates	2	gates	2	gates
Group VI (A380)			0		0		0		0		0	
Total Departures and Arrivals	***0***	***gates***	***2***	***gates***	***3***	***gates***	***4***	***gates***	***4***	***gates***	***4***	***gates***
International Flight Schedule Hardstand Gates												
Group I		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group II		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group III (Narrowbody)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group IIIa (Narrowbody)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group IV (Widebody)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group V (B747/A340/B777)		gates	0	gates	0	gates	0	gates	0	gates	0	gates
Group VI (A380)			0		0		0		0		0	
Total Departures and Arrivals	***0***	***gates***	***0***	***gates***	***0***	***gates***	***0***	***gates***	***0***	***gates***	***0***	***gates***

Bradley International Airport

Windsor Locks

	Existing		2017		2022		2027		2032		2037	
Departures Check-In Hall	41,900	SF	41,984		47,017		51,643		55,274		59,717	
Departures Public Concourse	27,250	SF	21,035	SF	23,415	SF	26,320	SF	28,070	SF	30,555	SF
Departures Meeter/ Greeter Area	0	SF	5,091	SF	5,831	SF	6,387	SF	6,942	SF	7,405	SF
Full-Service Positions												
Agent Position + Bag Scale		pos.	10	pos.	11	pos.	9	pos.	10	pos.	11	pos.
Max PAX in Queue		PAX	63	PAX	72	PAX	57	PAX	62	PAX	66	PAX
Processing Area		SF	1,271	SF	1,400	SF	1,152	SF	1,271	SF	1,400	SF
Queue		SF	1,055	SF	1,206	SF	958	SF	1,045	SF	1,109	SF
Cross Circulation		SF	0	SF	0	SF	0	SF	0	SF	0	SF
Total	13,350	SF	2,326	SF	2,606	SF	2,110	SF	2,316	SF	2,509	SF
Bag Drop												
Bag Drop Positions		pos.	16	pos.	18	pos.	21	pos.	22	pos.	24	pos.
Max PAX in Queue		PAX	67	PAX	76	PAX	90	PAX	97	PAX	104	PAX
Processing Area		SF	2,035	SF	2,293	SF	2,670	SF	2,799	SF	3,057	SF
Queue		SF	1,120	SF	1,271	SF	1,507	SF	1,626	SF	1,744	SF
Cross Circulation		SF	0	SF	0	SF	0	SF	0	SF	0	SF
Total	0	SF	3,155	SF	3,564	SF	4,177	SF	4,425	SF	4,801	SF
Self-Service Kiosks												
Kiosks		pos.	66	pos.	76	pos.	90	pos.	97	pos.	103	pos.
Max PAX in Queue		PAX	83	PAX	95	PAX	112	PAX	121	PAX	130	PAX
Processing Area		SF	1,045	SF	1,195	SF	1,421	SF	1,529	SF	1,626	SF
Queue		SF	1,873	SF	2,143	SF	2,530	SF	2,735	SF	2,939	SF
Total	0	SF	2,918	SF	3,338	SF	3,951	SF	4,264	SF	4,565	SF
Premier Check-In												
Counters			0		0		0		0		0	
Total			0		0		0		0		0	
Airline Ticket Offices (ATO)	11,200	SF	5,039	SF	5,620	SF	5,813	SF	6,201	SF	6,783	SF
Domestic Check-In Hall Restrooms												
Men's Restroom		SF	394	SF	458	SF	458	SF	458	SF	458	SF
Urinals		fixtures	4	fixtures	5	fixtures	5	fixtures	5	fixtures	5	fixtures
Water Closet		fixtures	4	fixtures	5	fixtures	5	fixtures	5	fixtures	5	fixtures
Lavatories		fixtures	4	fixtures	4	fixtures	4	fixtures	4	fixtures	4	fixtures
Women's Restroom		SF	444	SF	478	SF	512	SF	569	SF	603	SF
Water Closet		fixtures	9	fixtures	10	fixtures	11	fixtures	12	fixtures	13	fixtures
Lavatories		fixtures	3	fixtures	3	fixtures	3	fixtures	3	fixtures	3	fixtures
Companion Care		facilities	1	facilities	1	facilities	1	facilities	1	facilities	1	facilities
Companion Care Area		SF	44	SF	44	SF	44	SF	44	SF	44	SF
Janitor's Closet		facilities	2	facilities	2	facilities	2	facilities	2	facilities	2	facilities
Janitor's Closet Area		SF	50	SF	50	SF	50	SF	50	SF	50	SF
Circulation		SF	233	SF	258	SF	266	SF	280	SF	289	SF
Total	1,300	SF	1,165	SF	1,288	SF	1,330	SF	1,401	SF	1,444	SF
Departures Meeter/ Greeter Restrooms												
Men's Restroom		SF	110	SF	110	SF	110	SF	110	SF	110	SF
Urinals		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Water Closet		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Lavatories		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Women's Restroom		SF	80	SF	80	SF	80	SF	80	SF	80	SF
Water Closet		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Lavatories		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Companion Care		facilities	1	facilities	1	facilities	1	facilities	1	facilities	1	facilities
Companion Care Area		SF	44	SF	44	SF	44	SF	44	SF	44	SF
Janitor's Closet		facilities	2	facilities	2	facilities	2	facilities	2	facilities	2	facilities
Janitor's Closet Area		SF	50	SF	50	SF	50	SF	50	SF	50	SF
Circulation		SF	71	SF	71	SF	71	SF	71	SF	71	SF
Total		SF	355	SF	355	SF	355	SF	355	SF	355	SF
Check-In Hall Customer Svcs	0	SF	200	SF	200	SF	300	SF	300	SF	300	SF
Departures Public Concourse Ops & Support	0	SF	700	SF	800	SF	900	SF	1,000	SF	1,000	SF
Departures Passenger Processing	11,800	SF	30,345	SF	32,725	SF	37,019	SF	39,237	SF	43,456	SF
I+D Security Checkpoint												
Security Screening Units	8	units/lanes	14	units/lanes	15	units/lanes	17	units/lanes	18	units/lanes	20	units/lanes
Max PAX in Queue		PAX	317	PAX	357	PAX	400	PAX	427	PAX	462	PAX
Security Screening Area		SF	20,667	SF	22,142	SF	25,091	SF	26,566	SF	29,515	SF
Security Checkpoint Queue		SF	3,757	SF	4,231	SF	4,737	SF	5,060	SF	5,479	SF
Security Checkpoint Cross Circulation			5,167		5,544		6,276		6,642		7,385	
Total	11,800	SF	29,591	SF	31,917	SF	36,104	SF	38,268	SF	42,379	SF
Security Operations & Support	0	SF	754	SF	808	SF	915	SF	969	SF	1,077	SF

Bradley International Airport

Windsor Locks

	Existing		2017		2022		2027		2032		2037	
Concessions	*37,750*	SF	*69,919*	SF	*81,692*	SF	*88,829*	SF	*92,398*	SF	*100,034*	SF
Landside Concessions	*1,650*	SF	*8,740*	SF	*10,212*	SF	*11,104*	SF	*11,550*	SF	*12,504*	SF
Airside Concessions	*23,900*	SF	*49,526*	SF	*57,865*	SF	*62,920*	SF	*65,448*	SF	*70,858*	SF
Concession Storage	*12,200*	SF	*11,653*	SF	*13,615*	SF	*14,805*	SF	*15,400*	SF	*16,672*	SF
Departures Concourse (Secure)	*107,500*	SF	*124,290*	SF	*143,435*	SF	*159,286*	SF	*165,619*	SF	*177,084*	SF
Domestic Holdrooms												
Total Domestic Contact Gate Seats		seats	2,239	seats	2,436	seats	2,552	seats	2,668	seats	2,900	seats
Total Domestic Contact Gate Area		SF	56,421	SF	60,708	SF	63,599	SF	66,490	SF	72,272	SF
Total Domestic Hardstand Gate Seats		seats	0	seats	0	seats	0	seats	0	seats	0	seats
Total Domestic Hardstand Gate Area		SF	0	SF	0	SF	0	SF	0	SF	0	SF
Total	*41,350*	SF	*56,421*	SF	*60,708*	SF	*63,599*	SF	*66,490*	SF	*72,272*	SF
International Holdrooms												
Total International Contact Gate Seats		seats	150	seats	379	seats	530	seats	530	seats	530	seats
Total International Contact Gate Area		SF	5,620	SF	11,701	SF	17,237	SF	17,237	SF	17,237	SF
Total International Hardstand Gate Seats		seats	0	seats	0	seats	0	seats	0	seats	0	seats
Total International Hardstand Gate Area		SF	0	SF	0	SF	0	SF	0	SF	0	SF
Total	*0*	SF	*5,620*	SF	*11,701*	SF	*17,237*	SF	*17,237*	SF	*17,237*	SF
Domestic Concourse Restrooms												
Contact Gate Holdrooms Restrooms												
Men's Restroom		SF	1,218	SF	1,305	SF	1,479	SF	1,566	SF	1,717	SF
Urinals		fixtures	14	fixtures	15	fixtures	17	fixtures	18	fixtures	20	fixtures
Water Closet		fixtures	14	fixtures	15	fixtures	17	fixtures	18	fixtures	20	fixtures
Lavatories		fixtures	11	fixtures	12	fixtures	13	fixtures	14	fixtures	15	fixtures
Women's Restroom		SF	1,671	SF	1,853	SF	2,035	SF	2,194	SF	2,353	SF
Water Closet		fixtures	39	fixtures	43	fixtures	47	fixtures	51	fixtures	55	fixtures
Lavatories		fixtures	7	fixtures	8	fixtures	9	fixtures	9	fixtures	10	fixtures
Companion Care		facilities	1	facilities	1	facilities	1	facilities	1	facilities	1	facilities
Companion Care Area		SF	44	SF	44	SF	44	SF	44	SF	44	SF
Janitor's Closet		facilities	2	facilities	2	facilities	2	facilities	2	facilities	2	facilities
Janitor's Closet Area		SF	50	SF	50	SF	50	SF	50	SF	50	SF
Circulation		SF	746	SF	813	SF	902	SF	964	SF	1,041	SF
Sub-Total		SF	*3,729*	SF	*4,065*	SF	*4,510*	SF	*4,818*	SF	*5,205*	SF
International Concourse Restrooms												
Contact Gates												
Men's Restroom		SF	110	SF	110	SF	110	SF	110	SF	110	SF
Urinals		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Water Closet		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Lavatories		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Women's Restroom		SF	80	SF	80	SF	80	SF	80	SF	80	SF
Water Closet		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Lavatories		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Companion Care		facilities	1	facilities	1	facilities	1	facilities	1	facilities	1	facilities
Companion Care Area		SF	44	SF	44	SF	44	SF	44	SF	44	SF
Janitor's Closet		facilities	2	facilities	2	facilities	2	facilities	2	facilities	2	facilities
Janitor's Closet Area		SF	50	SF	50	SF	50	SF	50	SF	50	SF
Circulation		SF	71	SF	71	SF	71	SF	71	SF	71	SF
Sub-Total		SF	*355*	SF	*355*	SF	*355*	SF	*355*	SF	*355*	SF
Total	*6,250*	SF	*4,084*	SF	*4,420*	SF	*4,865*	SF	*5,173*	SF	*5,560*	SF
Airline Club Lounges												
Domestic	*2,700*	SF	*8,165*	SF	*9,325*	SF	*10,255*	SF	*11,120*	SF	*11,920*	SF
International		SF	*845*	SF	*1,530*	SF	*1,680*	SF	*1,820*	SF	*1,955*	SF
Concourse Customer Svcs												
Domestic Concourse	0	SF	500	SF	500	SF	600	SF	600	SF	600	SF
International Concourse	0	SF	100	SF	100	SF	100	SF	100	SF	100	SF
Total	*0*	SF	*600*	SF	*600*	SF	*700*	SF	*700*	SF	*700*	SF
Departures Concourse (Secure) Ops & Support	0	SF	900	SF	1,000	SF	1,100	SF	1,100	SF	1,200	SF
Concourse Circulation												
Domestic Concourse Circulation	57,200	SF	43,395	SF	44,730	SF	46,860	SF	48,990	SF	53,250	SF
Domestic Hardstand Gates Single Loaded		SF	0	SF	0	SF	0	SF	0	SF	0	SF
Total	*57,200*	SF	*43,395*	SF	*44,730*	SF	*46,860*	SF	*48,990*	SF	*53,250*	SF
International Concourse Circulation	0	SF	4,260	SF	9,420	SF	12,990	SF	12,990	SF	12,990	SF
International Hardstand Gates Single Loaded		SF	0	SF	0	SF	0	SF	0	SF	0	SF
Total	*0*	SF	*4,260*	SF	*9,420*	SF	*12,990*	SF	*12,990*	SF	*12,990*	SF

Bradley International Airport

Windsor Locks

	Existing		2017		2022		2027		2032		2037	
Baggage Processing	***44,700***	***SF***	***82,013***	***SF***	***92,341***	***SF***	***99,549***	***SF***	***102,649***	***SF***	***112,392***	***SF***
Outbound Baggage (Departures)												
Baggage Screening												
Baggage Screening EDS/ Screening Units	**8**	**units**	**4**	**units**	**4**	**units**	**4**	**units**	**5**	**units**	**5**	**units**
Baggage Screening Area		SF	10,000	SF	10,000	SF	10,000	SF	12,500	SF	12,500	SF
Baggage Screening ETD		SF	2,400	SF	2,400	SF	2,400	SF	3,000	SF	3,000	SF
Sub-Total	*4,450*	*SF*	*12,400*	*SF*	*12,400*	*SF*	*12,400*	*SF*	*15,500*	*SF*	*15,500*	*SF*
Baggage Make-Up												
Baggage Handling Slope-Plate Devices	**6**	**devices**	**8**	**devices**	**9**	**devices**	**10**	**devices**	**10**	**devices**	**11**	**devices**
Baggage Handling Slope-Plate Device Area		SF	16,000	SF	18,000	SF	20,000	SF	20,000	SF	22,000	SF
Baggage Train Circulation		SF	42,888	SF	48,096	SF	53,304	SF	53,304	SF	58,512	SF
Sub-Total	*26,850*	*SF*	*58,888*	*SF*	*66,096*	*SF*	*73,304*	*SF*	*73,304*	*SF*	*80,512*	*SF*
Total	***31,300***	***SF***	***71,288***	***SF***	***78,496***	***SF***	***85,704***	***SF***	***88,804***	***SF***	***96,012***	***SF***
Inbound Baggage (Arrivals)												
Domestic & LCC												
Domestic Inbound Baggage Stripping Belts	**8**	**belts**	**8**	**belts**	**8**	**belts**	**8**	**belts**	**8**	**belts**	**10**	**belts**
Domestic Inbound Total Device Frontage	**228**	**LF**	**520**	**LF**	**520**	**LF**	**520**	**LF**	**520**	**LF**	**650**	**LF**
Domestic Inbound Baggage Handling Area		SF	10,725	SF	10,725	SF	10,725	SF	10,725	SF	13,260	SF
International												
International Inbound Baggage Stripping Belts		**belts**	**0**	**belts**	**2**	**belts**	**2**	**belts**	**2**	**belts**	**2**	**belts**
International Inbound Device Frontage		**LF**	**0**	**LF**	**130**	**LF**	**130**	**LF**	**130**	**LF**	**130**	**LF**
International Inbound Baggage Handling Area		SF	0	SF	3,120	SF	3,120	SF	3,120	SF	3,120	SF
Total	***13,400***	***SF***	***10,725***	***SF***	***13,845***	***SF***	***13,845***	***SF***	***13,845***	***SF***	***16,380***	***SF***
Transfer Passenger Processing	***0***	***SF***	***0***	***SF***	***0***	***SF***	***0***	***SF***	***0***	***SF***	***0***	***SF***
Arrivals Passenger Processing	***0***	***SF***	***30,072***	***SF***	***37,610***	***SF***	***41,087***	***SF***	***41,141***	***SF***	***41,249***	***SF***
Sterile Arrivals Corridor	***0***	***SF***	***4,867***	***SF***	***10,285***	***SF***	***14,033***	***SF***	***14,033***	***SF***	***14,033***	***SF***
FIS Operations & Support	***0***	***SF***	***17,285***	***SF***	***17,803***	***SF***	***17,515***	***SF***	***17,569***	***SF***	***17,677***	***SF***
Primary Processing												
Immigration Positions		**single pos.**	**4**	**single pos.**	**5**	**single pos.**	**5**	**single pos.**	**6**	**single pos.**	**6**	**single pos.**
# of 2-person Immigration Counters		**Doublebooths**	**2**	**Doublebooths**	**3**	**Doublebooths**	**3**	**Doublebooths**	**3**	**Doublebooths**	**3**	**Doublebooths**
Counter Area		SF	260	SF	390	SF	390	SF	390	SF	390	SF
Immigration Queue		SF	2,600	SF	3,900	SF	3,900	SF	3,900	SF	3,900	SF
Immigration Cross Circulation		SF	260	SF	390	SF	390	SF	390	SF	390	SF
Total	***0***	***SF***	***3,120***	***SF***	***4,680***	***SF***	***4,680***	***SF***	***4,680***	***SF***	***4,680***	***SF***
Secondary Screening												
Exam Podiums		**positions**	**2**	**positions**	**2**	**positions**	**2**	**positions**	**2**	**positions**	**2**	**positions**
X-Ray Processing		**positions**	**1**	**positions**	**1**	**positions**	**1**	**positions**	**1**	**positions**	**1**	**positions**
Processing Area		SF	1,676	SF	1,676	SF	1,676	SF	1,676	SF	1,676	SF
Queue		SF	293	SF	293	SF	309	SF	309	SF	309	SF
Inbound Cross Circulation (Red Channel)			830		830		830		830		830	
Green Channel Corridor			448		448		448		448		448	
Blue Channel Corridor		SF	448	SF	448	SF	448	SF	448	SF	448	SF
Total	***0***	***SF***	***3,695***	***SF***	***3,695***	***SF***	***3,711***	***SF***	***3,711***	***SF***	***3,711***	***SF***
Immigration Restrooms												
Men's Restroom		SF	110	SF	110	SF	110	SF	110	SF	110	SF
Urinals		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Water Closet		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Lavatories		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Women's Restroom		SF	80	SF	114	SF	114	SF	114	SF	114	SF
Water Closet		fixtures	1	fixtures	2	fixtures	2	fixtures	2	fixtures	2	fixtures
Lavatories		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Companion Care		facilities	1	facilities	1	facilities	1	facilities	1	facilities	1	facilities
Companion Care Area		SF	44	SF	44	SF	44	SF	44	SF	44	SF
Janitor's Closet		facilities	2	facilities	2	facilities	2	facilities	2	facilities	2	facilities
Janitor's Closet Area		SF	50	SF	50	SF	50	SF	50	SF	50	SF
Circulation		SF	71	SF	80	SF	80	SF	80	SF	80	SF
Sub-Total	*0*	*SF*	*355*	*SF*	*398*	*SF*	*398*	*SF*	*398*	*SF*	*398*	*SF*

Bradley International Airport

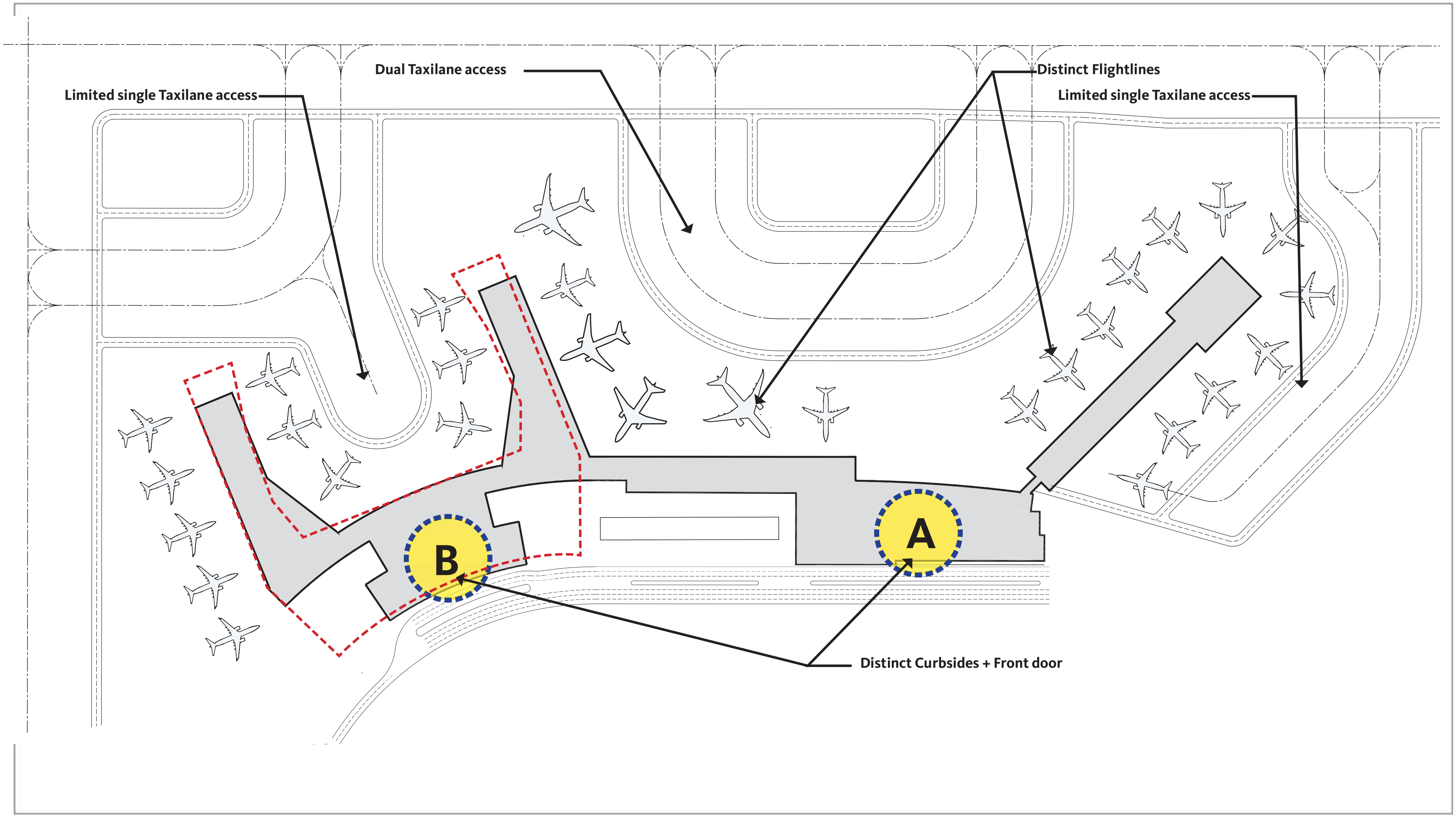
Windsor Locks

	Existing		2017		2022		2027		2032		2037	
Arrivals Baggage Claim Hall	**51,450**	SF	**52,291**	SF	**69,786**	SF	**71,171**	SF	**72,337**	SF	**82,376**	SF
Baggage Claim Hall												
Domestic & LCC												
Domestic Bag Claim Devices	8	Units	4	Units	4	Units	4	Units	4	Units	5	Units
Domestic Bag Claim Length Required	900	LF	643	LF	664	LF	730	LF	792	LF	848	LF
Domestic Claim Devices Area		SF	6,400	SF	6,400	SF	6,400	SF	6,400	SF	8,000	SF
Domestic Positive Claim Area		SF	34,425	SF	34,425	SF	34,425	SF	34,425	SF	41,850	SF
Sub-Total	32,400	SF	40,825	SF	40,825	SF	40,825	SF	40,825	SF	49,850	SF
International + TB												
International Bag Claim Devices	0	Units	0	Units	1	Units	1	Units	1	Units	1	Units
International Bag Claim Length Required	0	LF	0	LF	128	LF	141	LF	153	LF	165	LF
International Claim Device Area	0	SF	0	SF	2,400	SF	2,400	SF	2,400	SF	2,400	SF
International Positive Claim Area	0	SF	0	SF	13,050	SF	13,050	SF	13,050	SF	13,050	SF
Sub-Total	0	SF	0	SF	15,450	SF	15,450	SF	15,450	SF	15,450	SF
Total	32,400	SF	40,825	SF	56,275	SF	56,275	SF	56,275	SF	65,300	SF
Baggage Claim Hall Customer Svcs	0	SF	200	SF	200	SF	200	SF	200	SF	200	SF
Baggage Claim Hall Restrooms												
Domestic Baggage Claim Hall Restrooms												
Men's Restroom		SF	197	SF	197	SF	261	SF	261	SF	261	SF
Urinals		fixtures	2	fixtures	2	fixtures	3	fixtures	3	fixtures	3	fixtures
Water Closet		fixtures	2	fixtures	2	fixtures	3	fixtures	3	fixtures	3	fixtures
Lavatories		fixtures	2	fixtures	2	fixtures	2	fixtures	2	fixtures	2	fixtures
Women's Restroom		SF	216	SF	273	SF	330	SF	330	SF	330	SF
Water Closet		fixtures	5	fixtures	6	fixtures	7	fixtures	7	fixtures	7	fixtures
Lavatories		fixtures	1	fixtures	1	fixtures	2	fixtures	2	fixtures	2	fixtures
Companion Care		facilities	1	facilities	1	facilities	1	facilities	1	facilities	1	facilities
Companion Care Area		SF	44	SF	44	SF	44	SF	44	SF	44	SF
Janitor's Closet		facilities	2	facilities	2	facilities	2	facilities	2	facilities	2	facilities
Janitor's Closet Area		SF	50	SF	50	SF	50	SF	50	SF	50	SF
Circulation		SF	127	SF	141	SF	171	SF	171	SF	171	SF
Sub-Total		SF	634	SF	705	SF	856	SF	856	SF	856	SF
International Baggage Claim Hall Restrooms												
Men's Restroom		SF	110	SF	110	SF	110	SF	110	SF	110	SF
Urinals		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Water Closet		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Lavatories		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Women's Restroom		SF	114	SF	114	SF	114	SF	114	SF	148	SF
Water Closet		fixtures	2	fixtures	2	fixtures	2	fixtures	2	fixtures	3	fixtures
Lavatories		fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures	1	fixtures
Companion Care		facilities	1	facilities	1	facilities	1	facilities	1	facilities	1	facilities
Companion Care Area		SF	44	SF	44	SF	44	SF	44	SF	44	SF
Janitor's Closet		facilities	2	facilities	2	facilities	2	facilities	2	facilities	2	facilities
Janitor's Closet Area		SF	50	SF	50	SF	50	SF	50	SF	50	SF
Circulation		SF	80	SF	80	SF	80	SF	80	SF	88	SF
Sub-Total		SF	398	SF	398	SF	398	SF	398	SF	440	SF
Total	2,150	SF	1,031	SF	1,103	SF	1,254	SF	1,254	SF	1,296	SF
Baggage Claim Hall Ops & Support	0	SF	700	SF	800	SF	900	SF	1,000	SF	1,000	SF
Arrivals Public Concourse	16,900	SF	7,938	SF	9,488	SF	10,437	SF	11,317	SF	12,127	SF
Arrivals Meeter/ Greeter Area	0	SF	1,597	SF	1,921	SF	2,106	SF	2,291	SF	2,453	SF
Terminal Operations	**79,841**	SF	**27,444**	SF	**30,931**	SF	**33,737**	SF	**37,060**	SF	**39,471**	SF
Operations & Support Area	73,091	SF	24,564	SF	28,051	SF	30,857	SF	33,460	SF	35,871	SF
Loading Dock	3	Bays	4	Bays	4	Bays	4	Bays	5	Bays	5	Bays
	6,750	SF	2,880	SF	2,880	SF	2,880	SF	3,600	SF	3,600	SF
Total Terminal												
Departures Check-In Hall	41,900	SF	41,984	SF	47,017	SF	51,643	SF	55,274	SF	59,717	SF
Departures Passenger Processing	11,800	SF	30,345	SF	32,725	SF	37,019	SF	39,237	SF	43,456	SF
Departures Concourse (Secure)	107,500	SF	124,290	SF	143,435	SF	159,286	SF	165,619	SF	177,084	SF
Baggage Processing	44,700	SF	82,013	SF	92,341	SF	99,549	SF	102,649	SF	112,392	SF
Transfer Passenger Processing	0	SF	0	SF	0	SF	0	SF	0	SF	0	SF
Arrivals Passenger Processing	0	SF	30,072	SF	37,610	SF	41,087	SF	41,141	SF	41,249	SF
Arrivals Baggage Claim Hall	51,450	SF	52,291	SF	69,786	SF	71,171	SF	72,337	SF	82,376	SF
Terminal Operations	79,841	SF	27,444	SF	30,931	SF	33,737	SF	37,060	SF	39,471	SF
Sub-Total Net Terminal Area	337,191	SF	388,439	SF	453,845	SF	493,492	SF	513,317	SF	555,744	SF
Concessions	37,750	SF	69,919	SF	81,692	SF	88,829	SF	92,398	SF	100,034	SF
Total Net Terminal Area	374,941	SF	458,358	SF	535,537	SF	582,320	SF	605,715	SF	655,778	SF
Mechanical, Electrical and Plumbing & IT Systems	21,976	SF	45,836	SF	53,554	SF	58,233	SF	60,572	SF	65,578	SF
Structure/Non-Net Areas	0	SF	9,168	SF	10,711	SF	11,647	SF	12,115	SF	13,116	SF
Gross Building Area	440,777	SF	513,362	SF	599,802	SF	652,200	SF	678,402	SF	734,472	SF

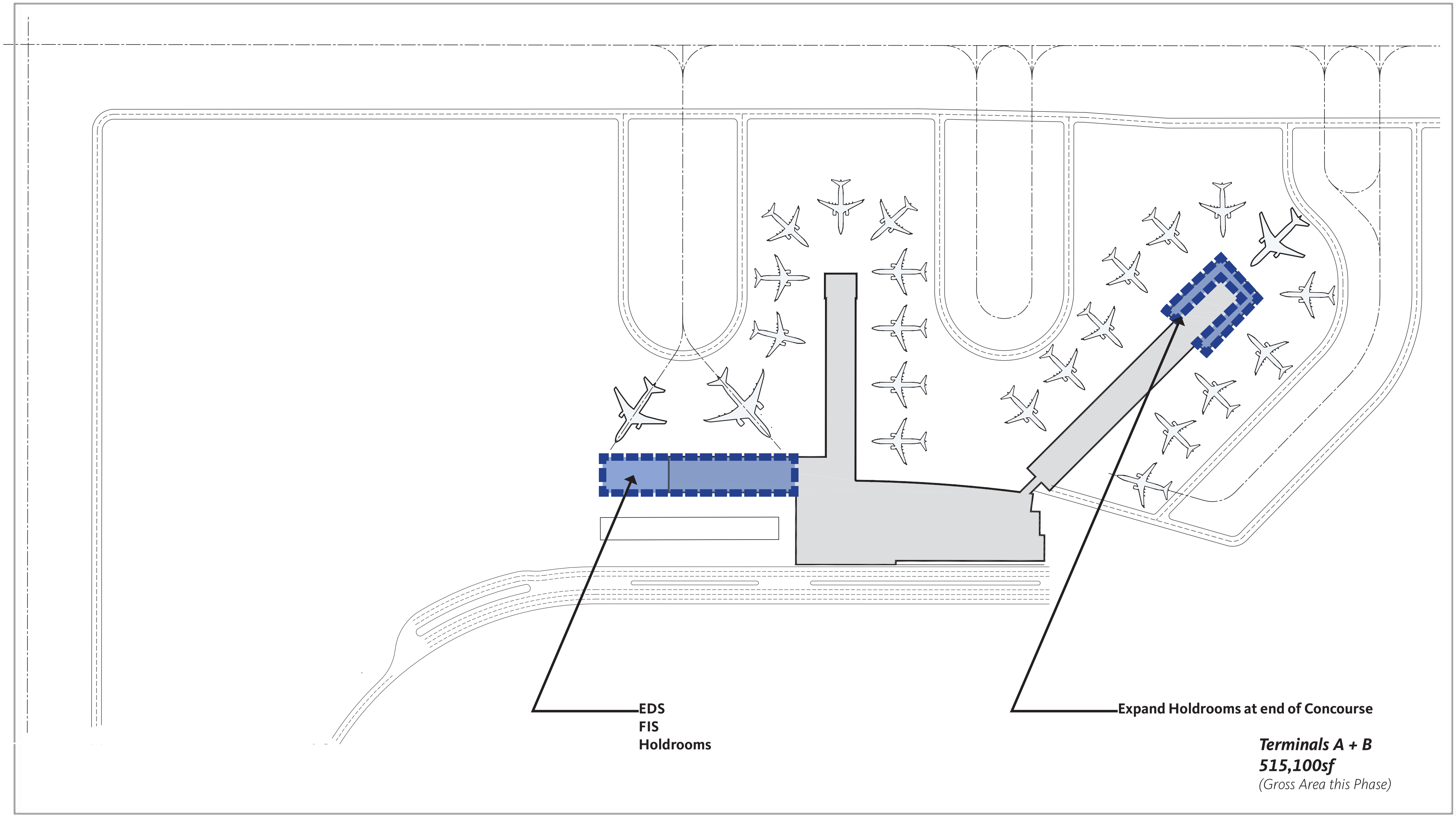
APPENDIX G

TERMINAL PLAN

INDEPENDENT TERMINALS ALTERNATIVE



Independent Terminals
Conceptual Approach



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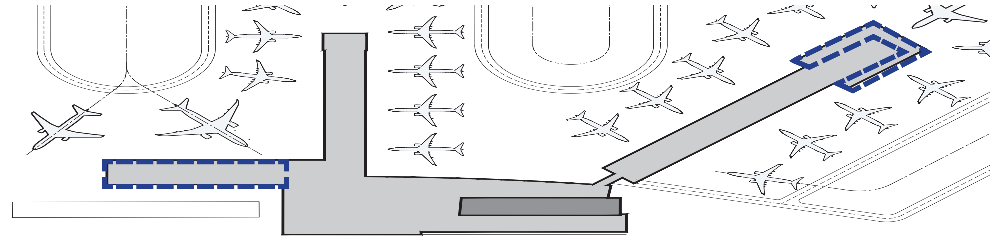
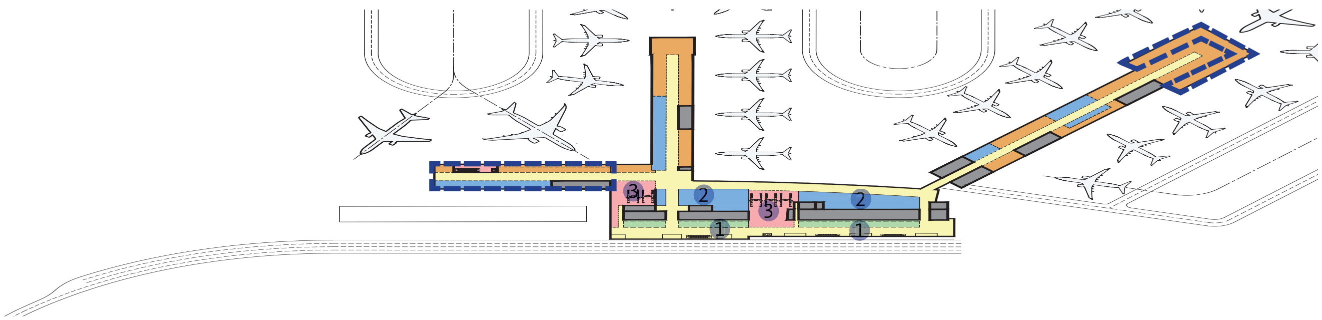
Independent Terminals
2017 - New Construction

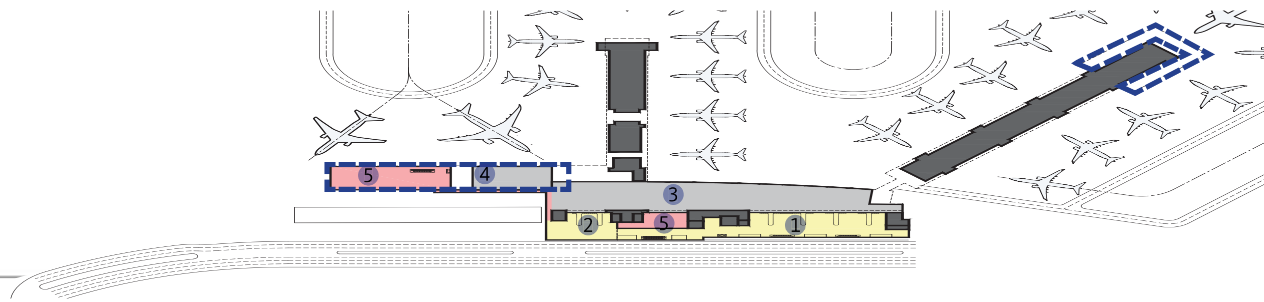


Mezzanine Level



Departures Level

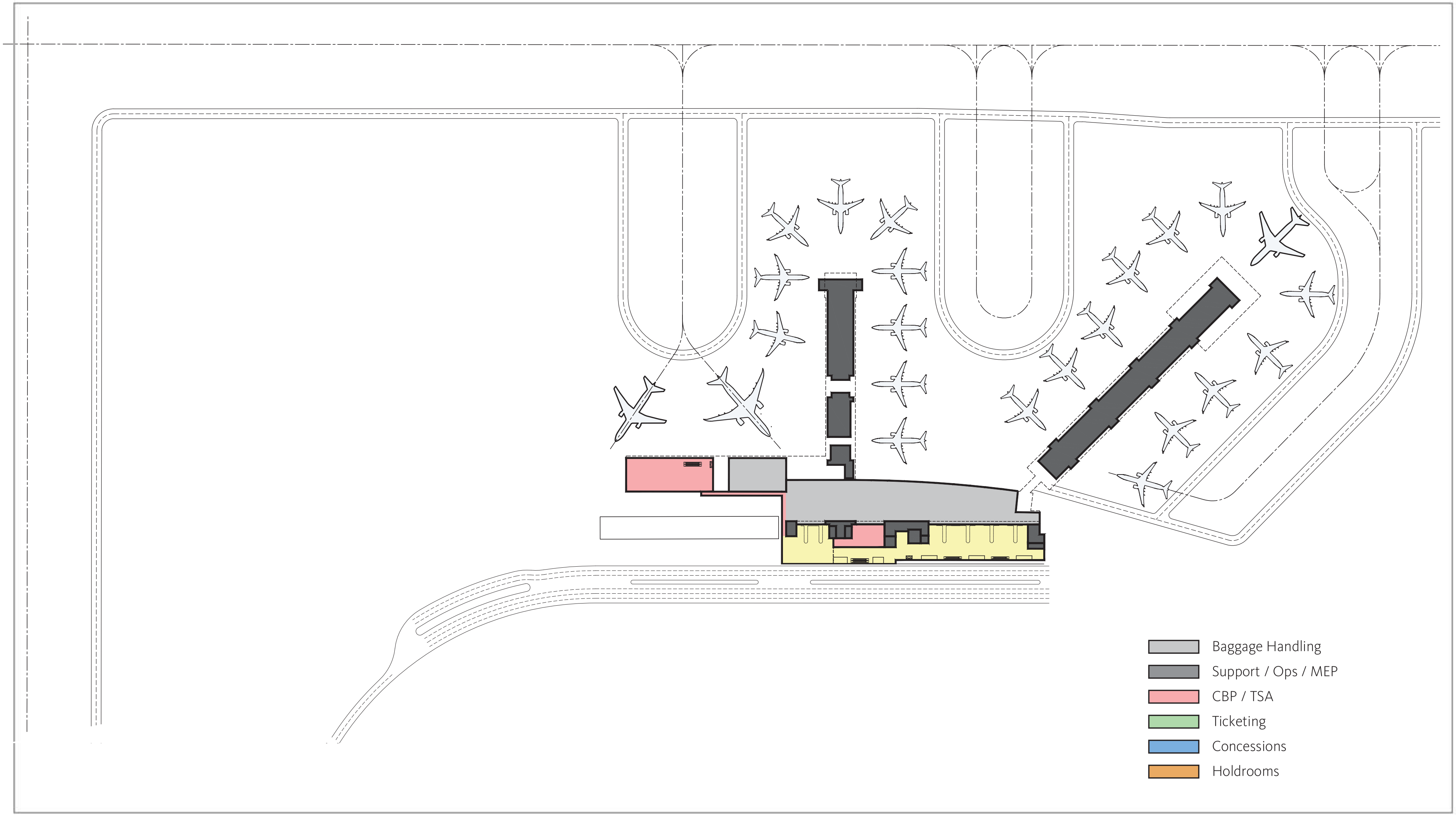
1. Check-In
2. Retail Nodes
3. Security Checkpoints



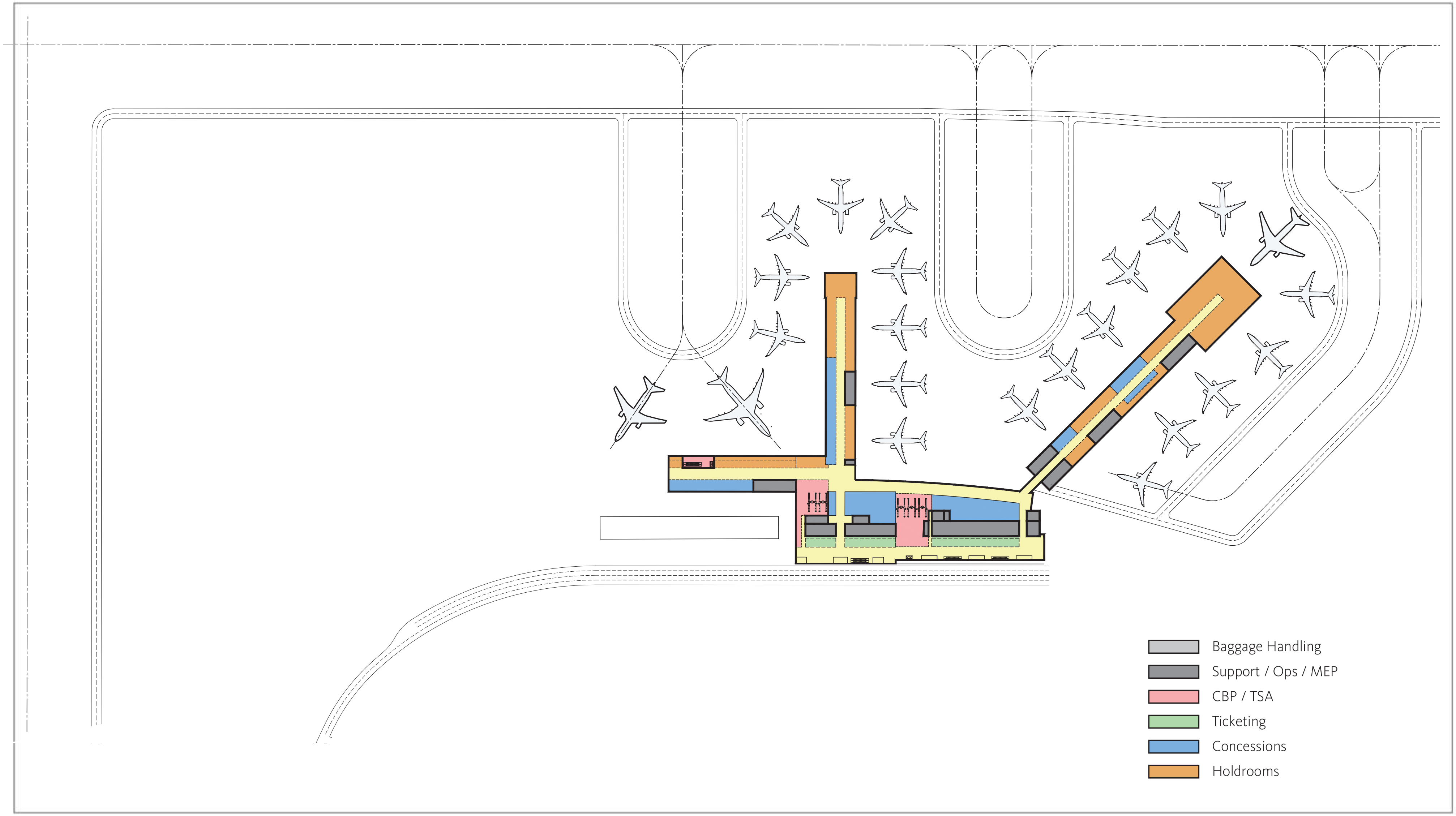
Arrivals Level

1. Bag Claim
2. International Claim
3. Bag Make-Up
4. Bag Screening
5. FIS

Independent Terminals
2017 - Overview
Functional Stack



Independent Terminals
2017 - Overview
Arrivals Level



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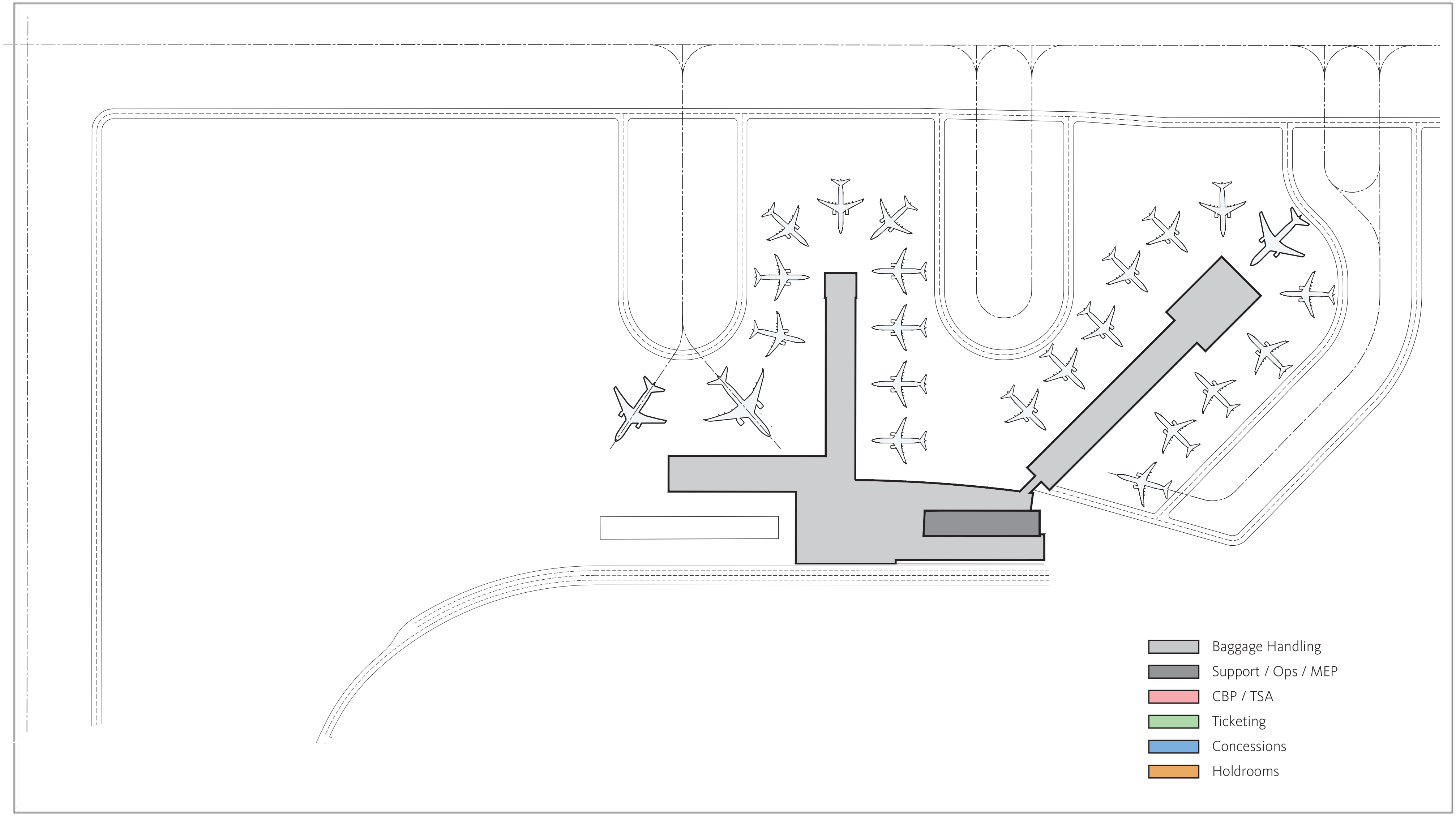
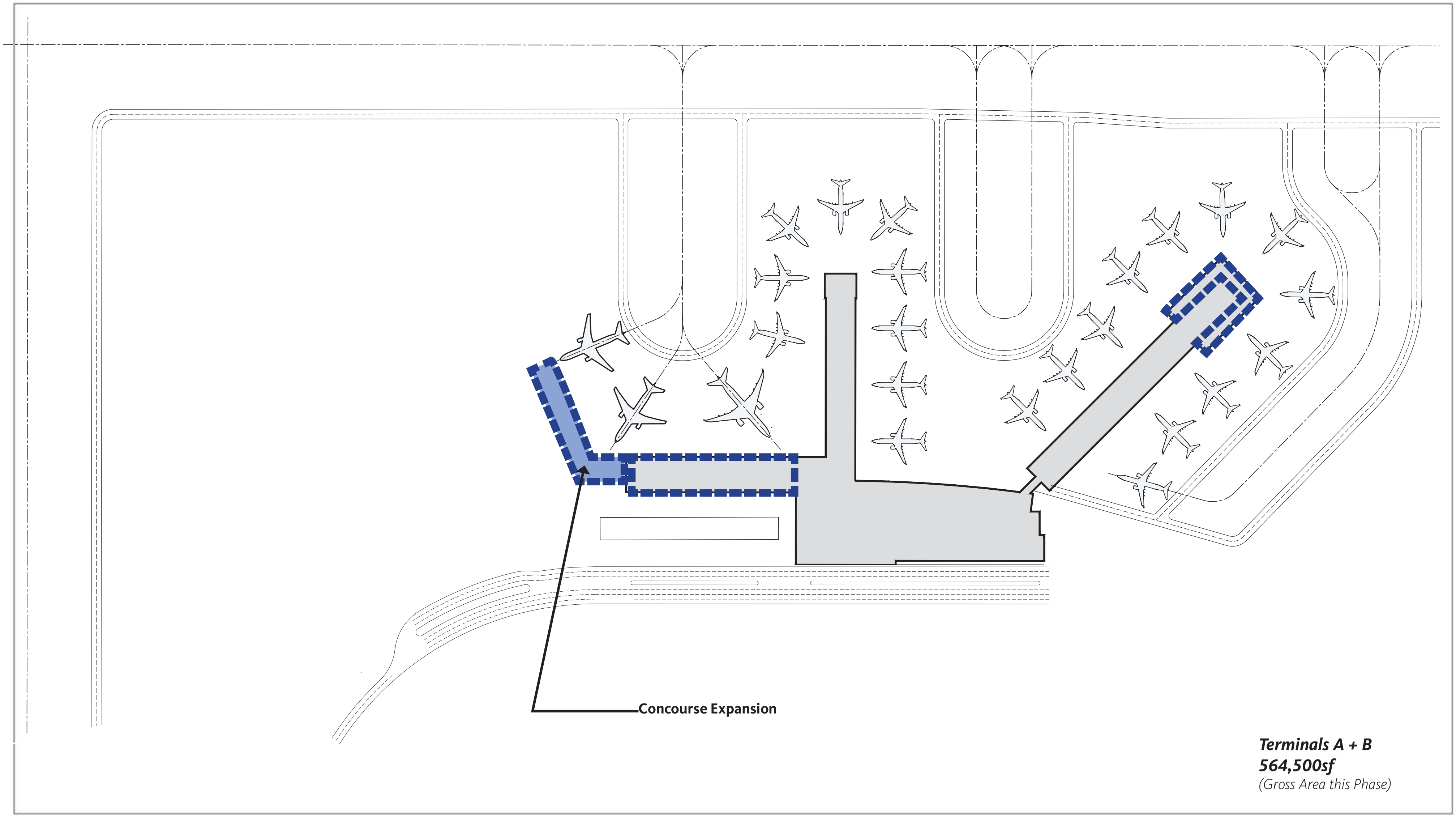
Independent Terminals
2017 - Overview
Departures Level



Independent Terminals
2017 - Overview
Mezzanine Level



Independent Terminals
2022 - New Construction

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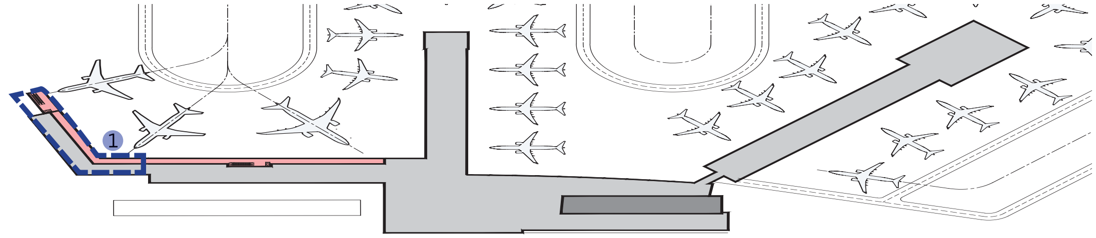
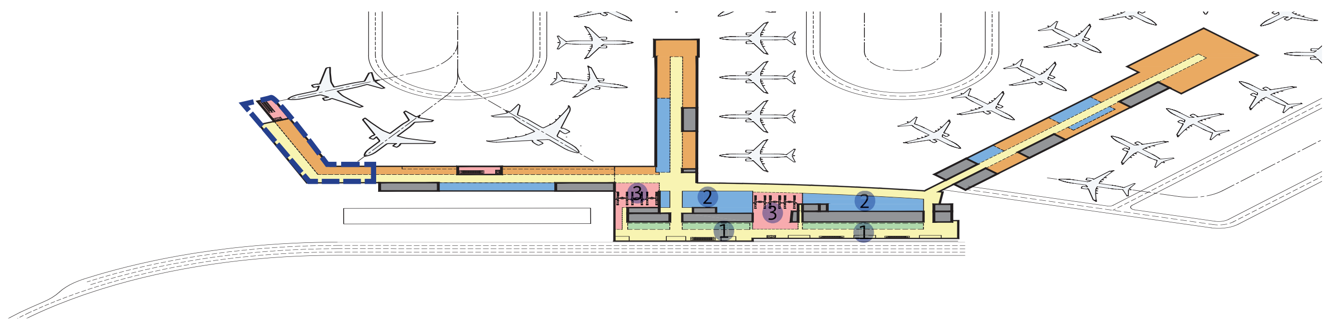
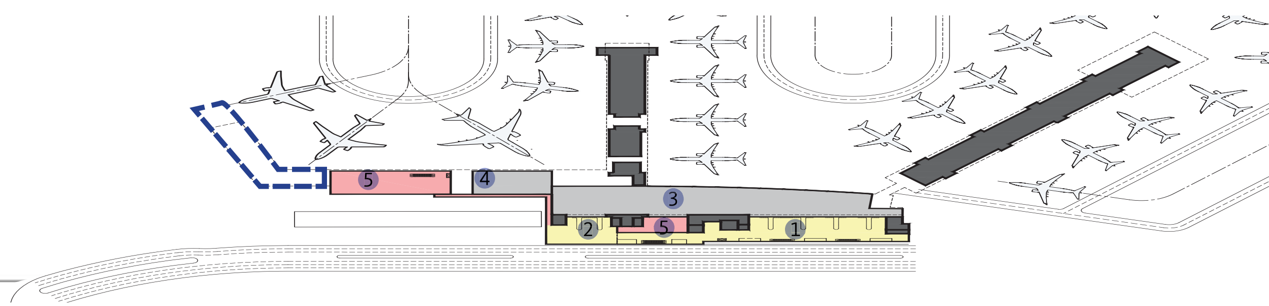


Mezzanine Level
1. Sterile Arrivals Corridor

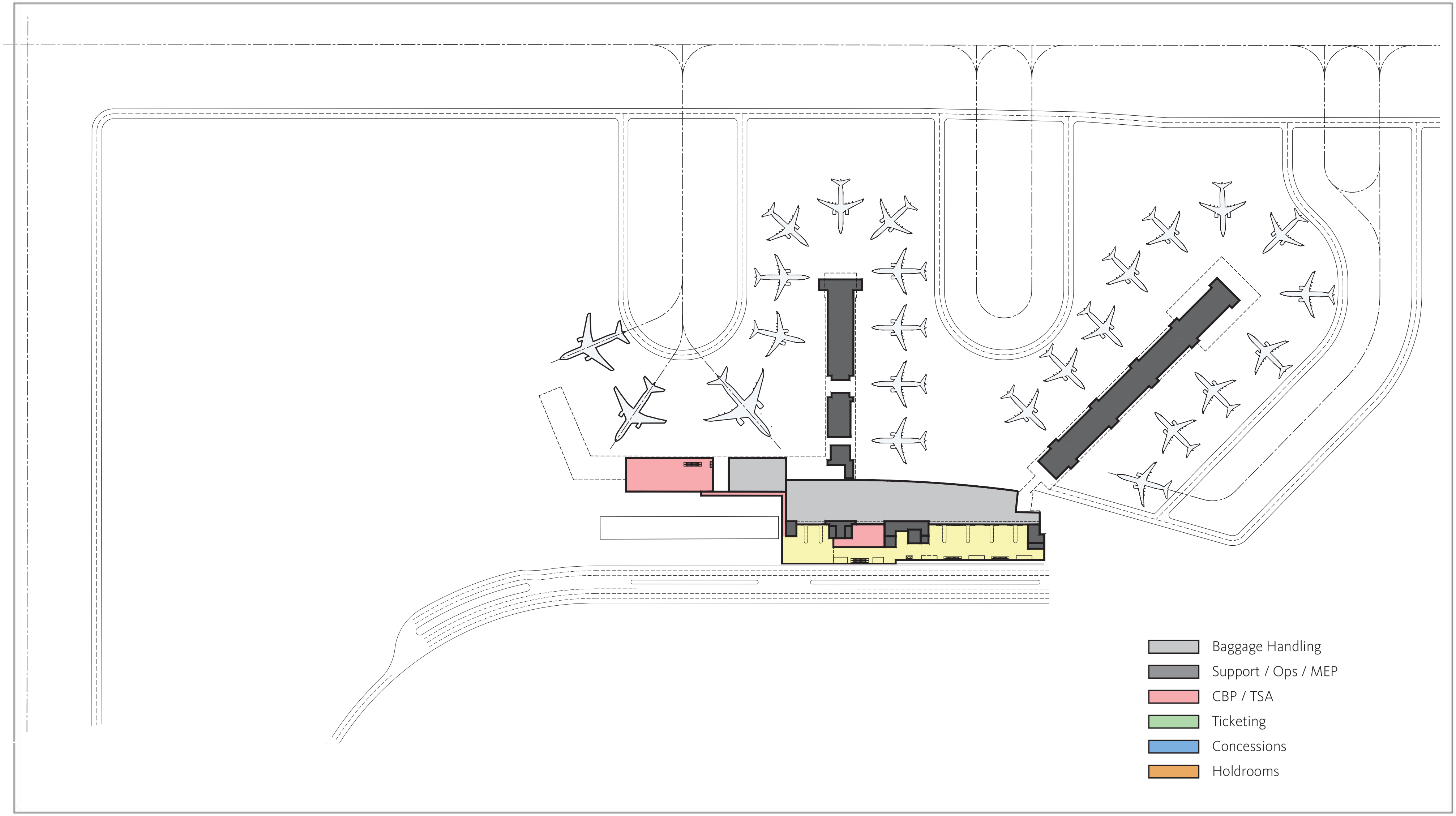


Departures Level
1. Check-In
2. Retail Nodes
3. Security Checkpoints



Arrivals Level
1. Bag Claim
2. International Claim
3. Bag Make-Up
4. Bag Screening
5. FIS

Independent Terminals
2022 - Overview
Functional Stack



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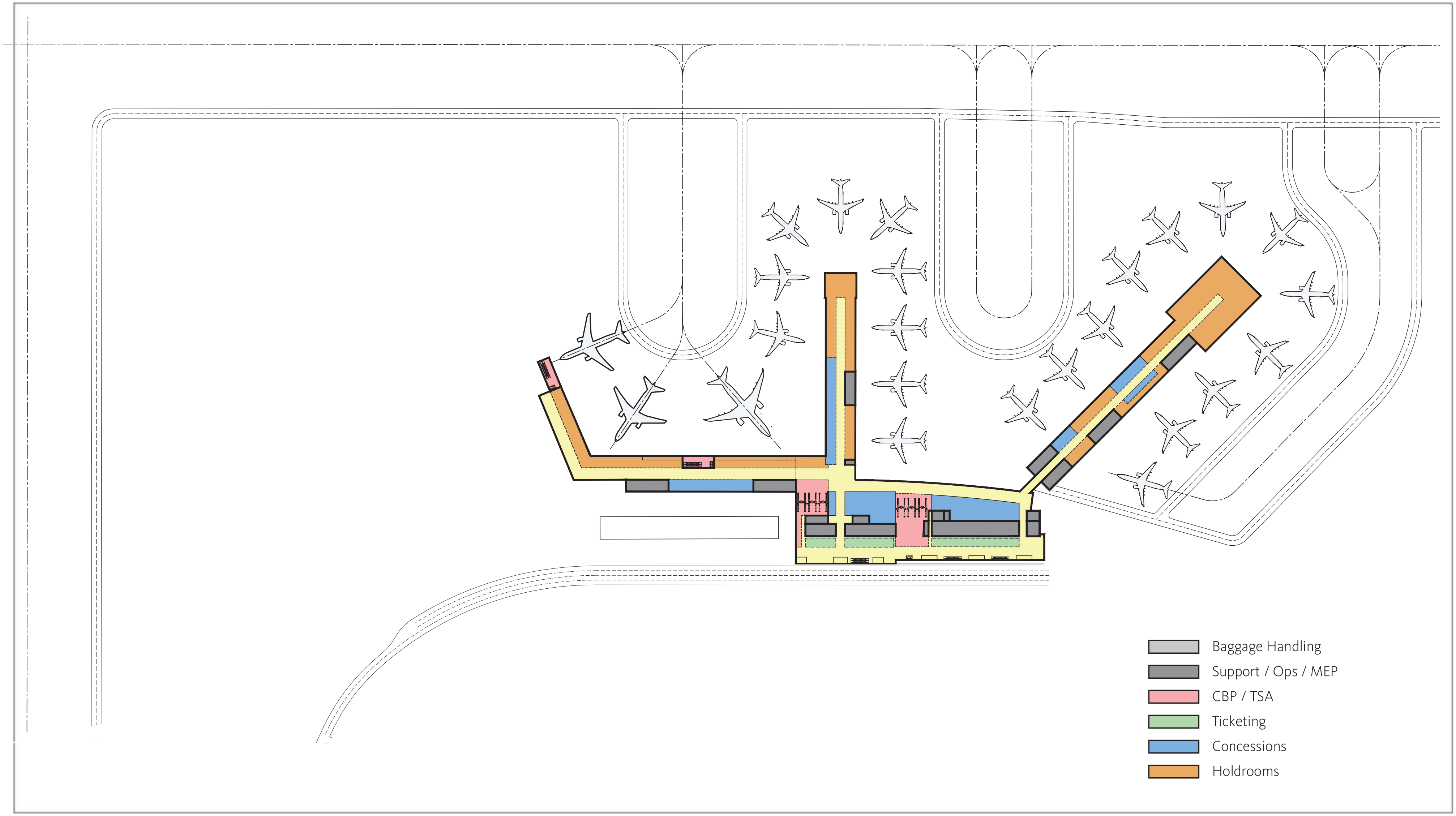
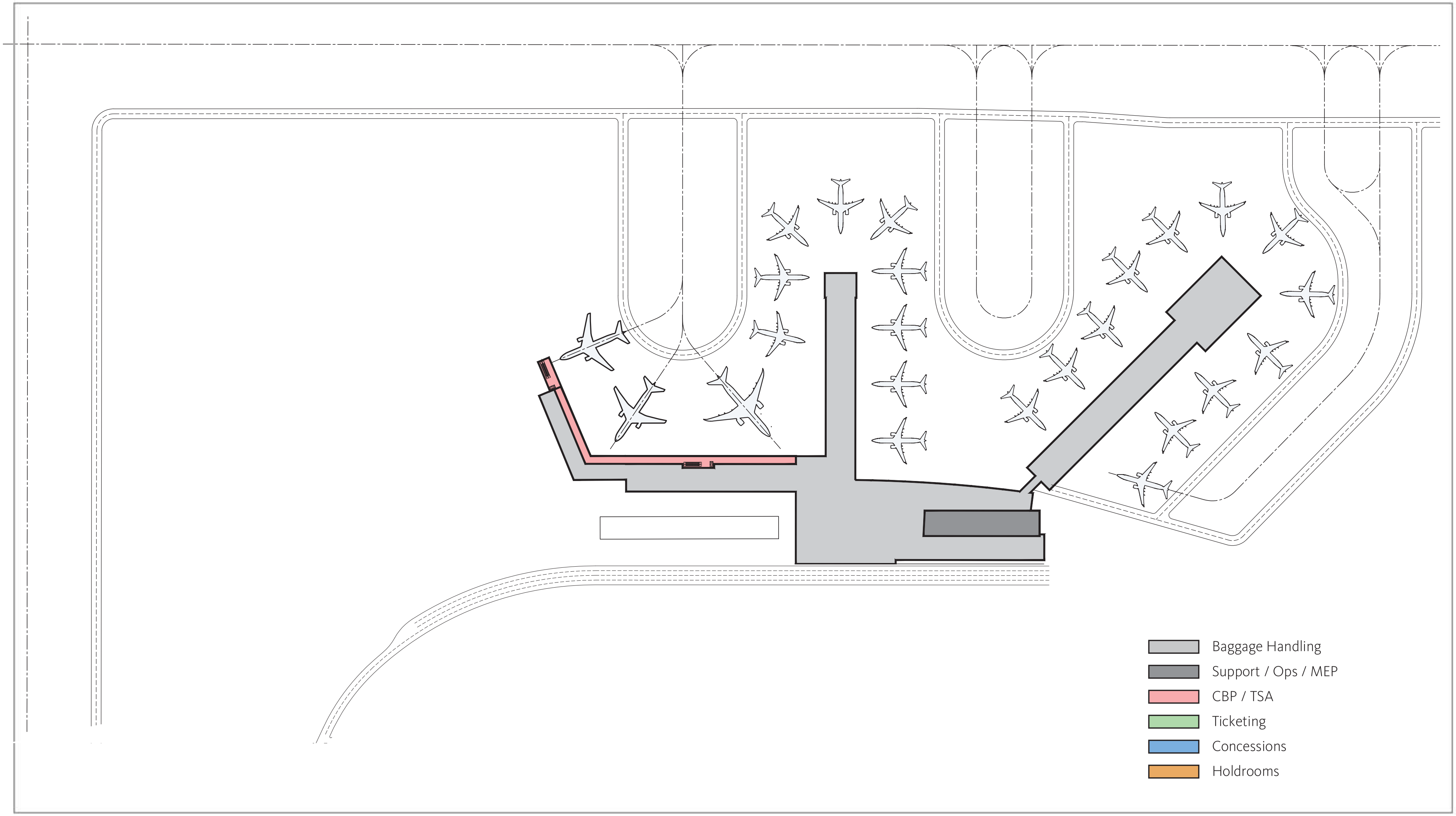
MASTER PLAN UPDATE

Independent Terminals
2022 - Overview
Arrivals Level



Independent Terminals
2022 - Overview
Departures Level



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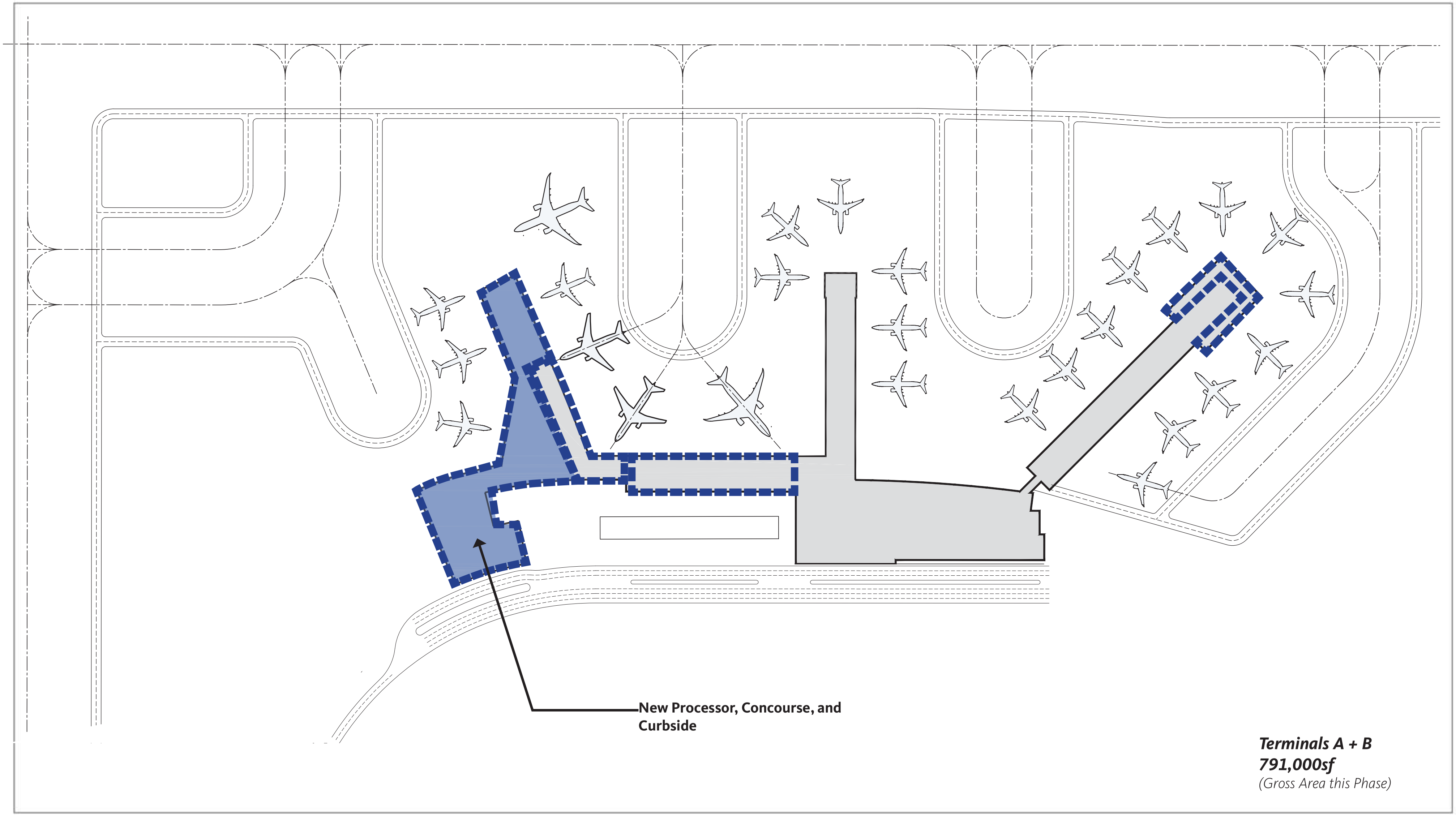
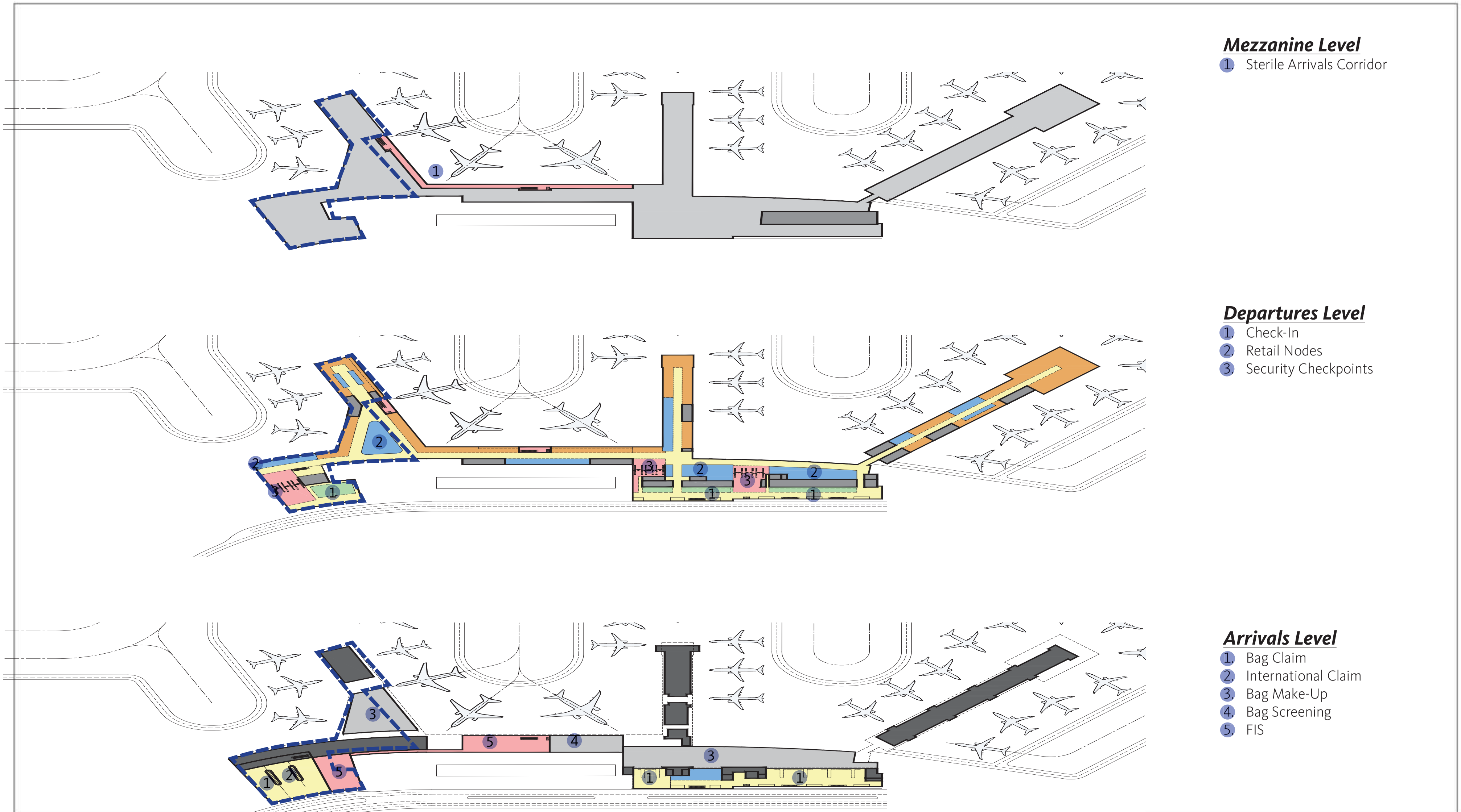
Independent Terminals
2022 - Overview
Mezzanine Level



Independent Terminals
2027 - New Construction



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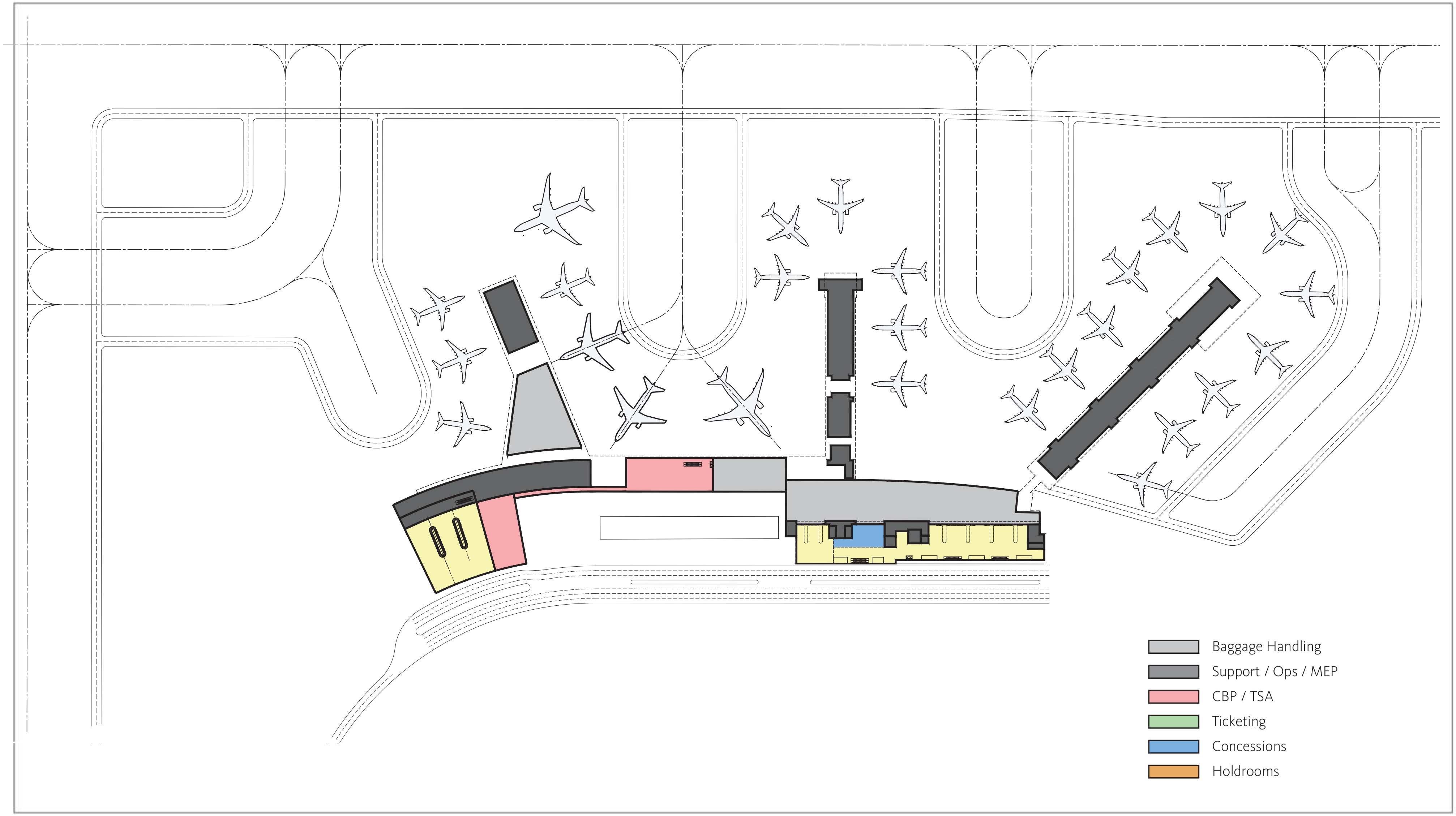
MASTER PLAN UPDATE

Independent Terminals
2027 - Overview
Functional Stack



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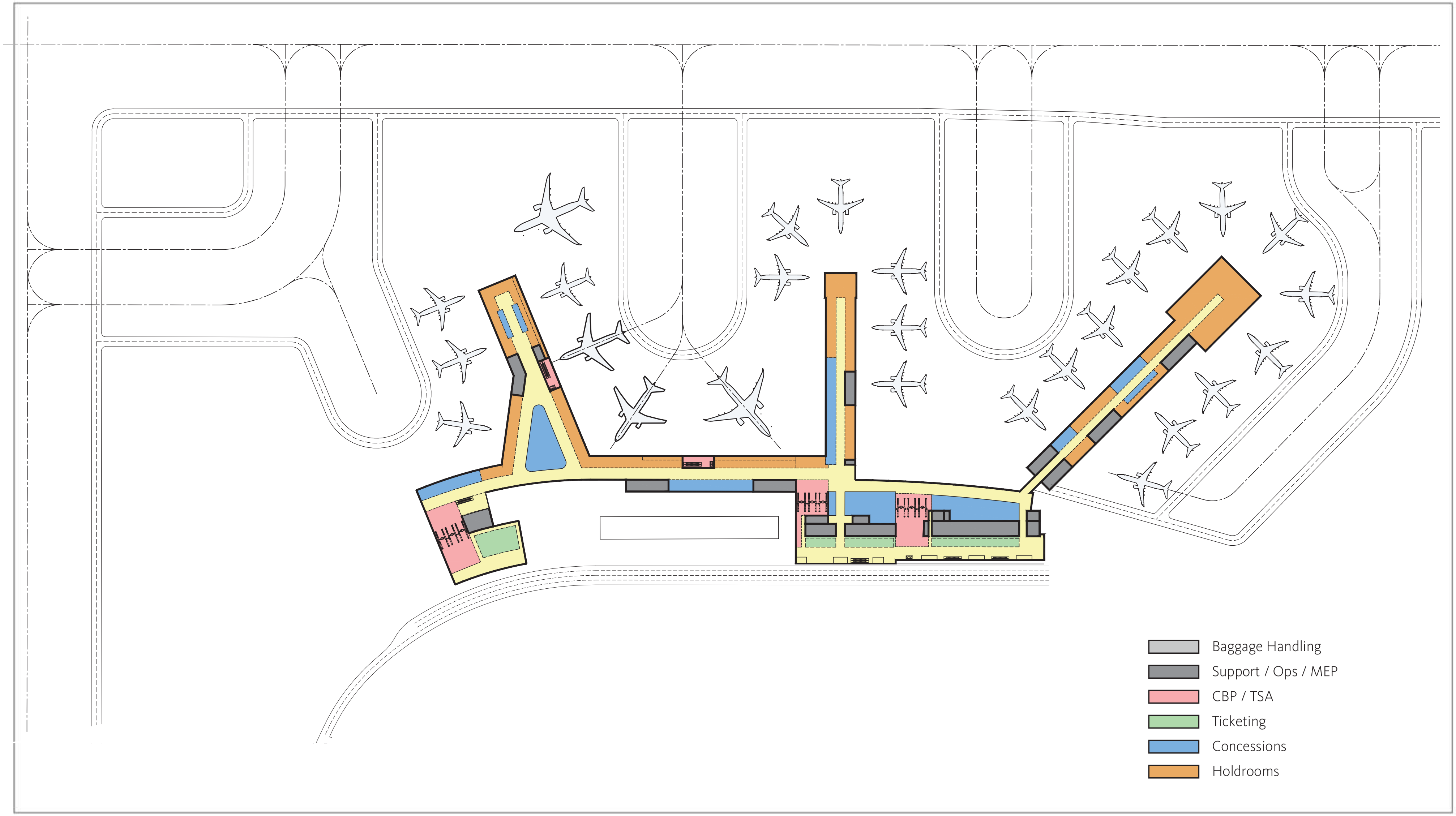
Independent Terminals
2027 - Overview
Arrivals Level



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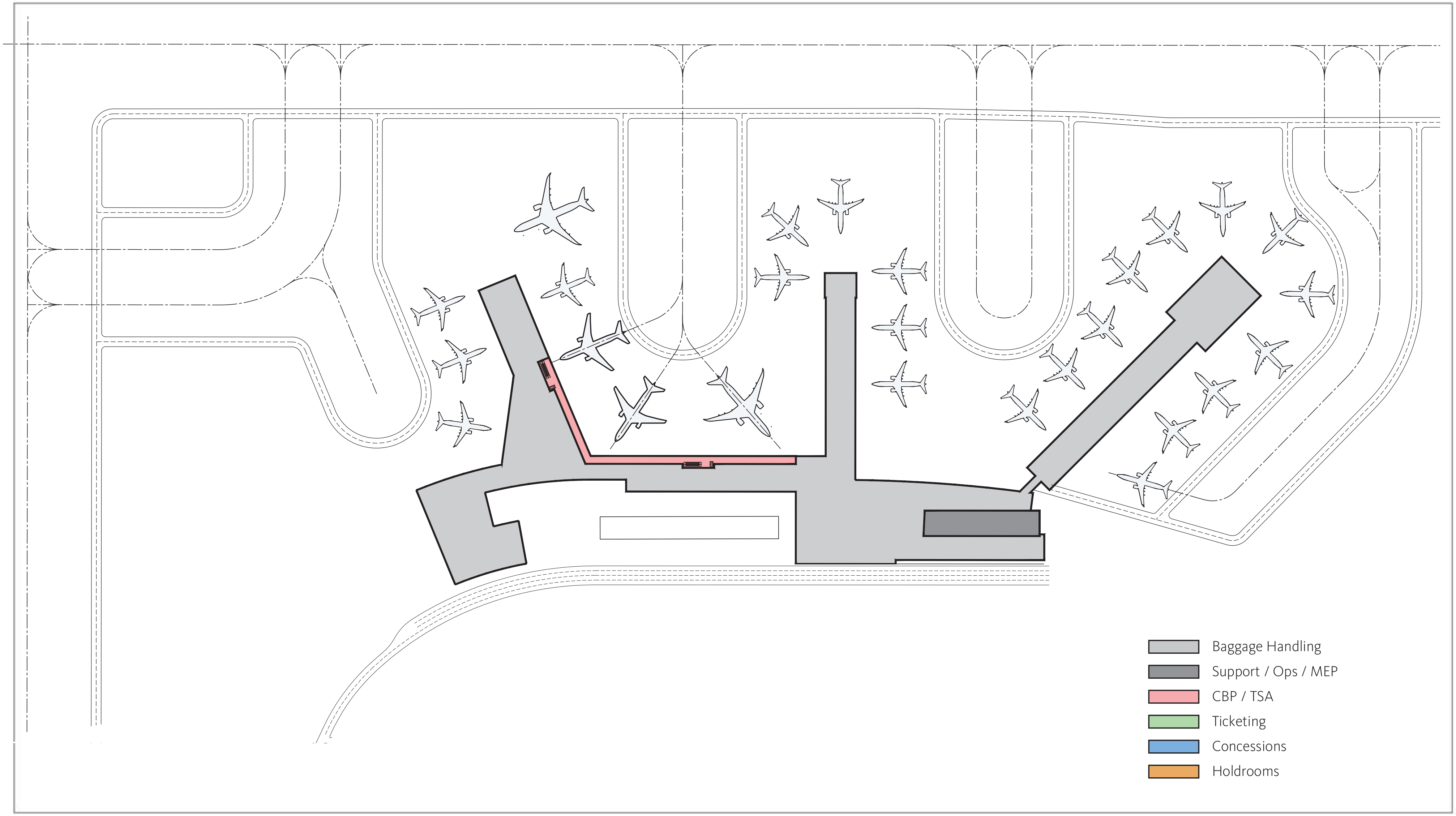
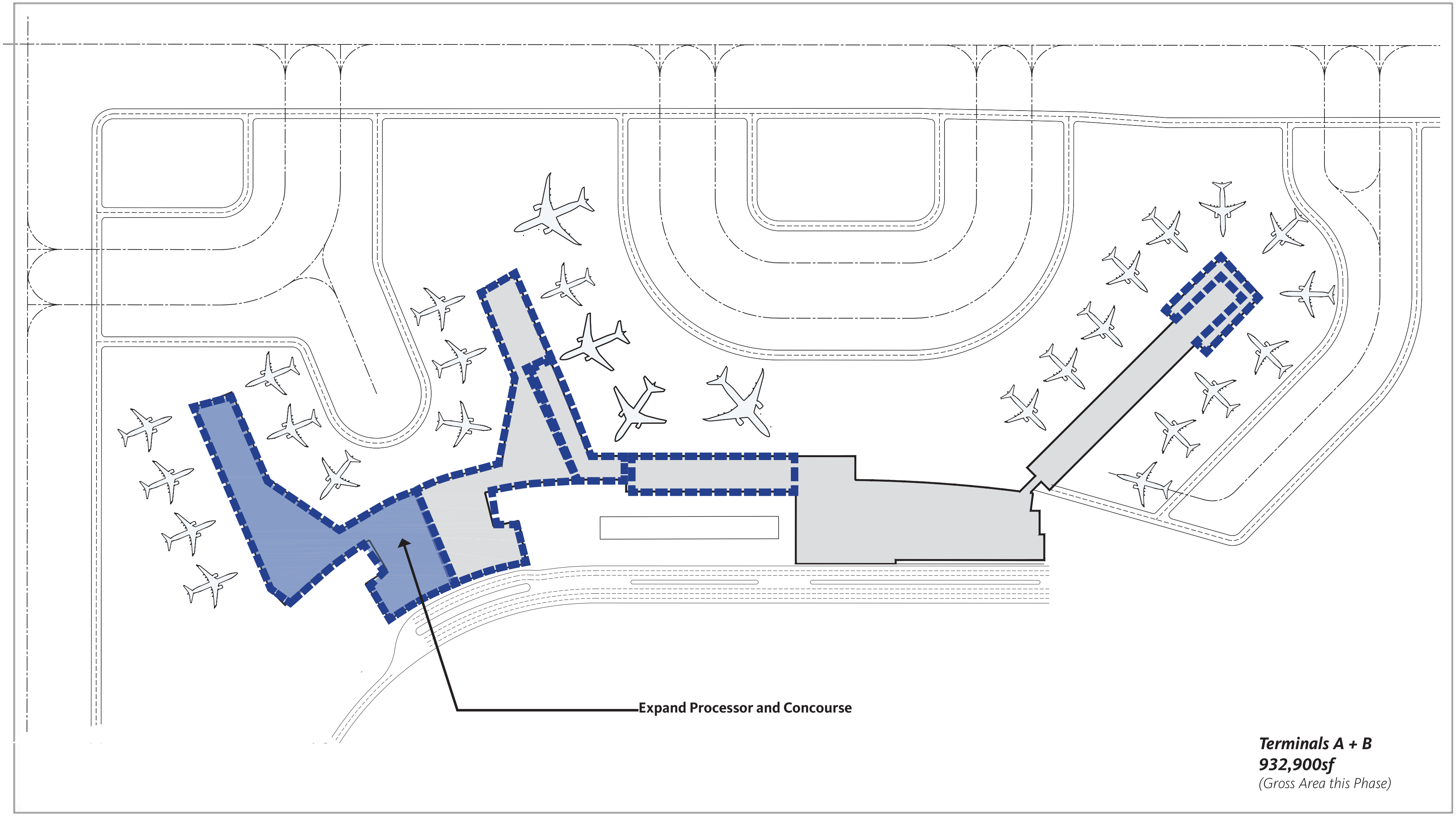
MASTER PLAN UPDATE

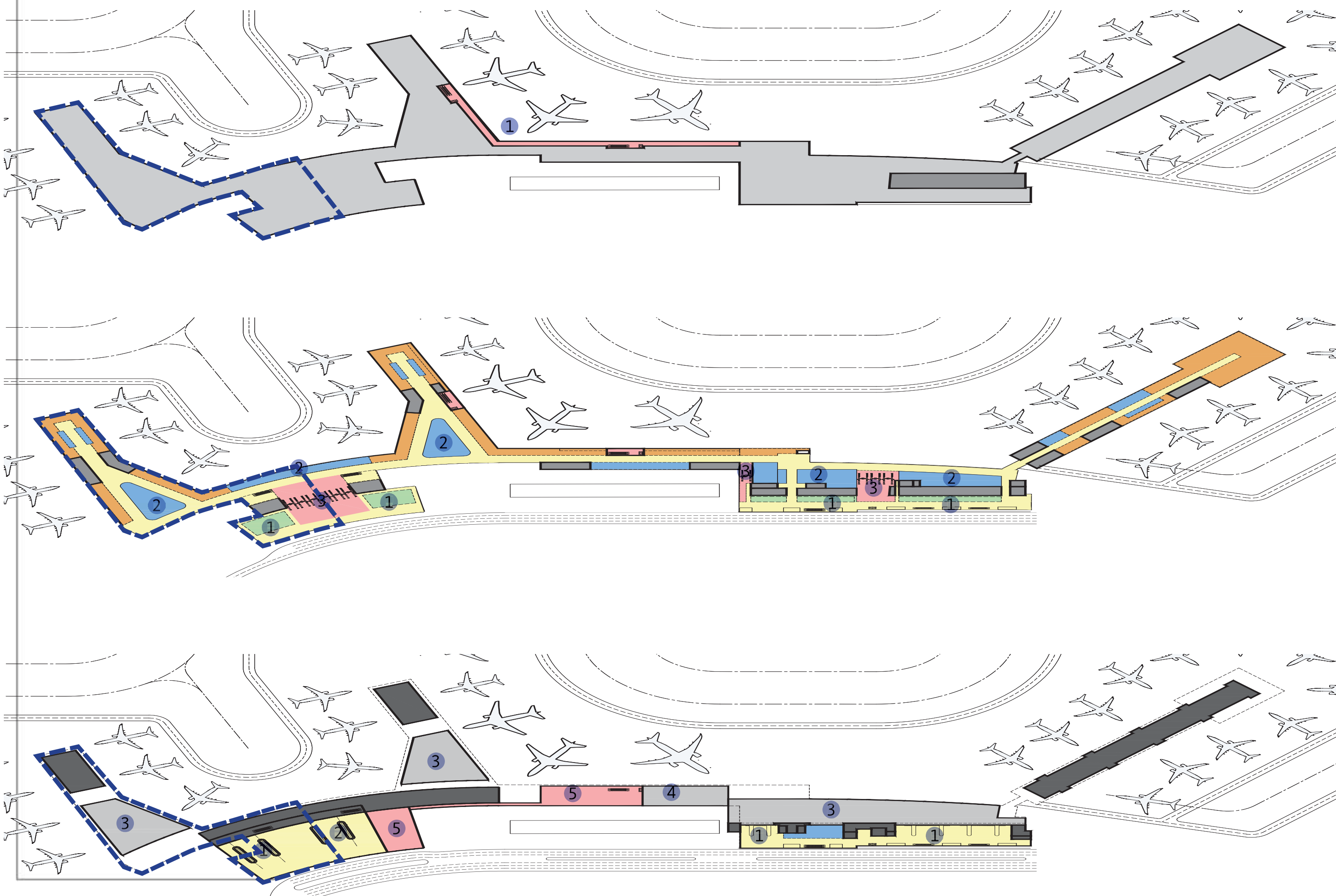
Independent Terminals
2027 - Overview
Departures Level



Independent Terminals
2027 - Overview
Mezzanine Level



Independent Terminals
2032 - New Construction



Mezzanine Level

1. Sterile Arrivals Corridor

Departures Level

1. Check-In
2. Retail Nodes
3. Security Checkpoints

Arrivals Level

1. Bag Claim
2. International Claim
3. Bag Make-Up
4. Bag Screening
5. FIS

Independent Terminals
2032 - Overview
Functional Stack

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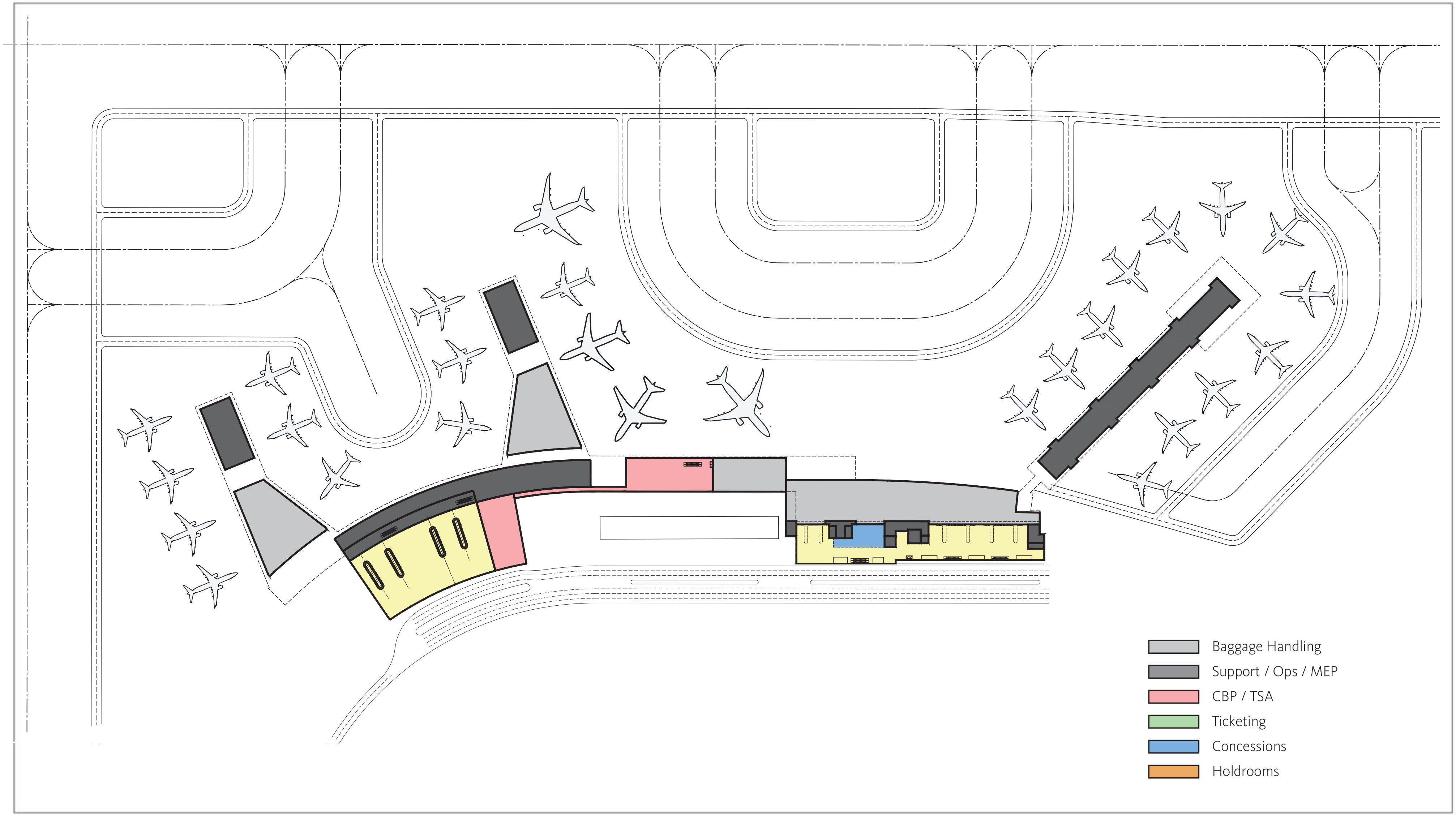
MASTER PLAN UPDATE



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BRADLEY INTERNATIONAL AIRPORT
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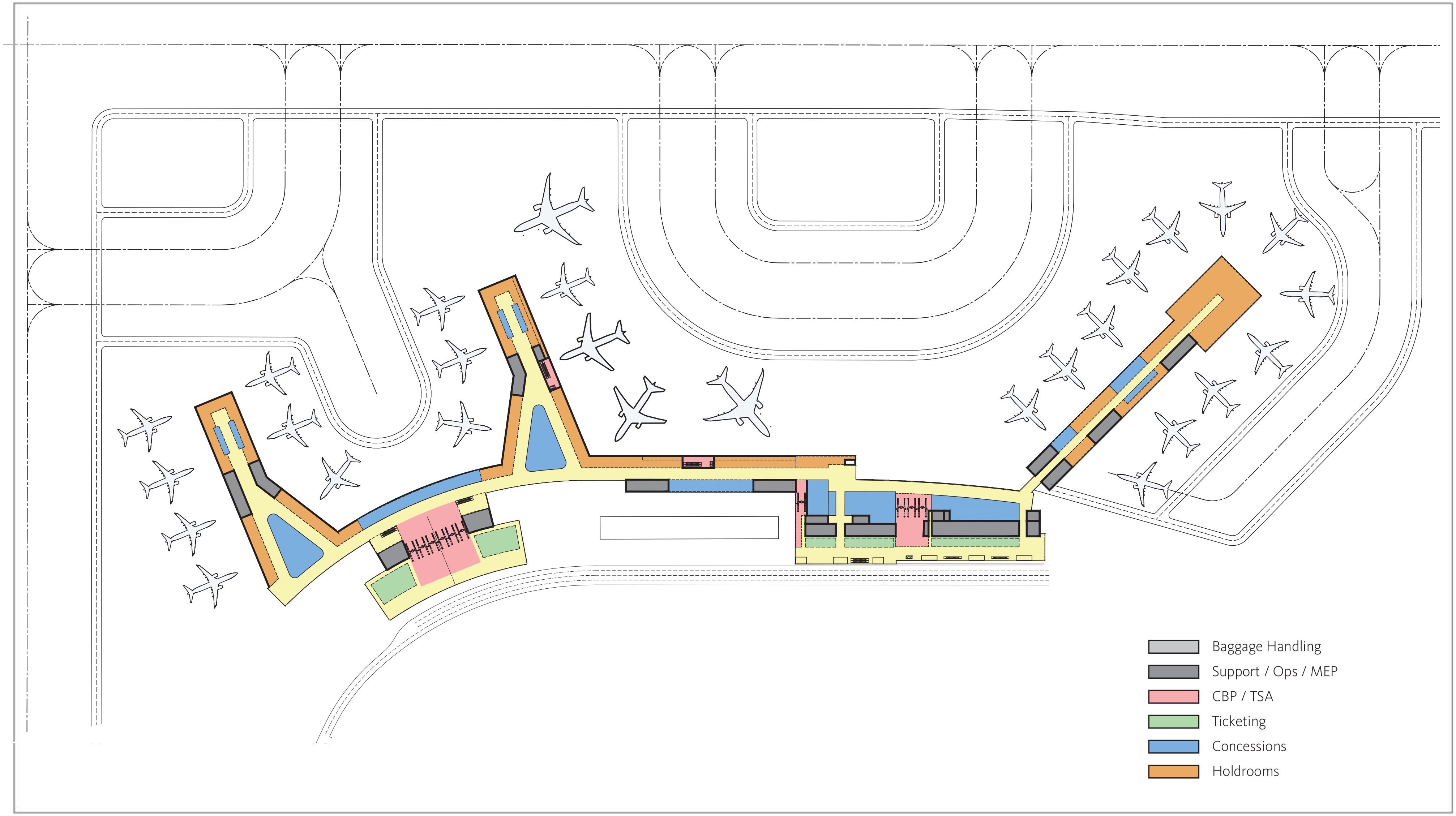
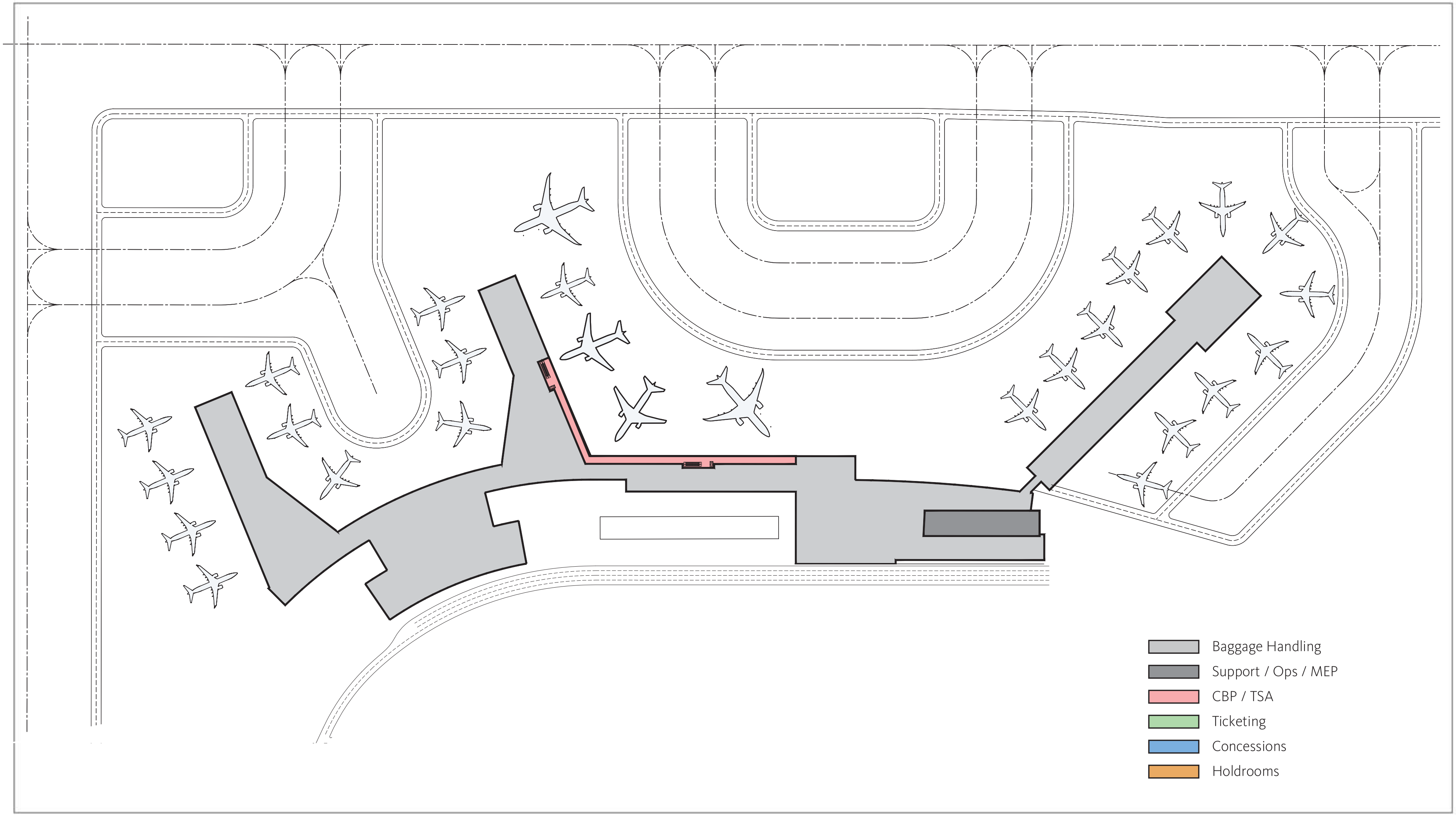
MASTER PLAN UPDATE

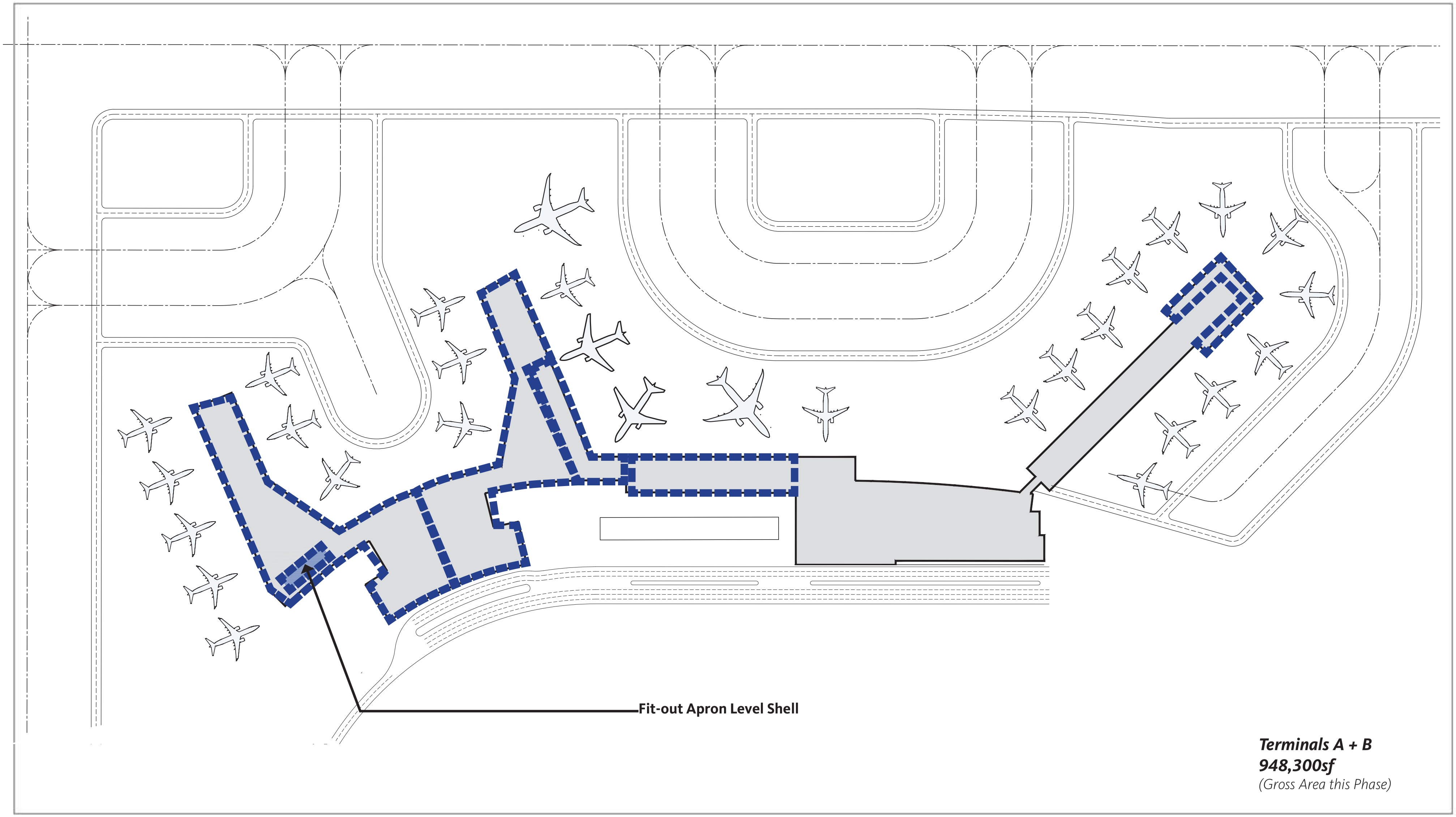
Independent Terminals
2032 - Overview
Arrivals Level



Independent Terminals
2032 - Overview
Departures Level



Independent Terminals
2032 - Overview
Mezzanine Level



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BRADLEY INTERNATIONAL AIRPORT
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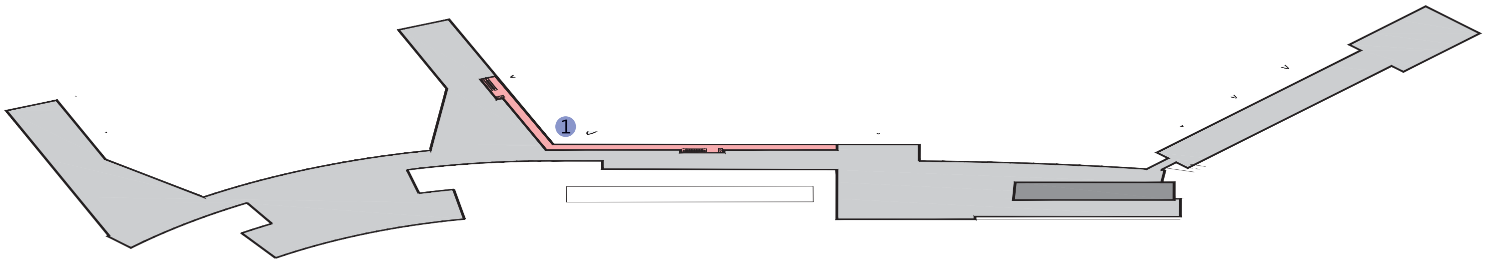
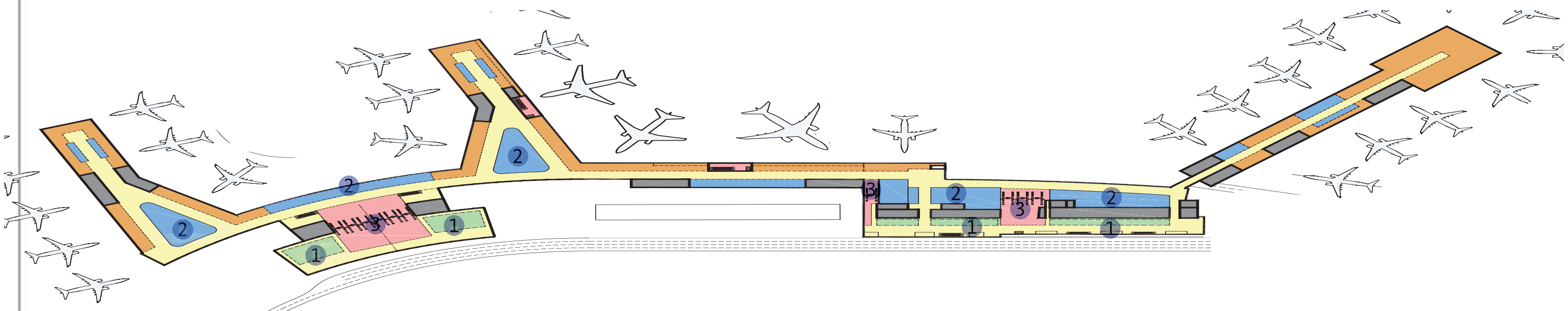
MASTER PLAN UPDATE

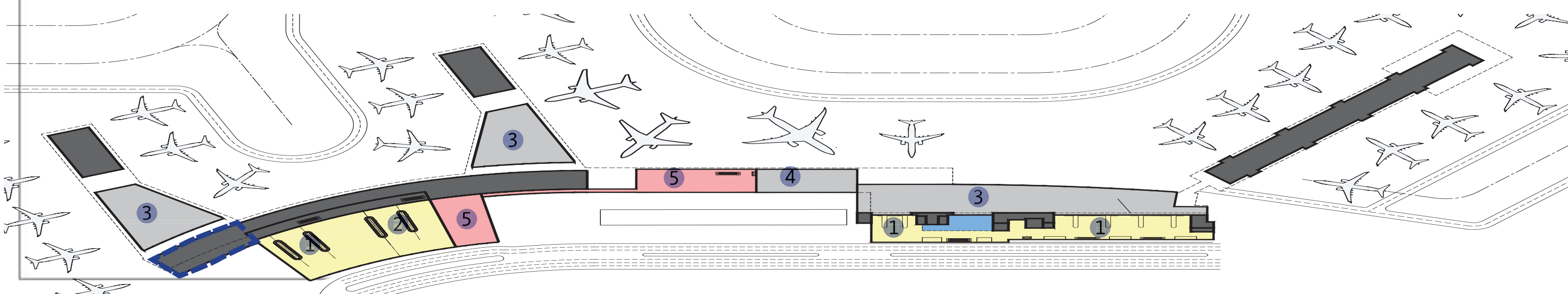
Independent Terminals
2037 - New Construction`



Mezzanine Level
1. Sterile Arrivals Corridor

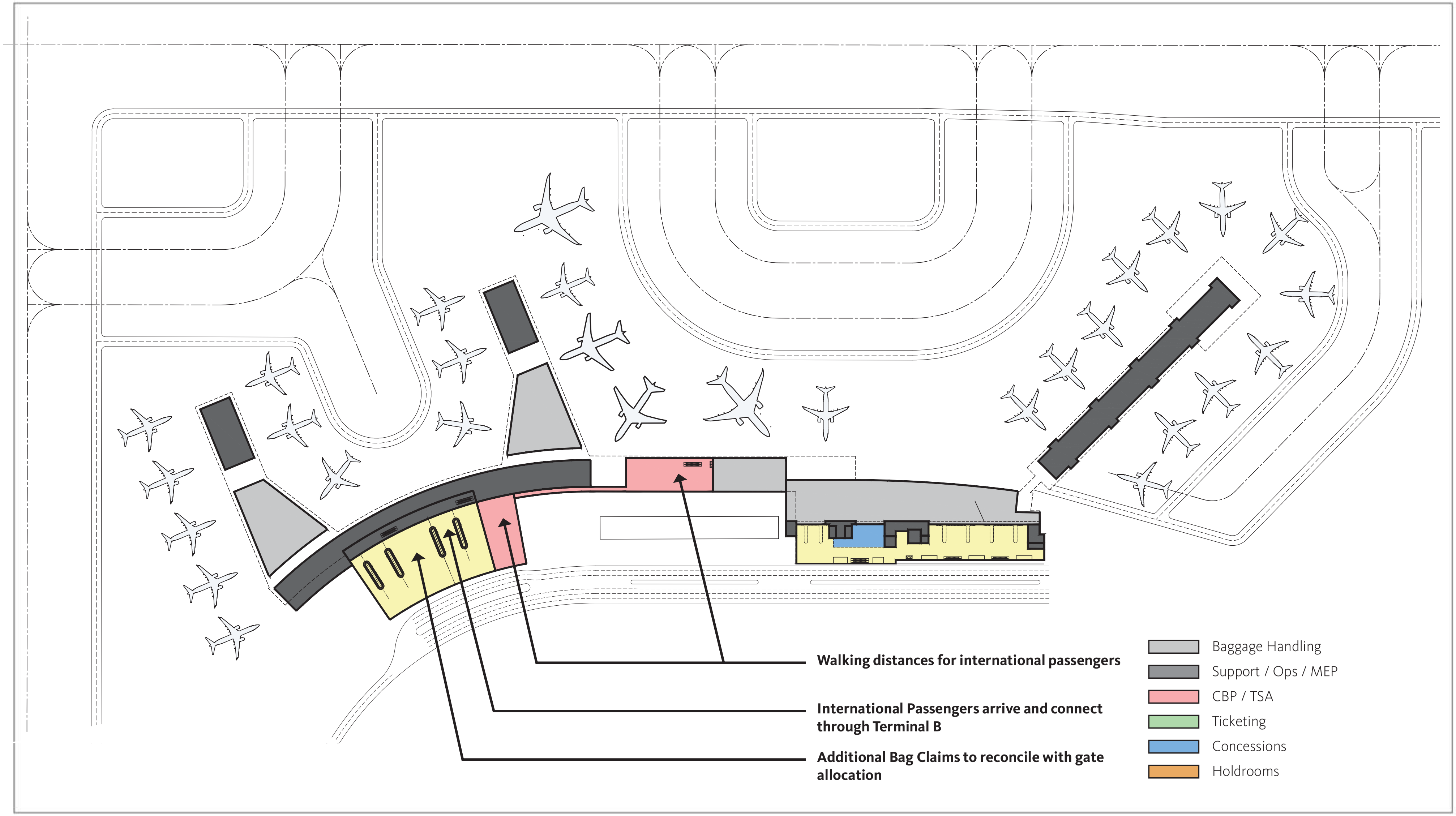


Departures Level
1. Check-In
2. Retail Nodes
3. Security Checkpoints

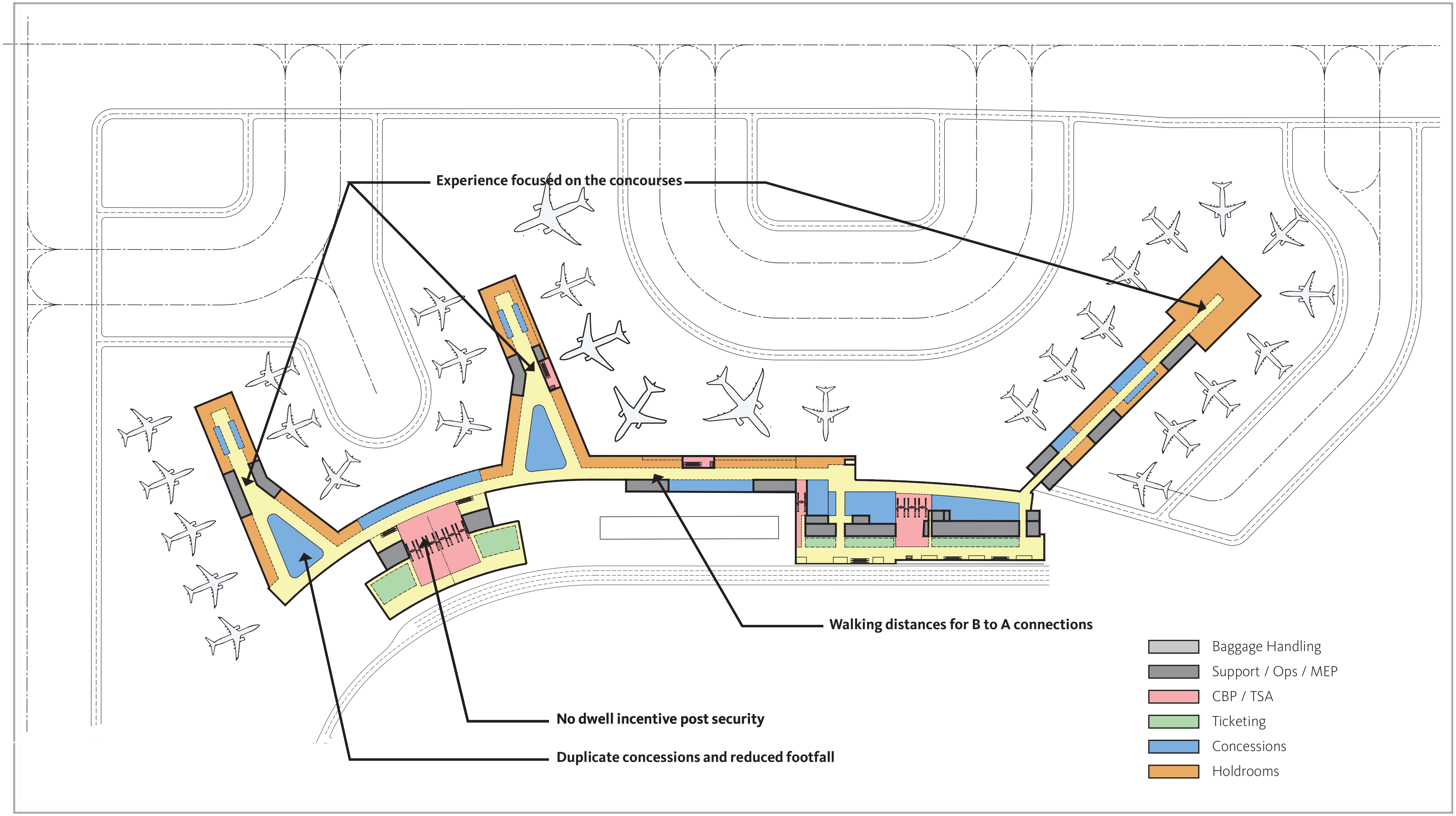


Arrivals Level
1. Bag Claim
2. International Claim
3. Bag Make-Up
4. Bag Screening
5. FIS

Independent Terminals
2037 - Overview
Functional Stack



Independent Terminals
2037 - Overview
Arrivals Level



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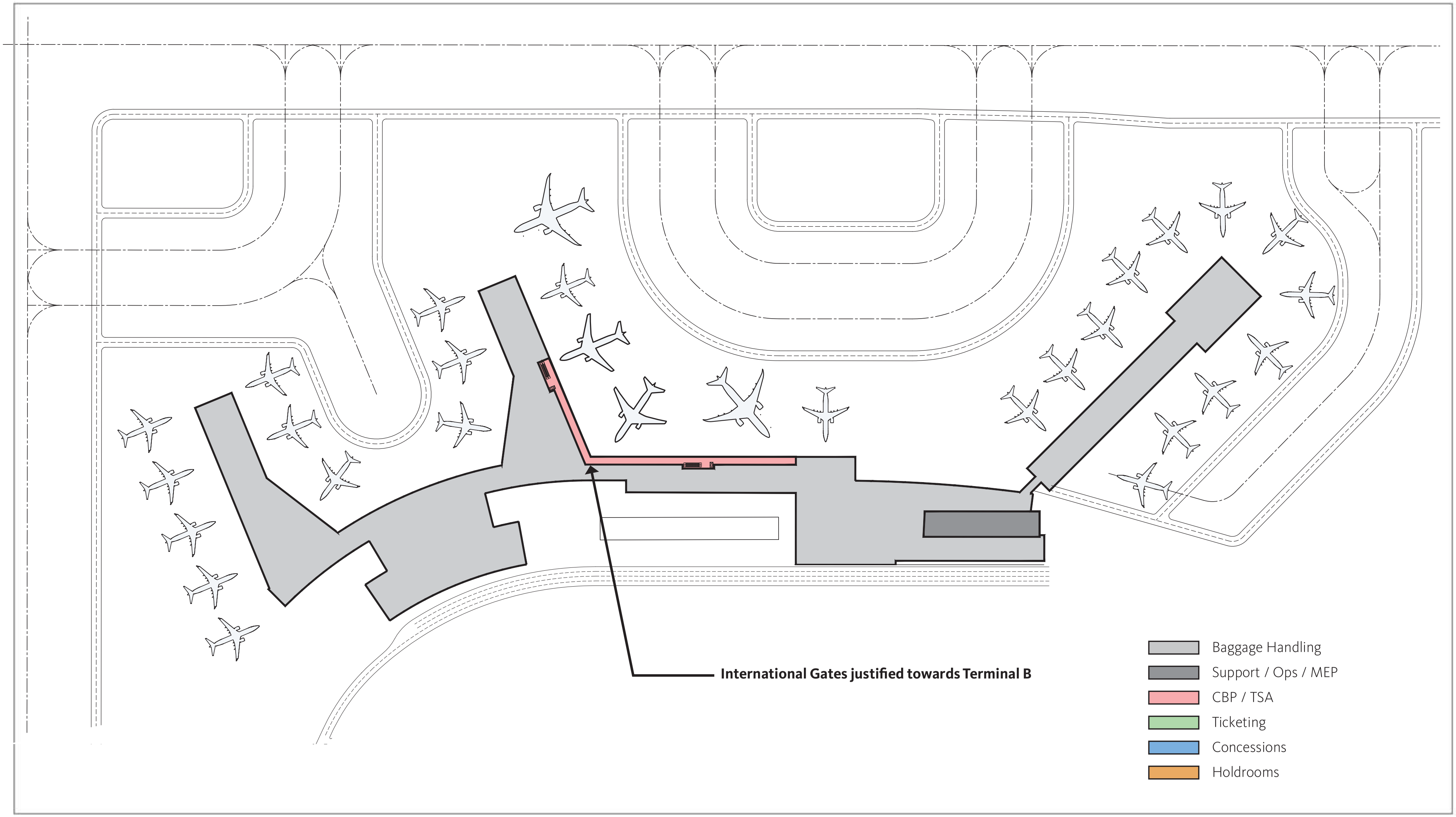
MASTER PLAN UPDATE

Independent Terminals
2037 - Overview
Departures Level



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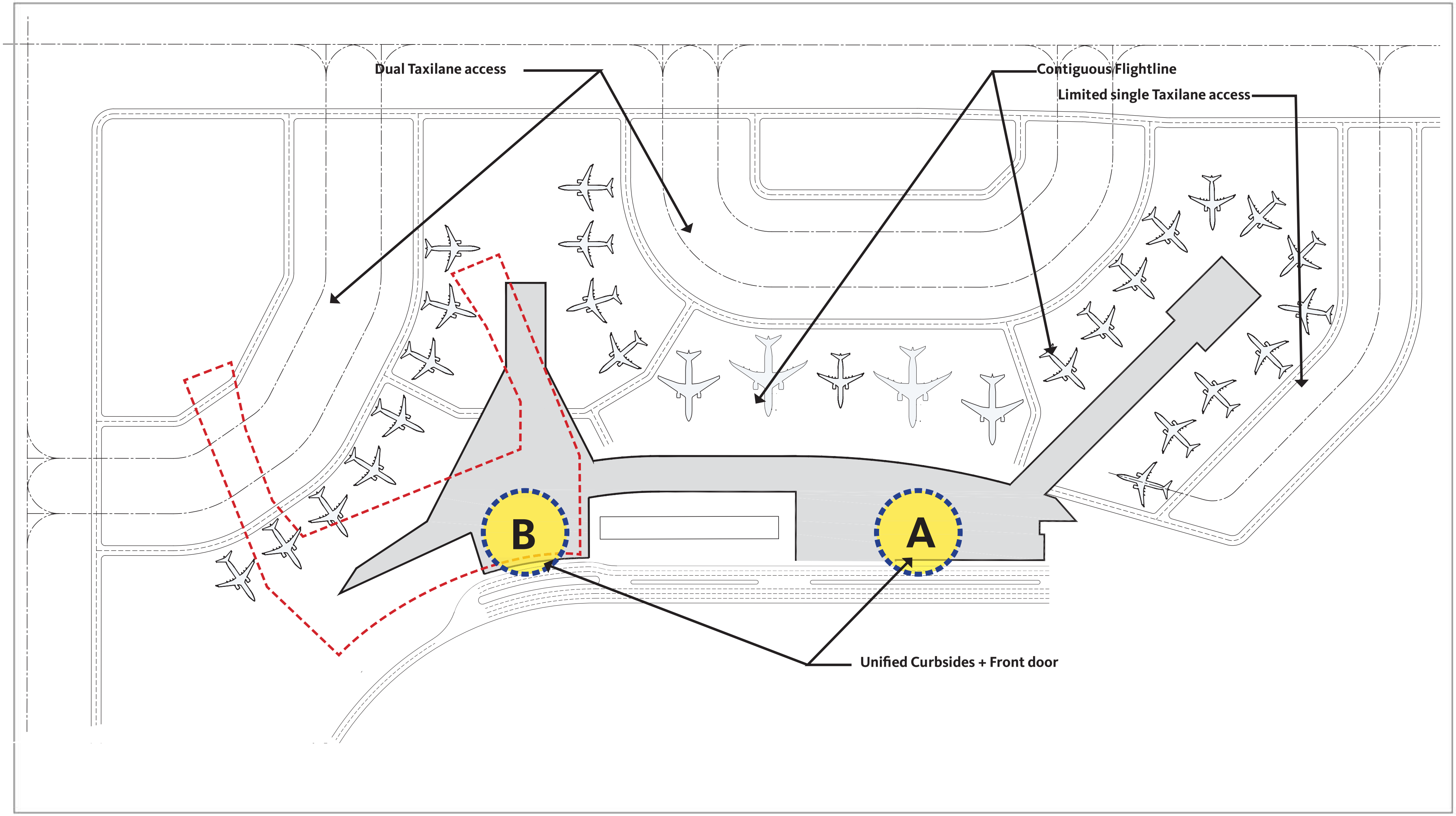
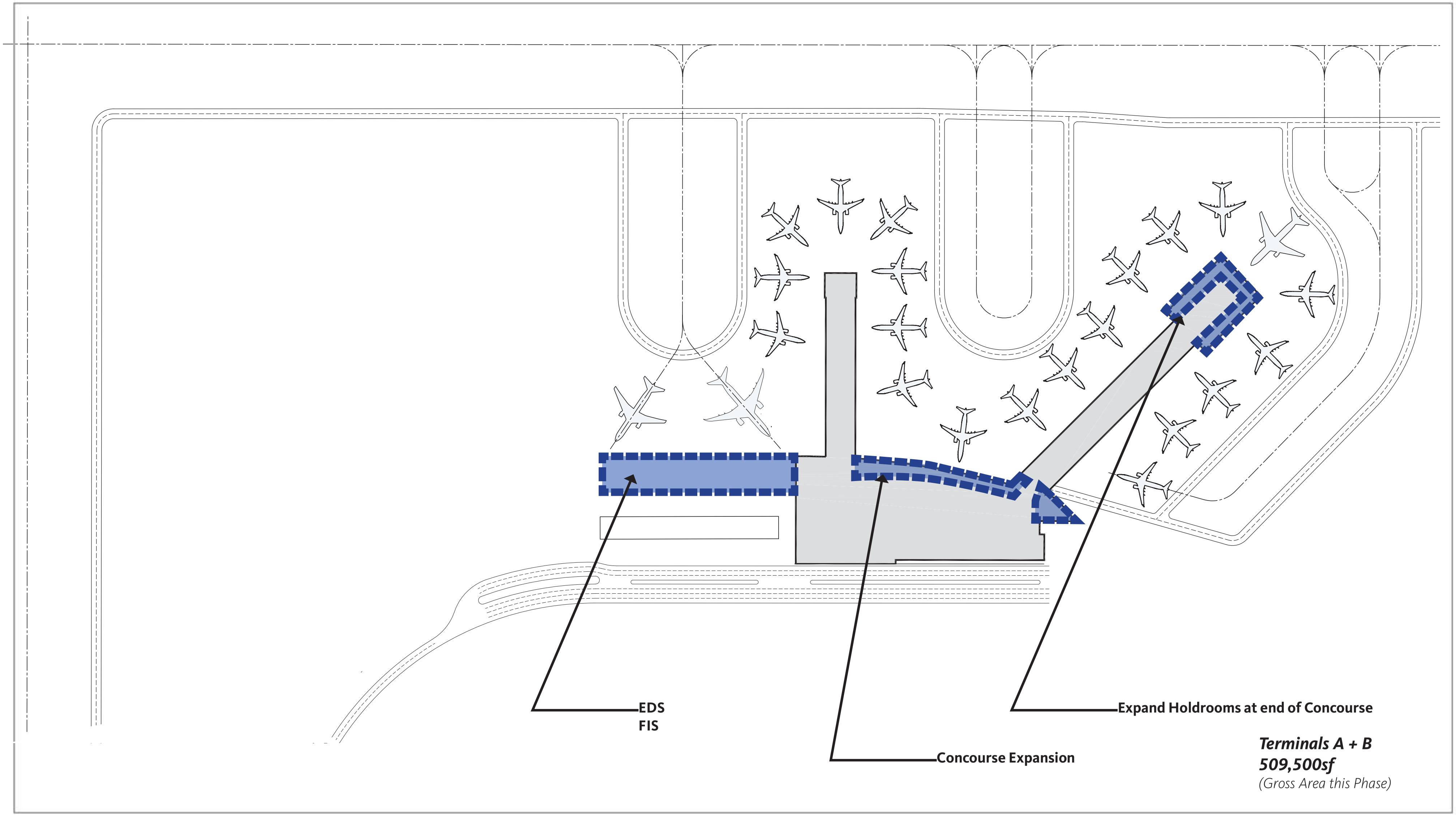
Independent Terminals
2037 - Overview
Mezzanine Level

CONSOLIDATED TERMINAL ALTERNATIVE

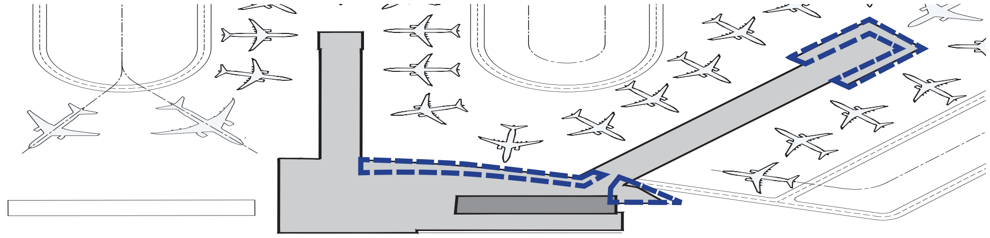


Consolidated Terminal
Conceptual Approach

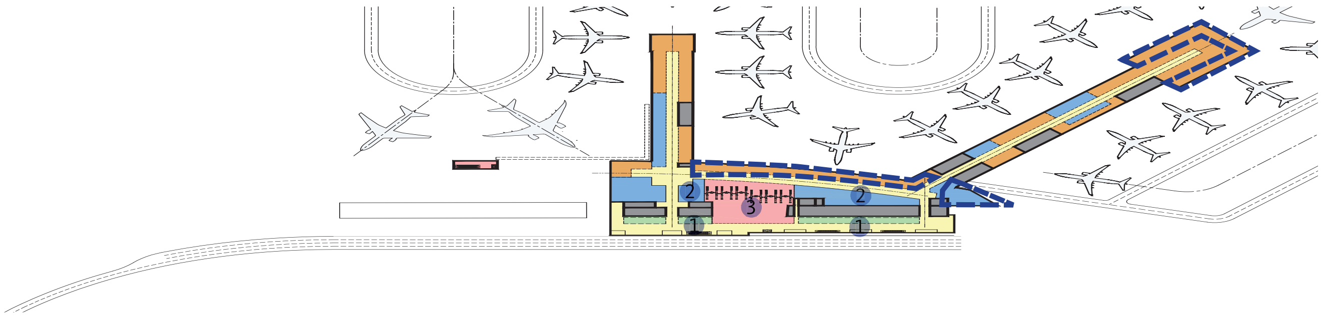


**Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A*

Consolidated Terminal
2017 - New Construction

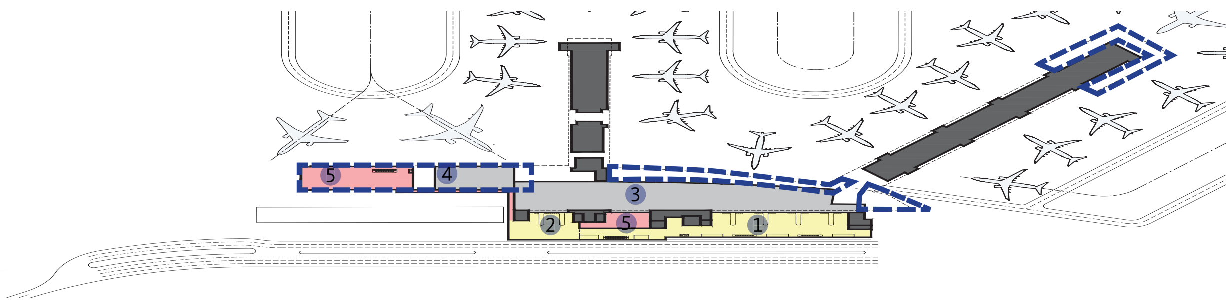


Mezzanine Level



Departures Level

1. Check-In
2. Retail Nodes
3. Security Checkpoints

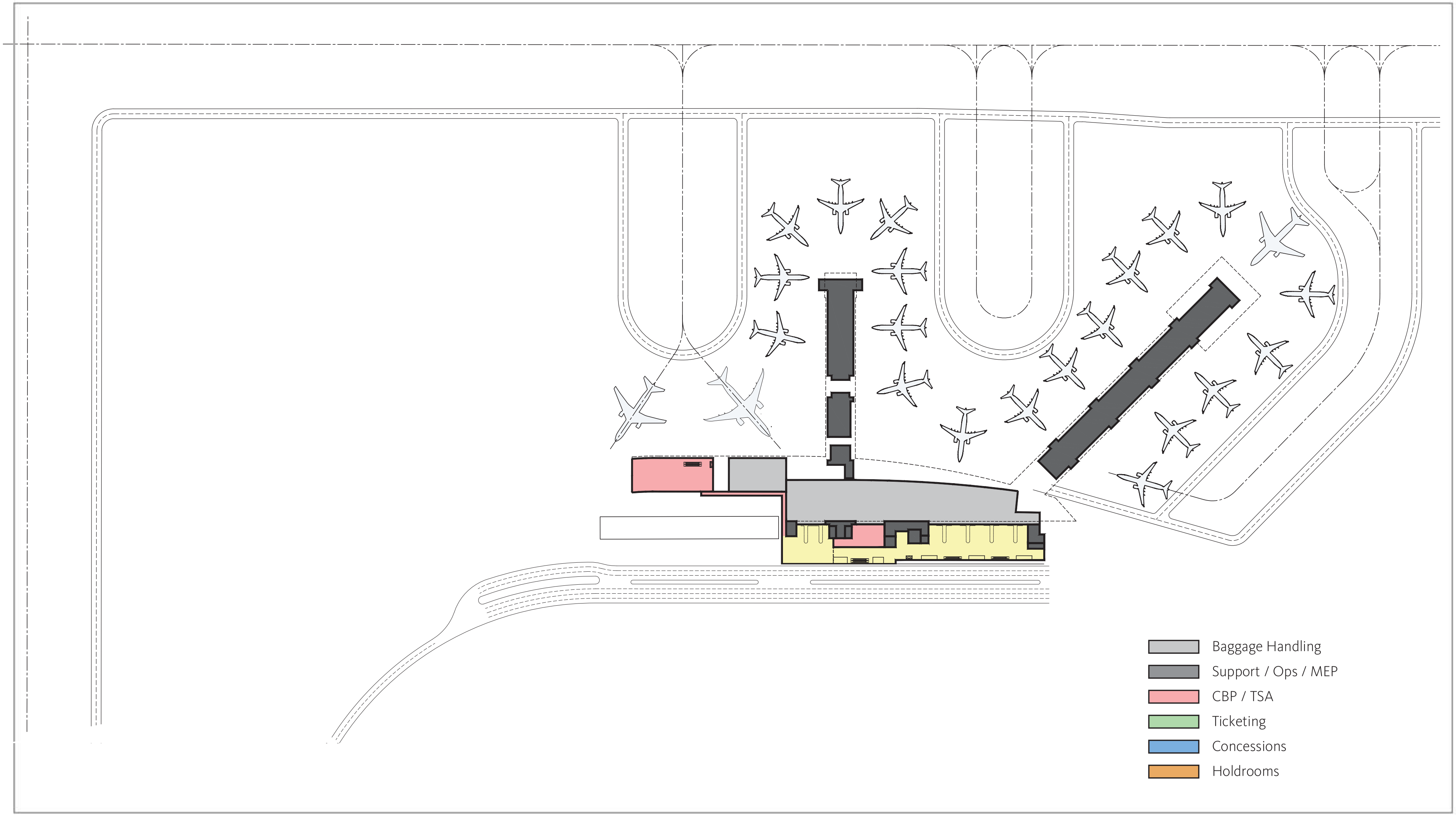


Arrivals Level

1. Bag Claim
2. International Claim
3. Bag Make-Up
4. Bag Screening
5. FIS

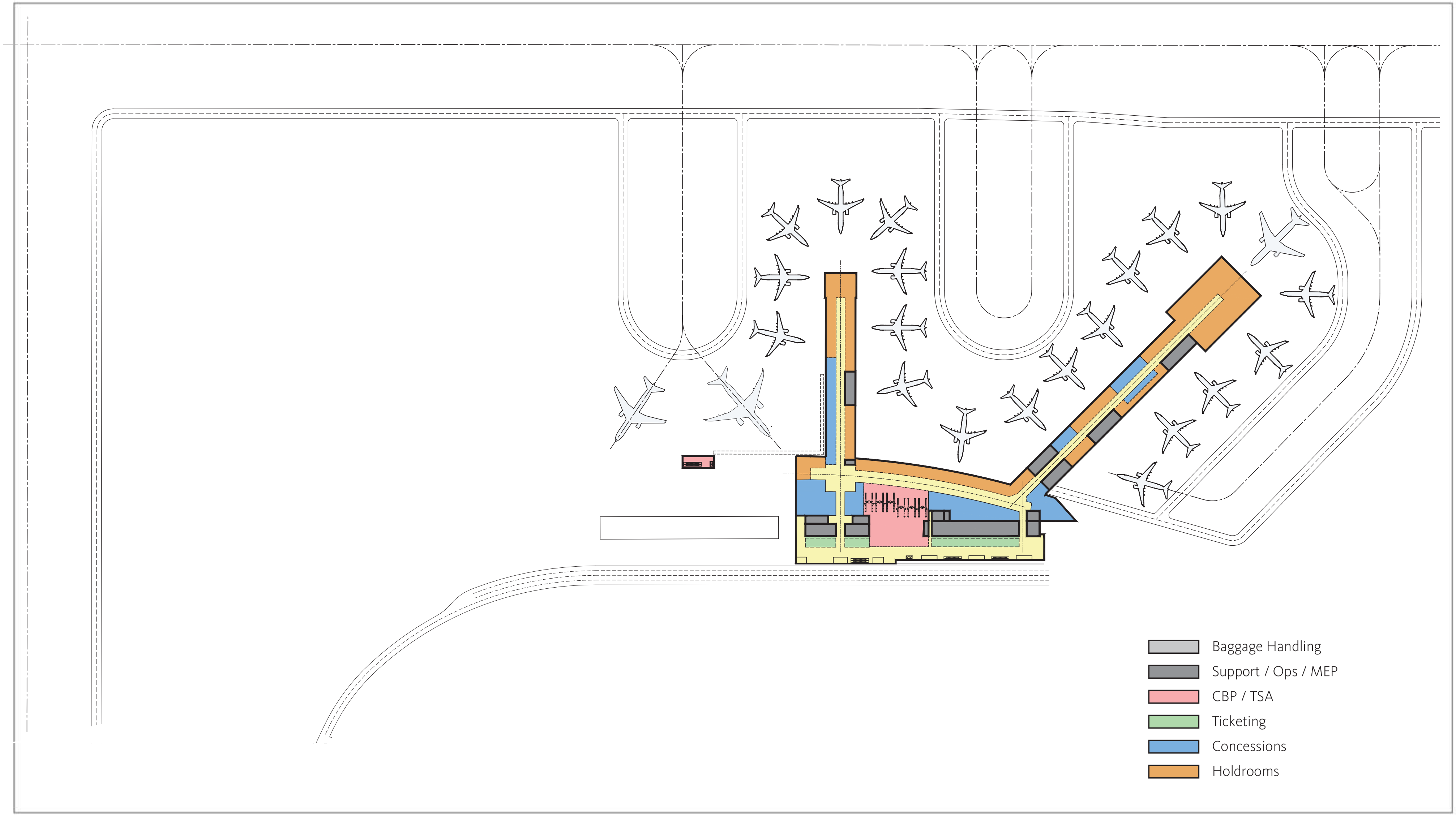
**Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A*

Consolidated Terminal
2017 - Overview
Functional Stack



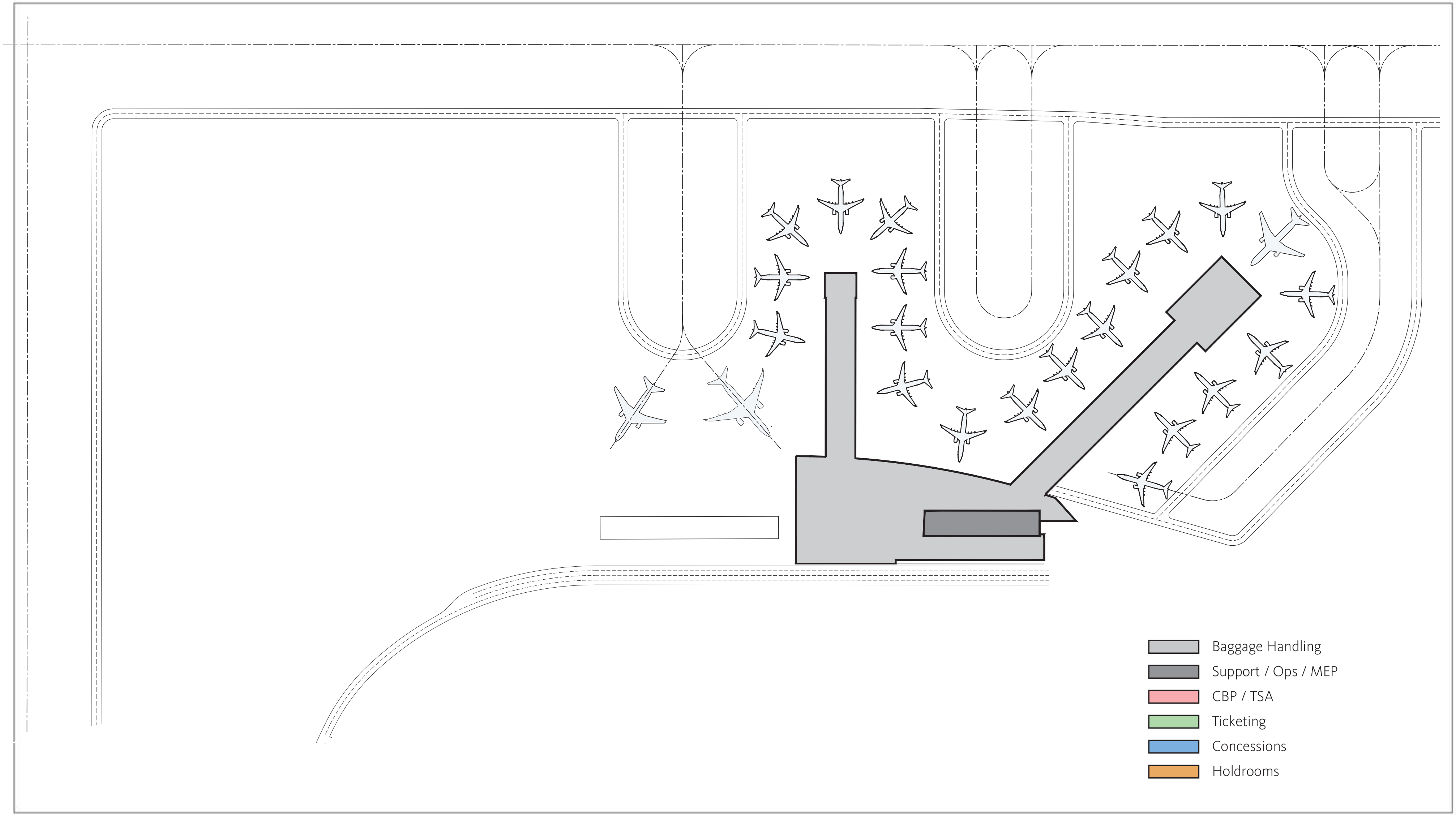
Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2017 - Overview
Arrivals Level



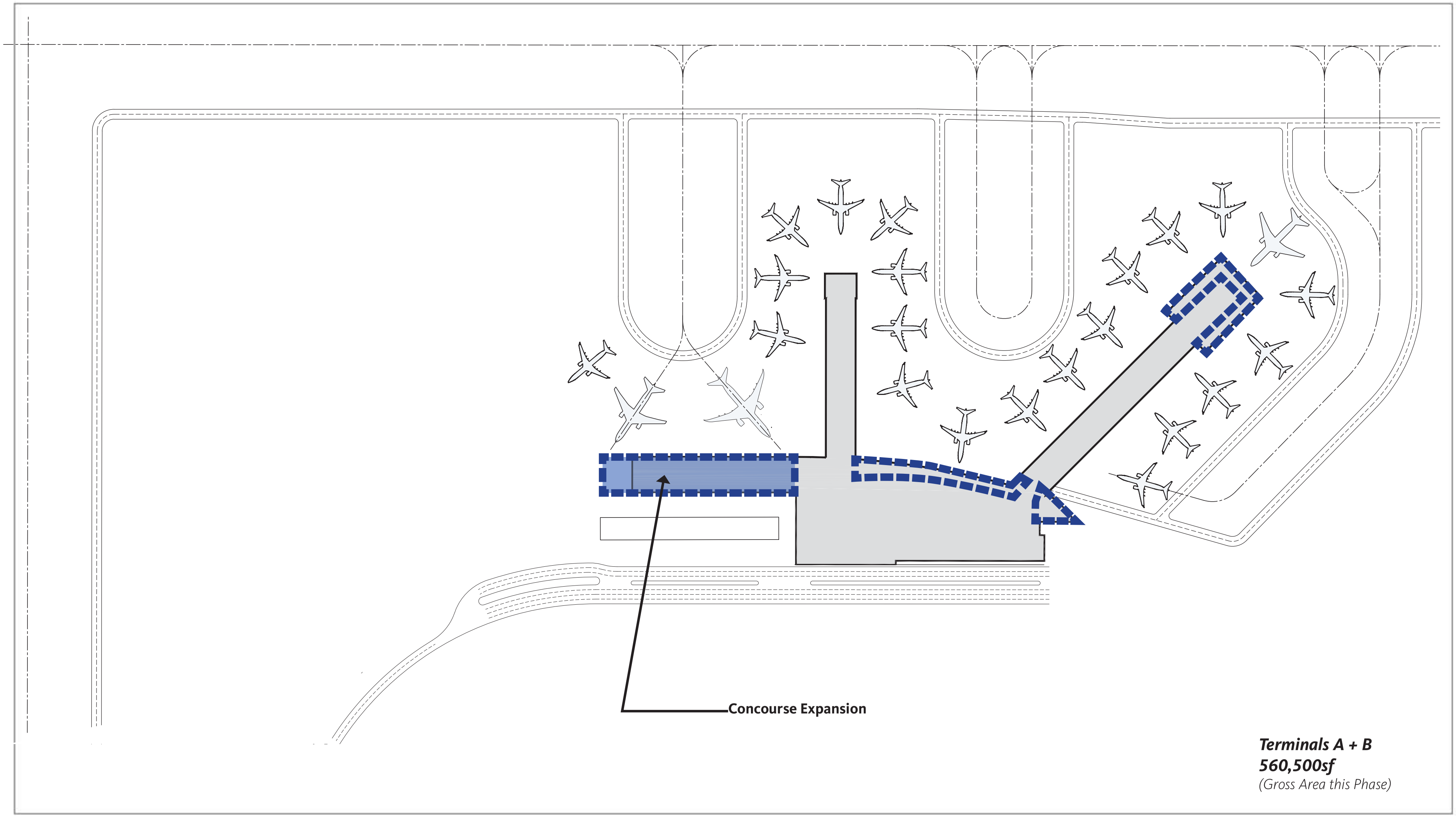
*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2017 - Overview
Departures Level



*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2017 - Overview
Mezzanine Level



*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2022 - New Construction

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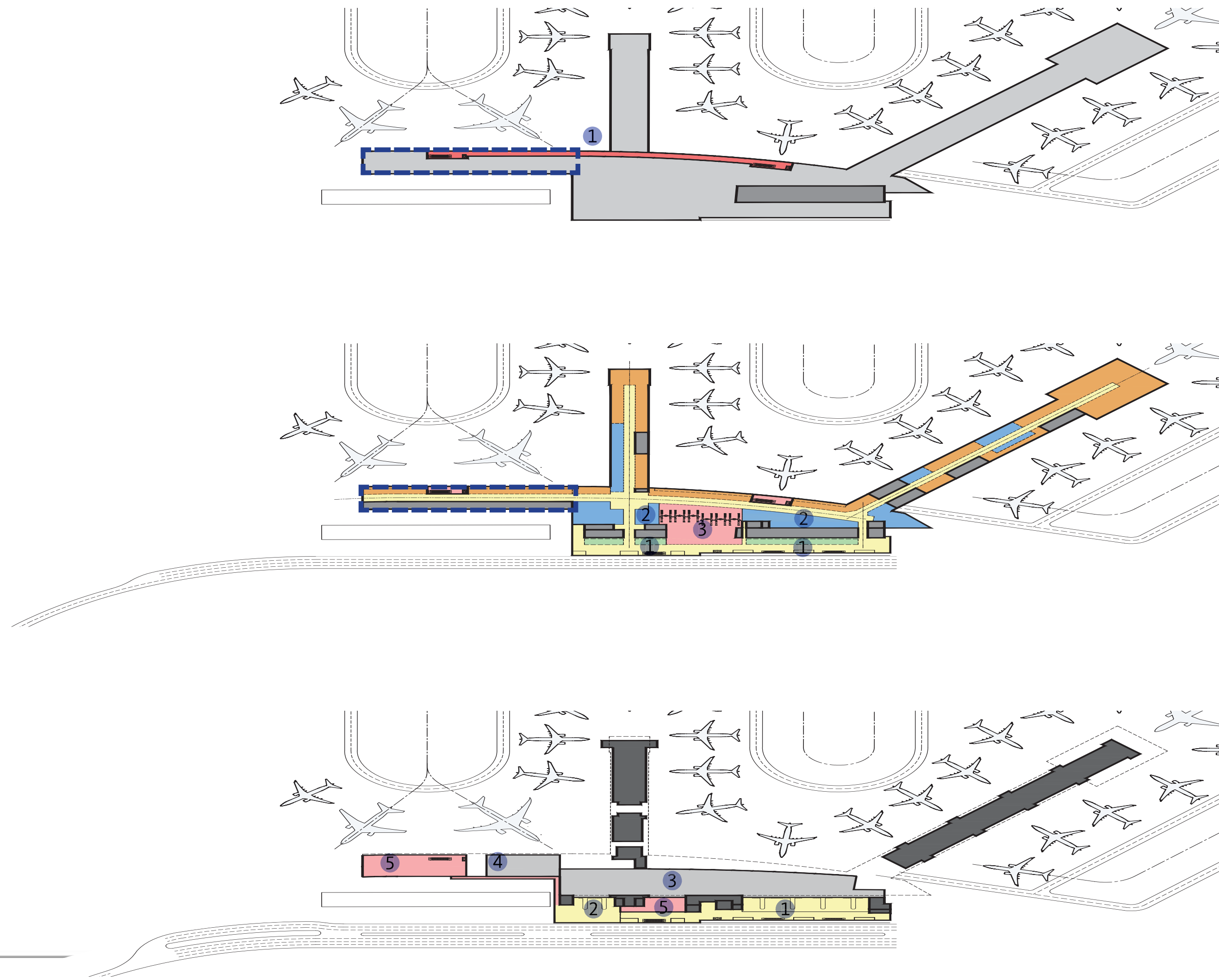


Mezzanine Level

1. Sterile Arrivals Corridor

Departures Level

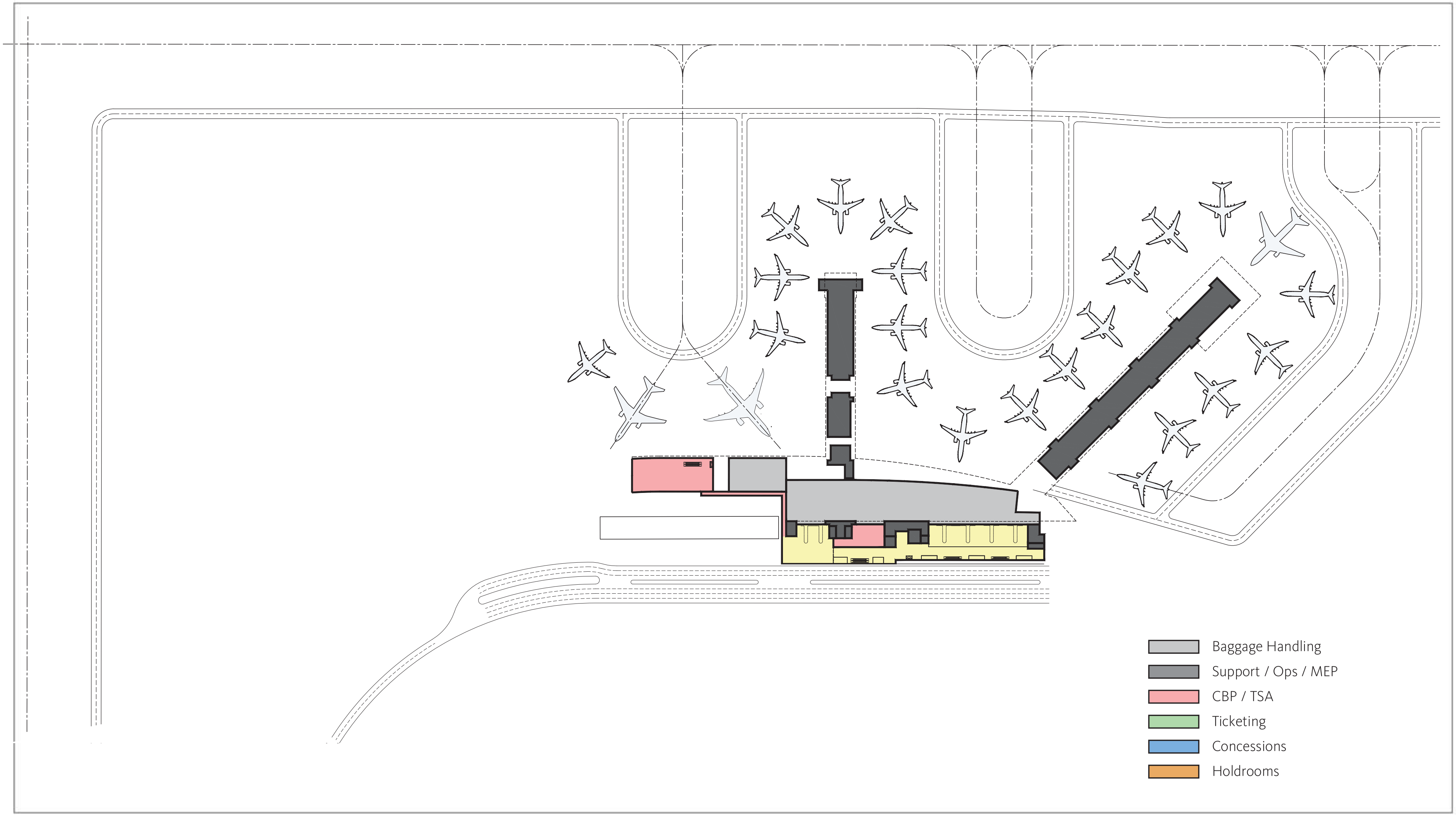
1. Check-In
2. Retail Nodes
3. Security Checkpoints

Arrivals Level

1. Bag Claim
2. International Claim
3. Bag Make-Up
4. Bag Screening
5. FIS

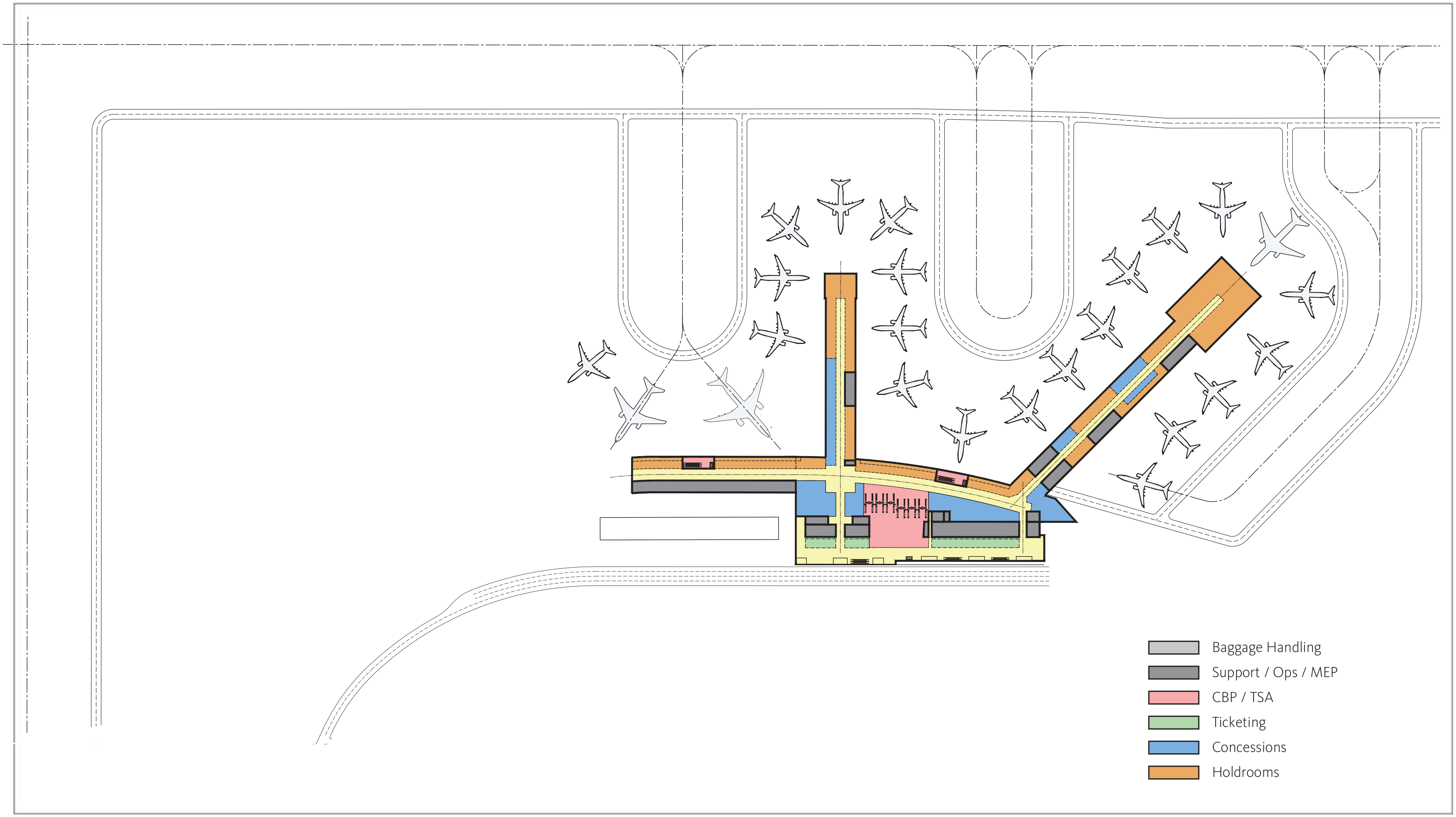
**Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A*

Consolidated Terminal
2022 - Overview
Functional Stack



*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2022 - Overview
Arrivals Level



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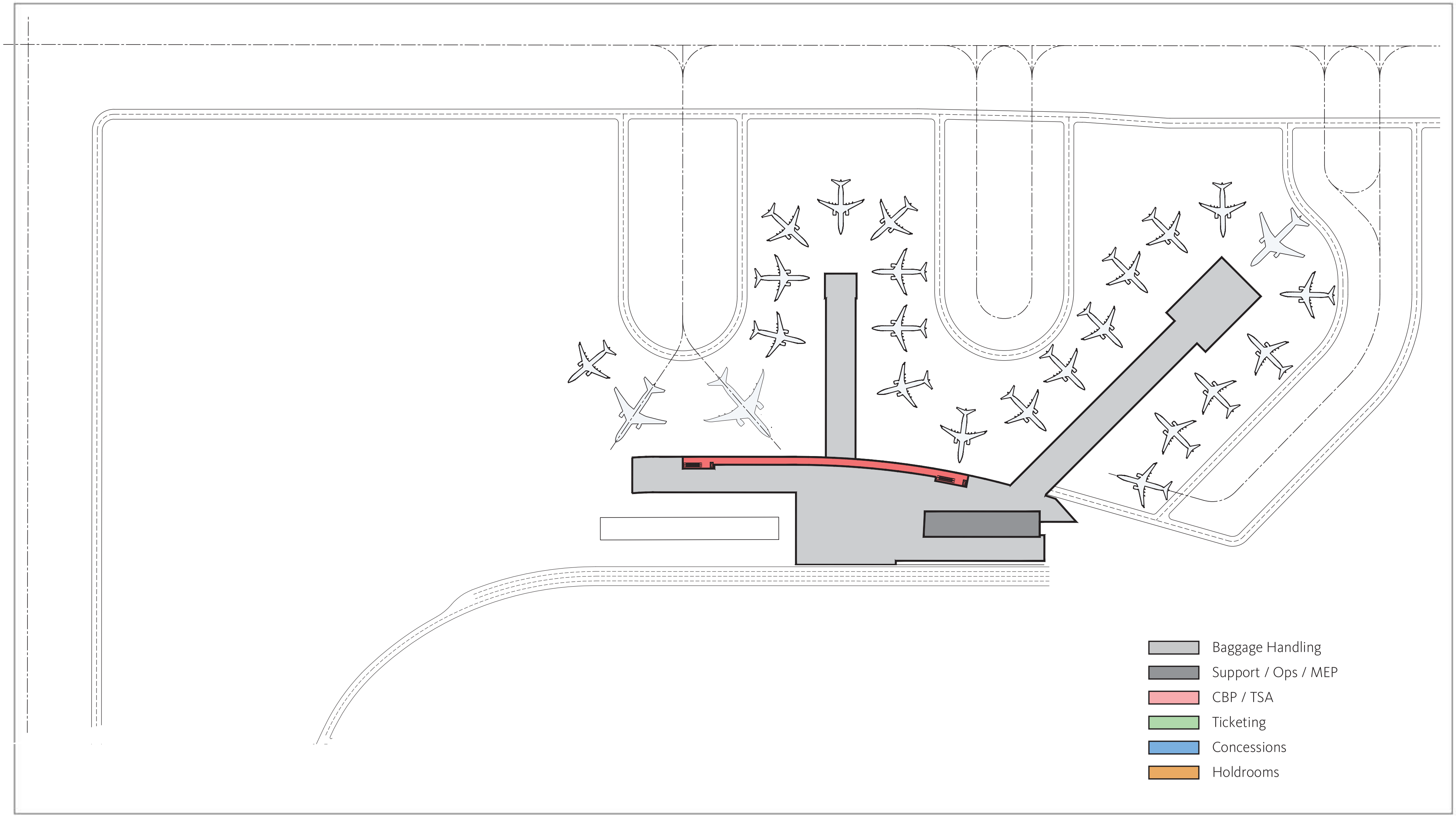
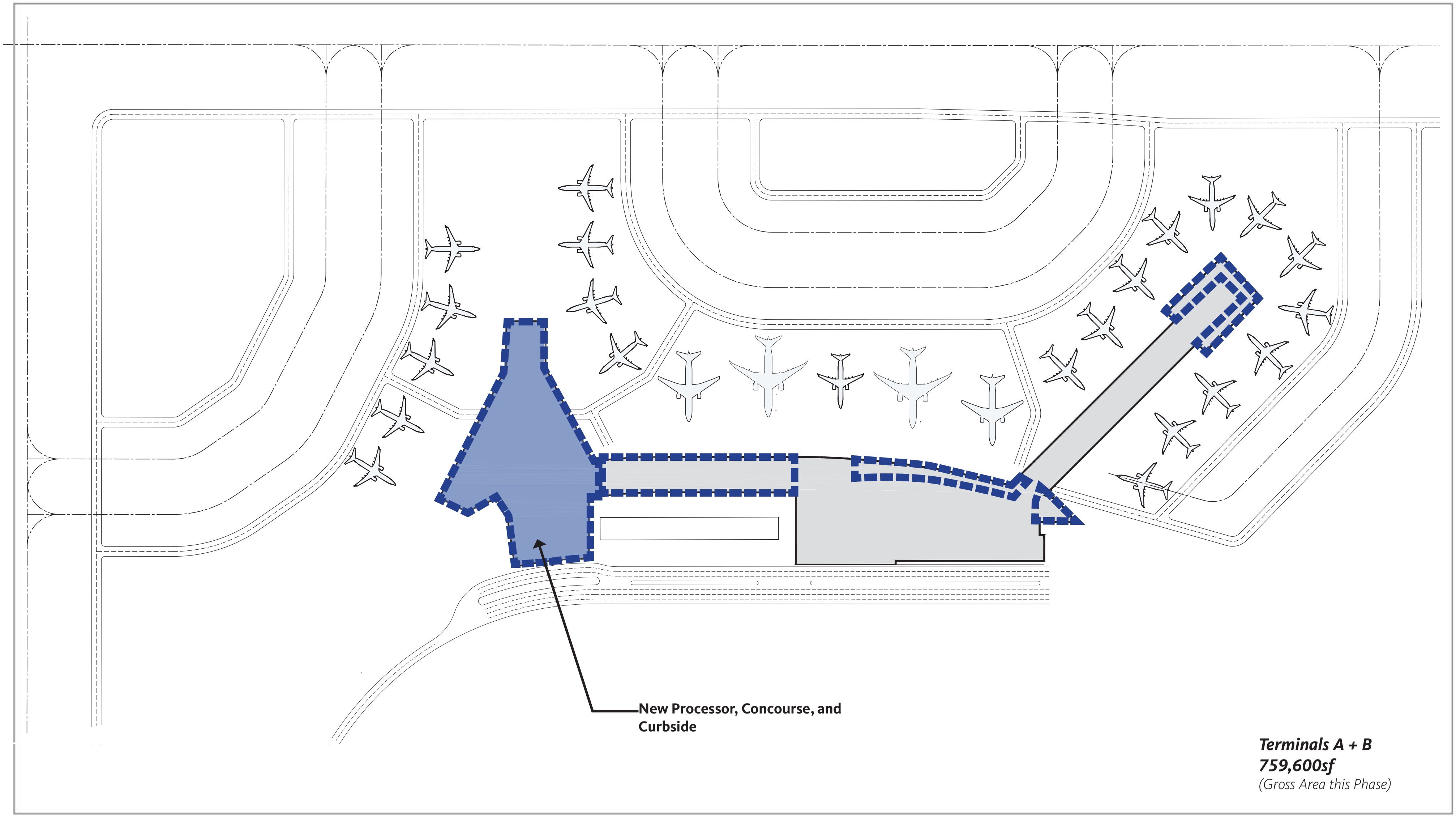
**Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A*

Consolidated Terminal
2022 - Overview
Departures Level



*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2022 - Overview
Mezzanine Level



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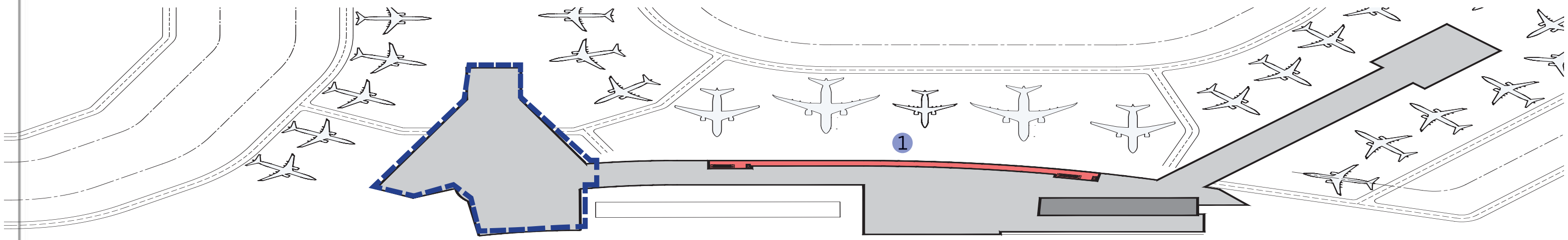
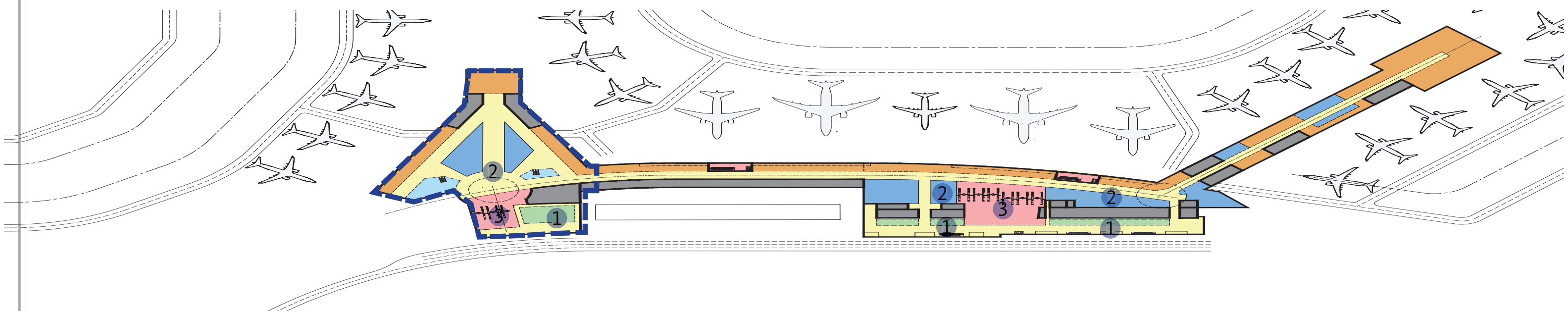
*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2027 - New Construction



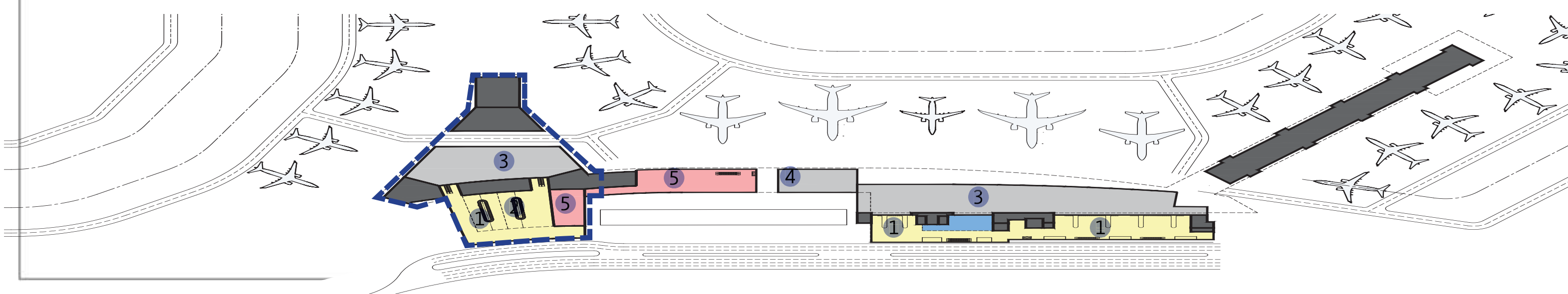
Mezzanine Level

1. Sterile Arrivals Corridor



Departures Level

1. Check-In
2. Retail Nodes
3. Security Checkpoints



Arrivals Level

1. Bag Claim
2. International Claim
3. Bag Make-Up
4. Bag Screening
5. FIS

**Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A*

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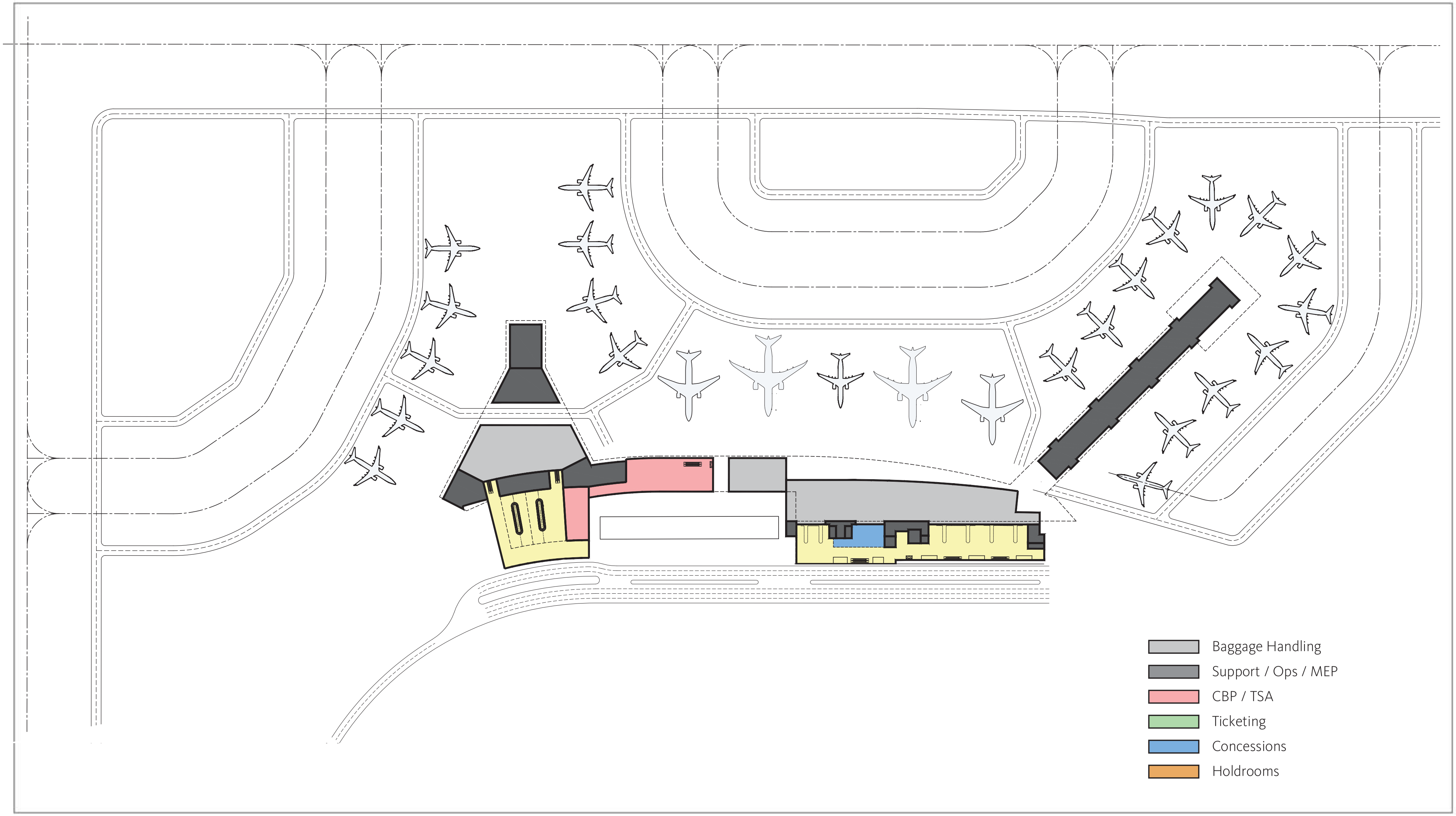
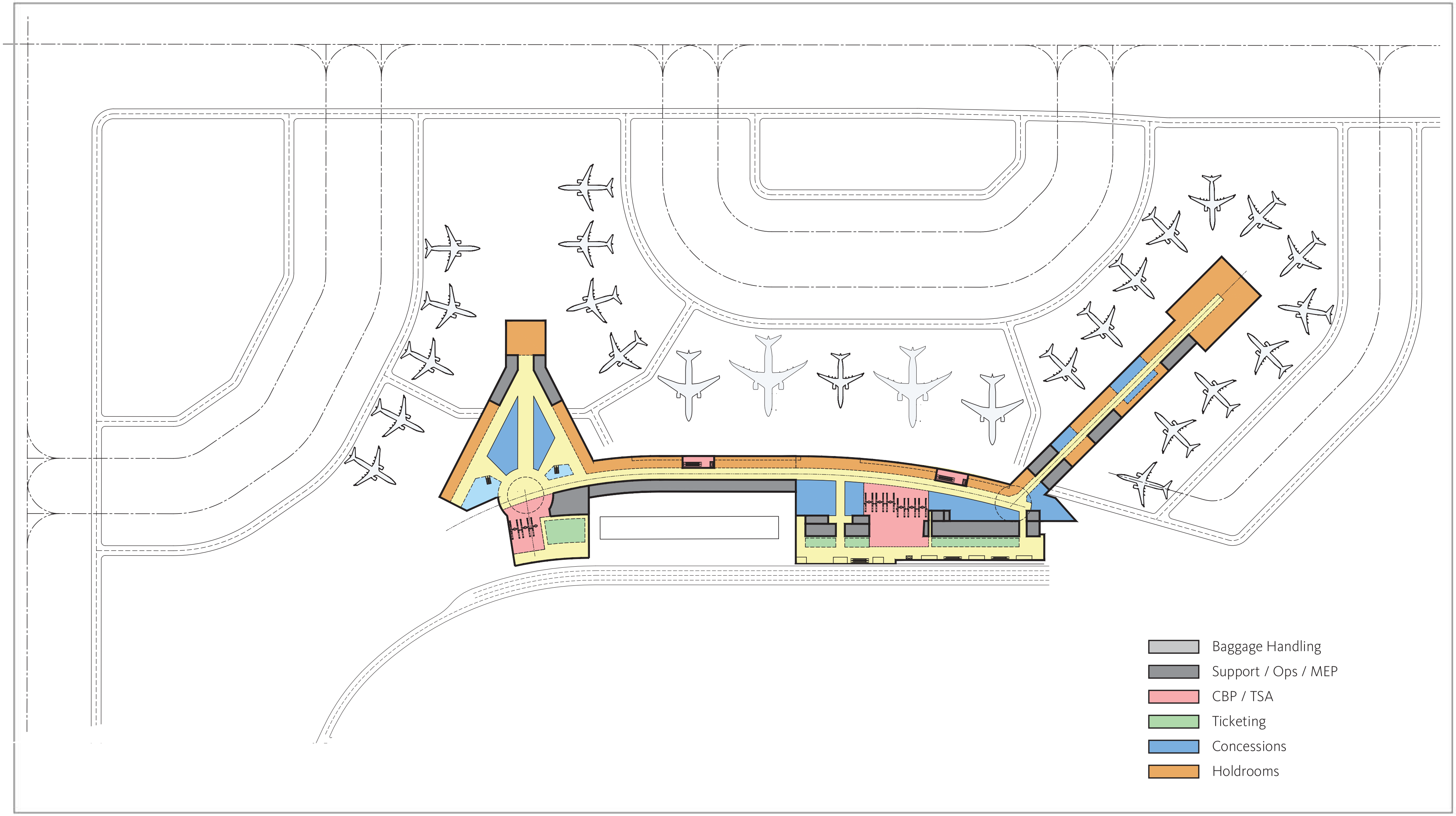
Consolidated Terminal
2027 - Overview
Functional Stack



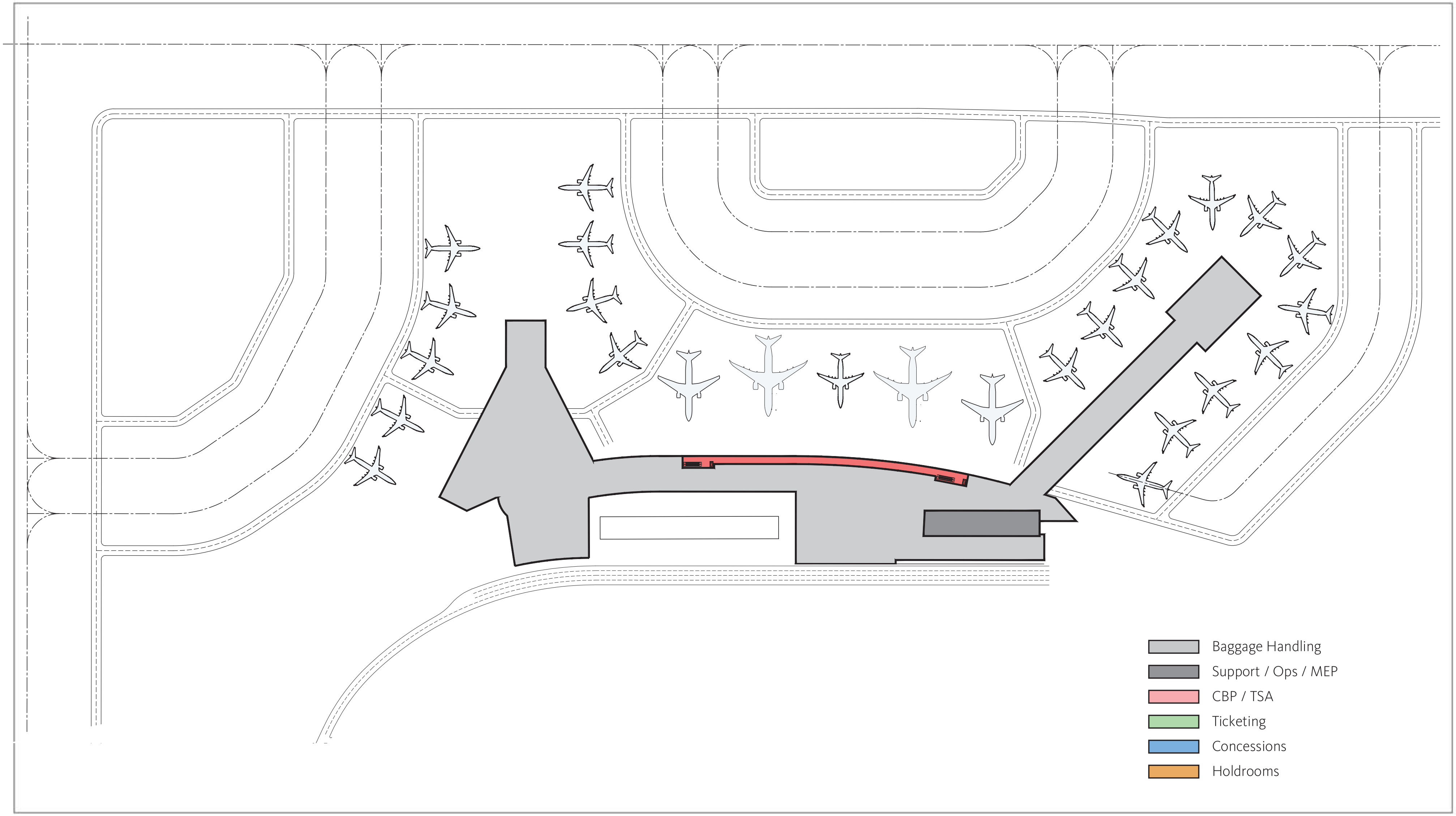
*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2027 - Overview
Arrivals Level



Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2027 - Overview
Departures Level



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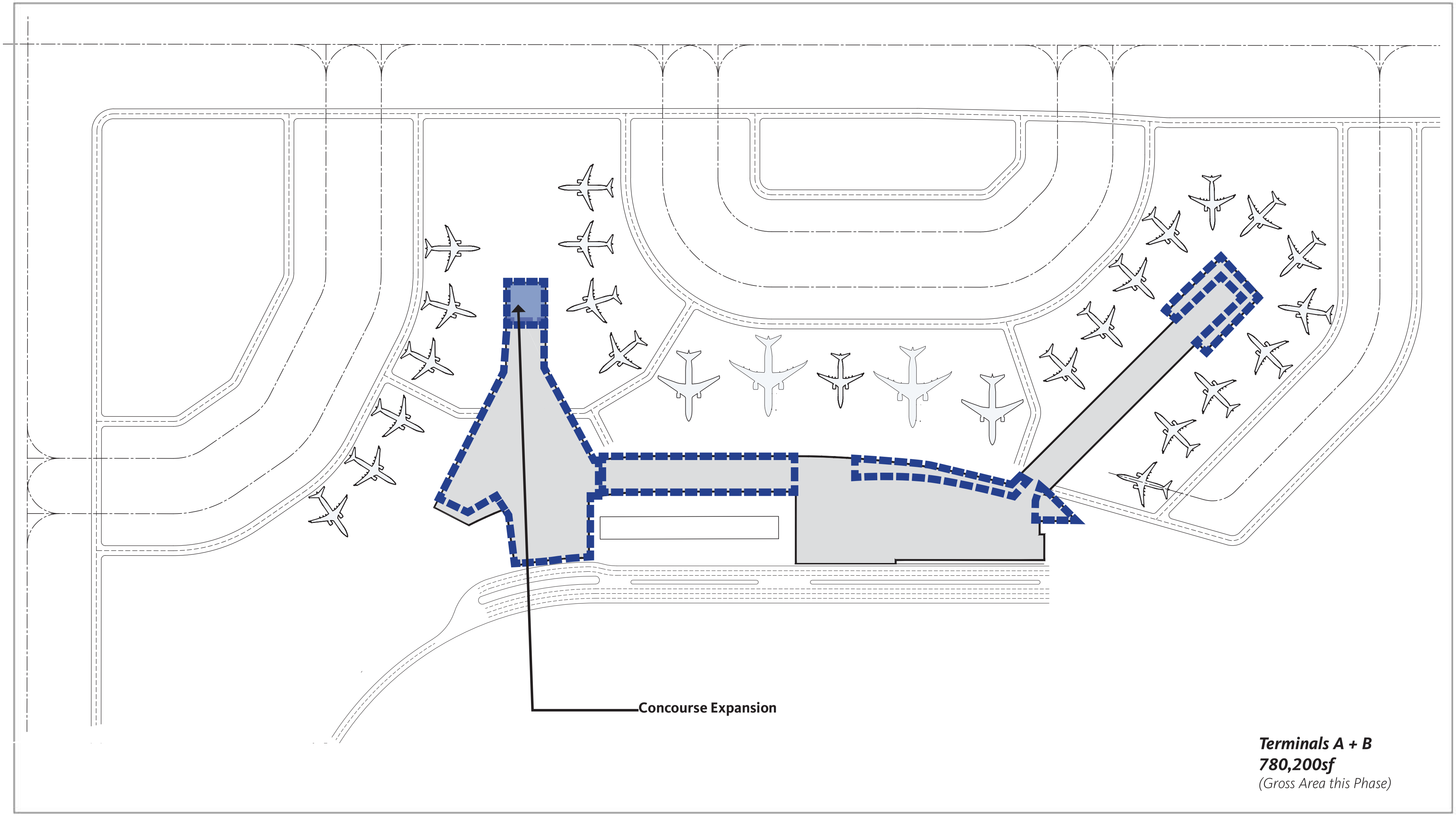
Consolidated Terminal
2027 - Overview
Mezzanine Level



**Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A*

Consolidated Terminal
2032 - New Construction

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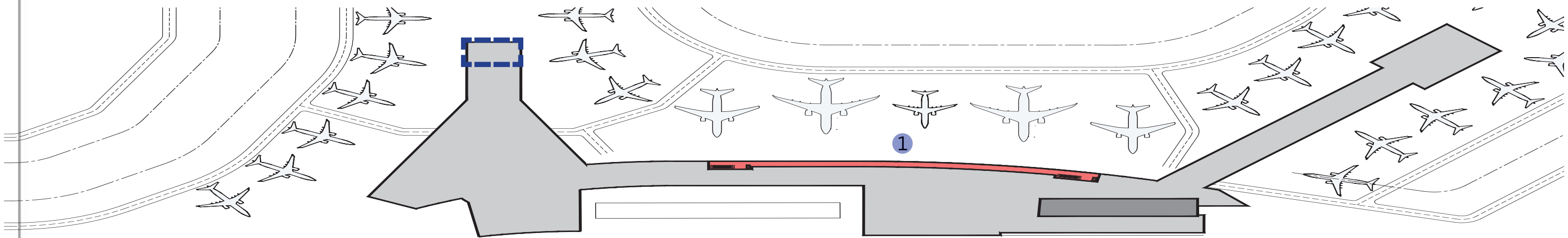
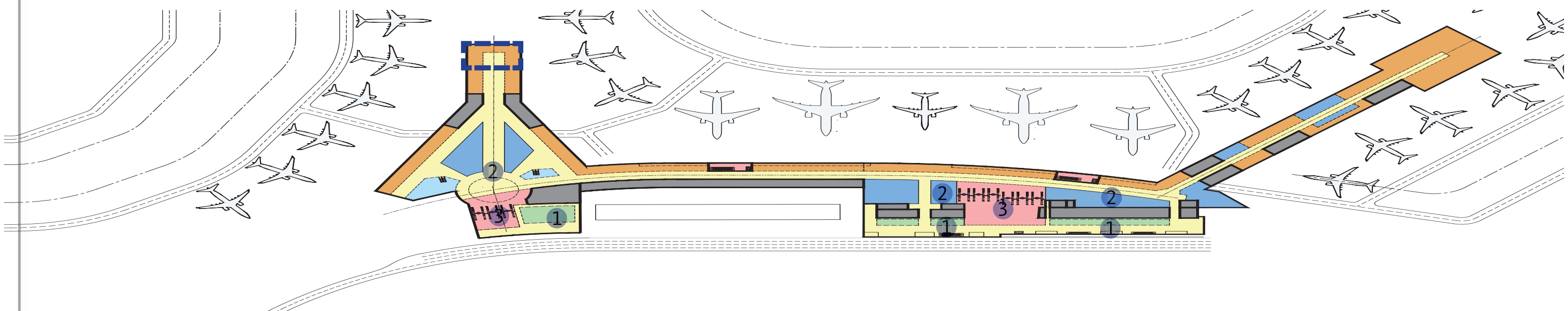
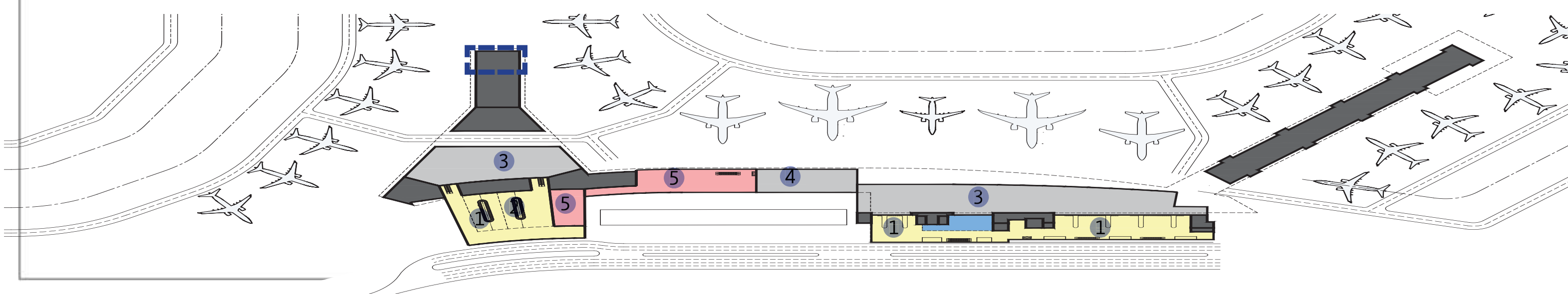


Mezzanine Level
1. Sterile Arrivals Corridor



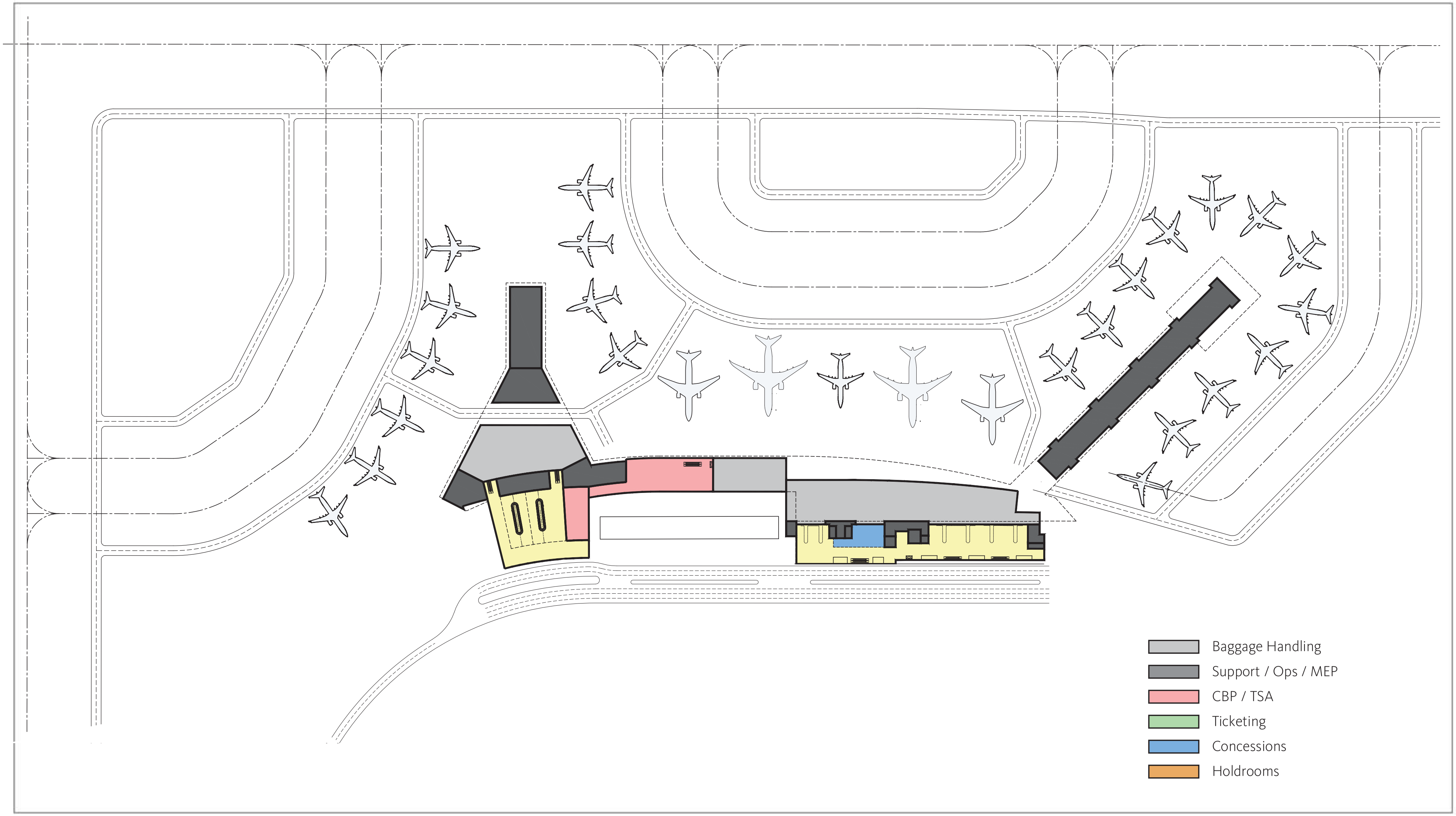
Departures Level
1. Check-In
2. Retail Nodes
3. Security Checkpoints



Arrivals Level
1. Bag Claim
2. International Claim
3. Bag Make-Up
4. Bag Screening
5. FIS

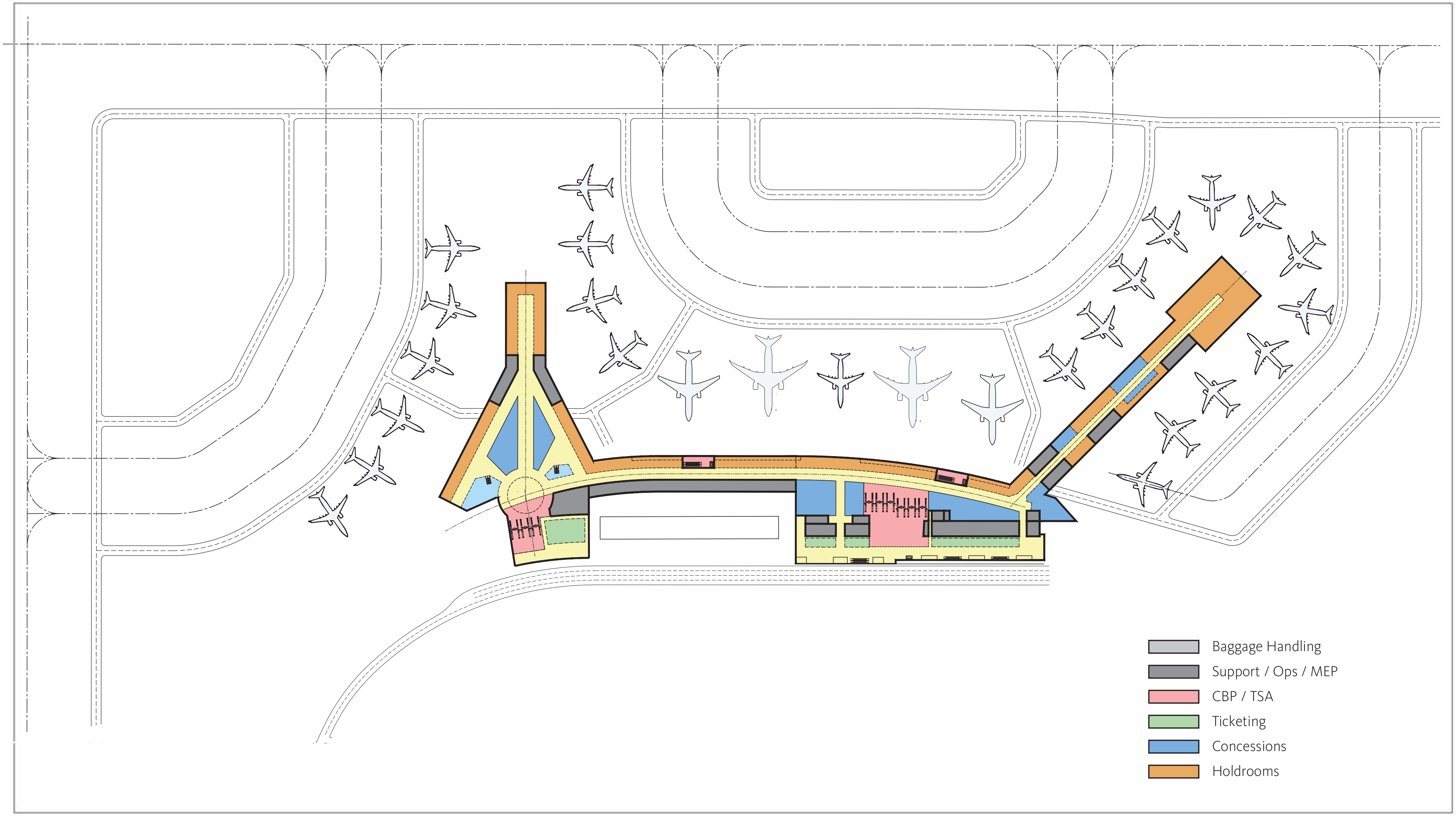
**Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A*

Consolidated Terminal
2032 - Overview
Functional Stack



*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2032 - Overview
Arrivals Level



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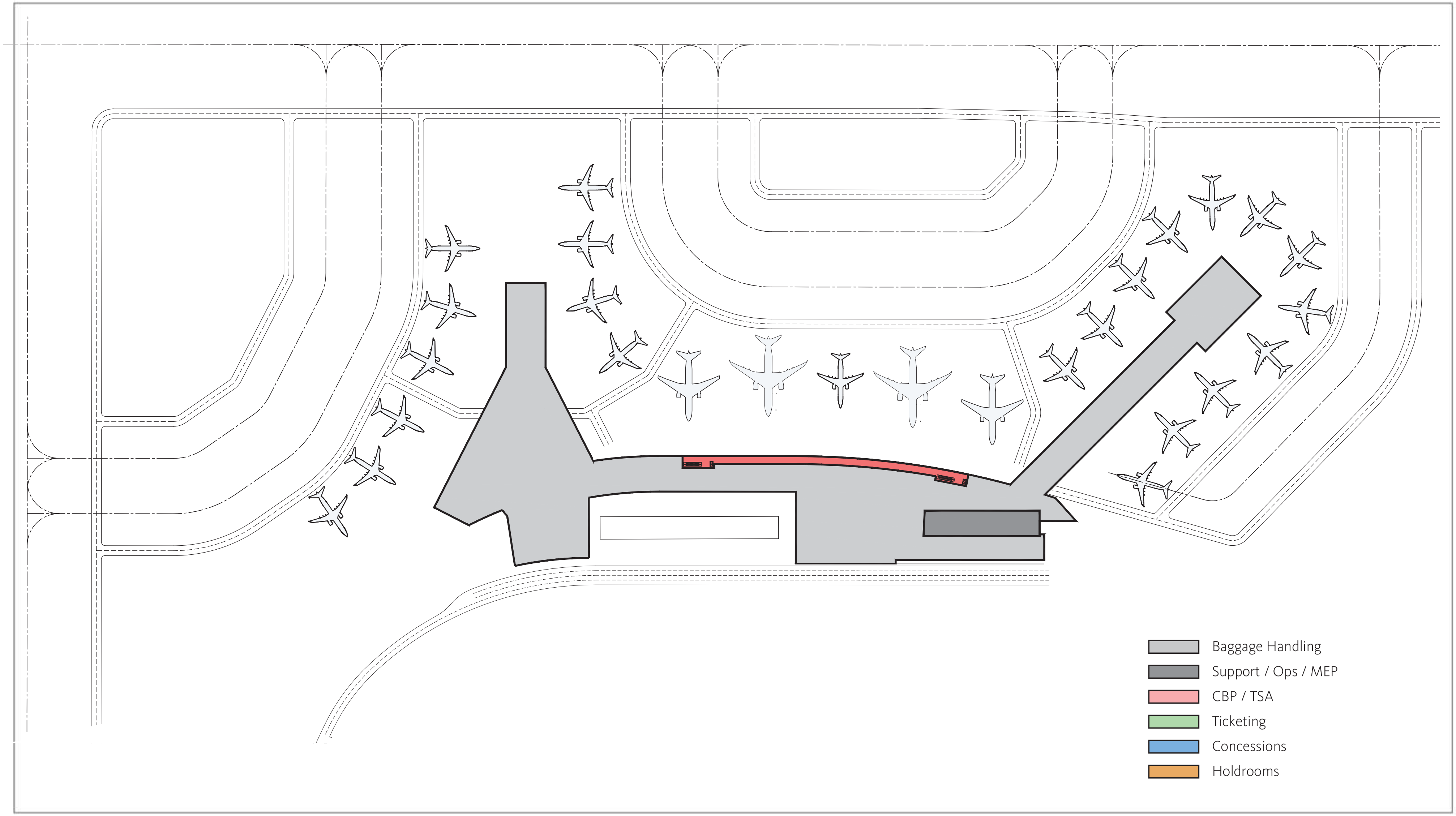
Consolidated Terminal
2032 - Overview
Departures Level



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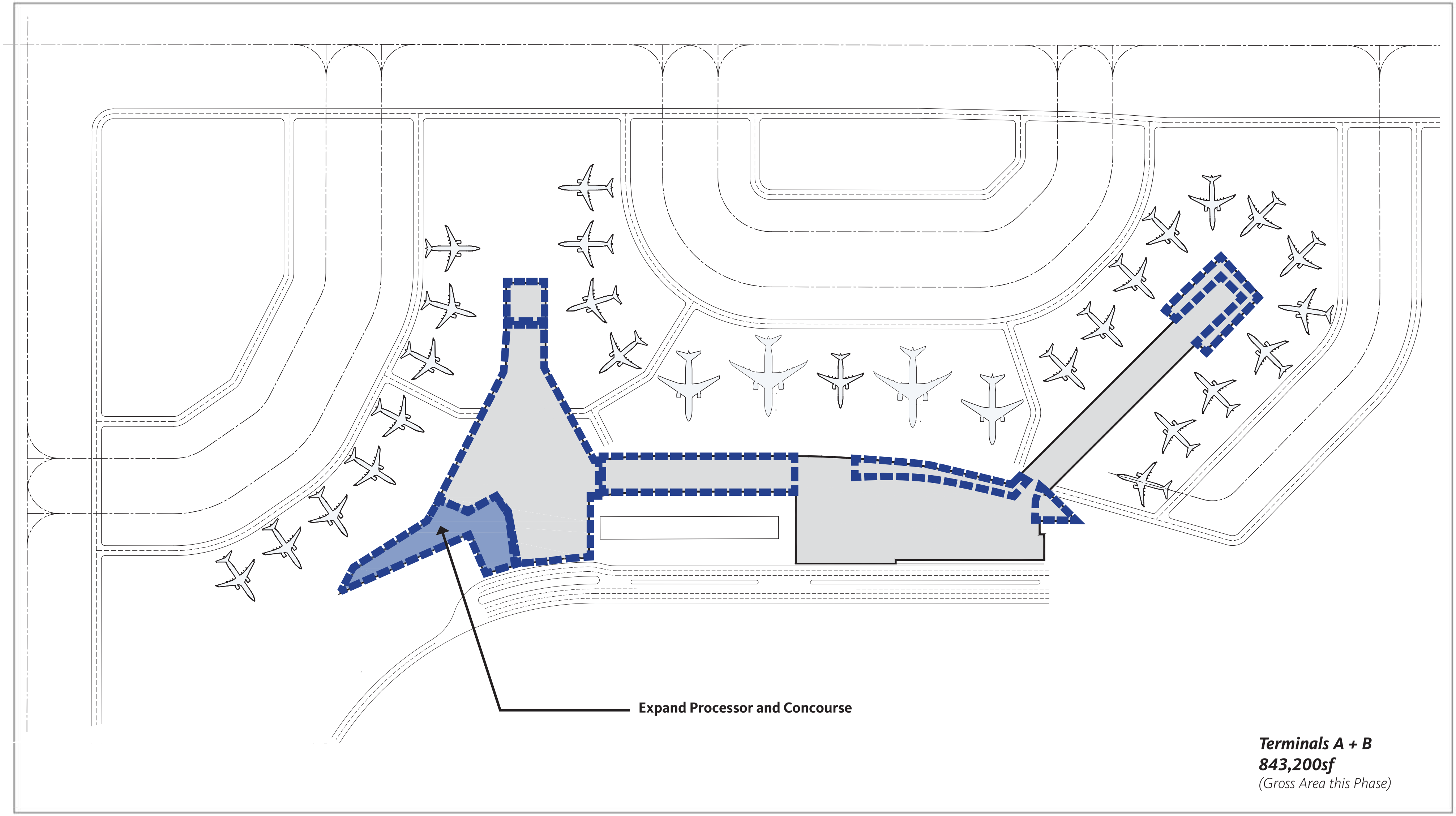
**Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A*

Consolidated Terminal
2032 - Overview
Mezzanine Level



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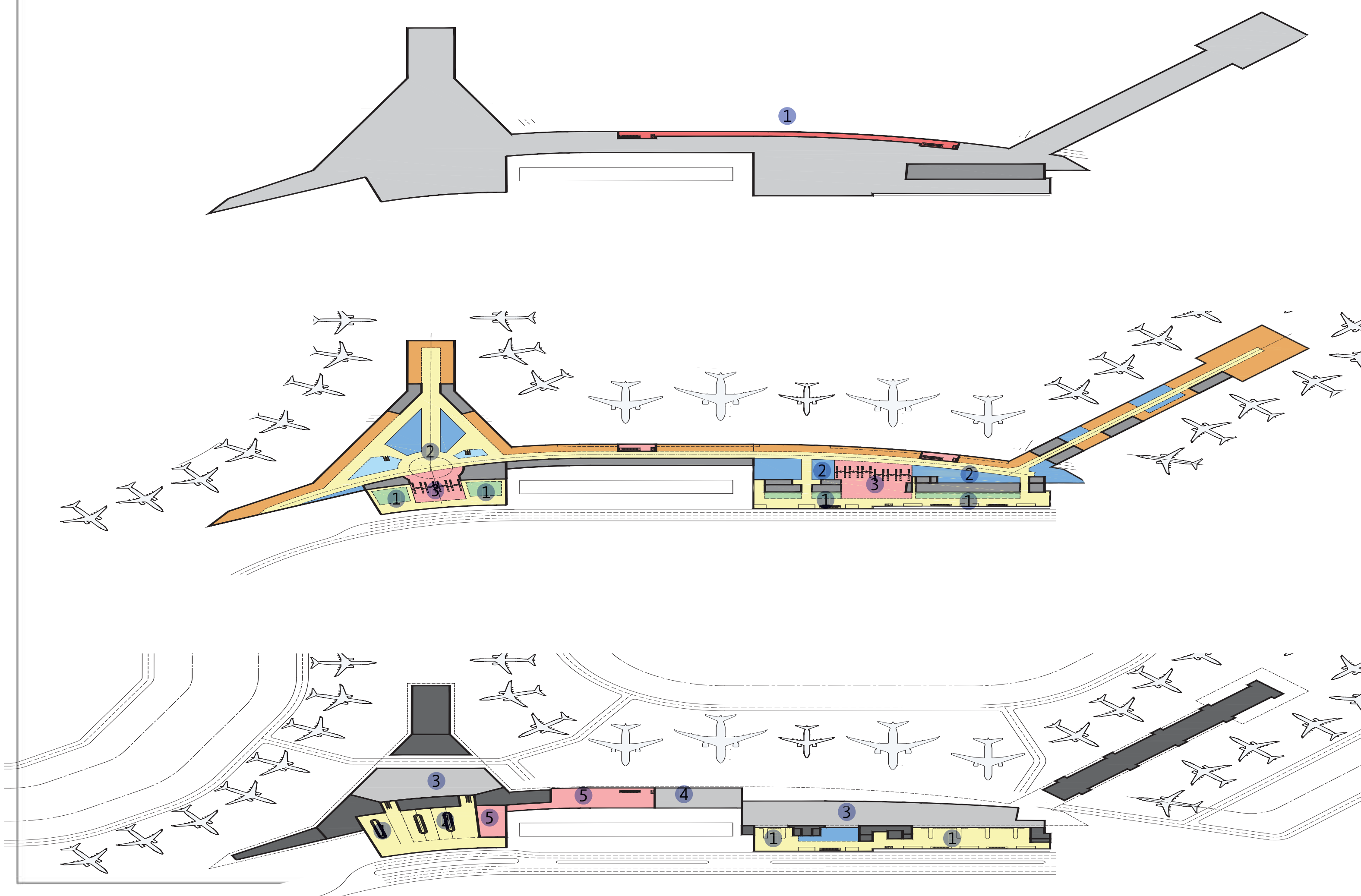
**Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A*

Consolidated Terminal
2037 - New Construction



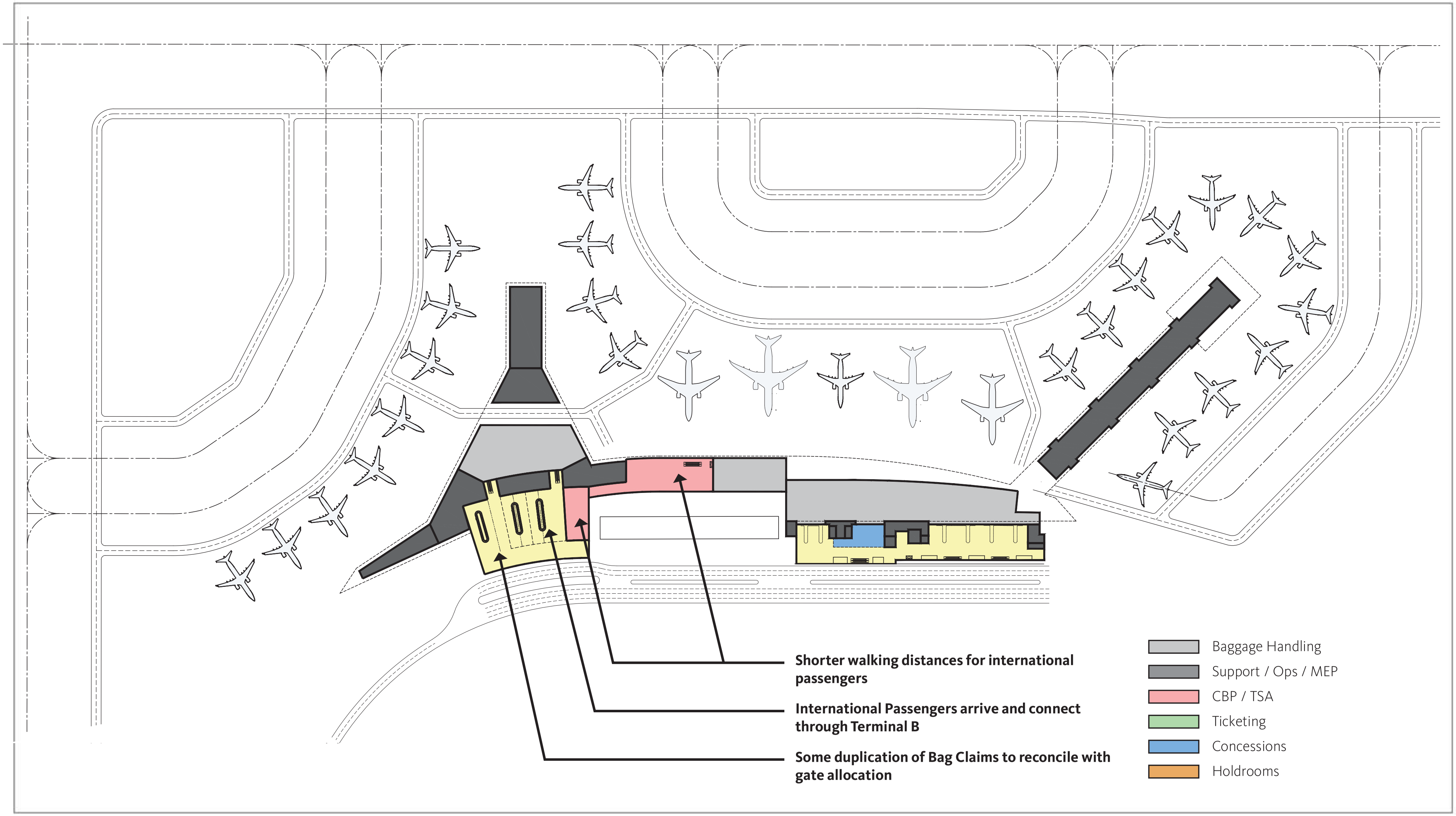
Mezzanine Level
1. Sterile Arrivals Corridor

Departures Level
1. Check-In
2. Retail Nodes
3. Security Checkpoints

Arrivals Level
1. Bag Claim
2. International Claim
3. Bag Make-Up
4. Bag Screening
5. FIS

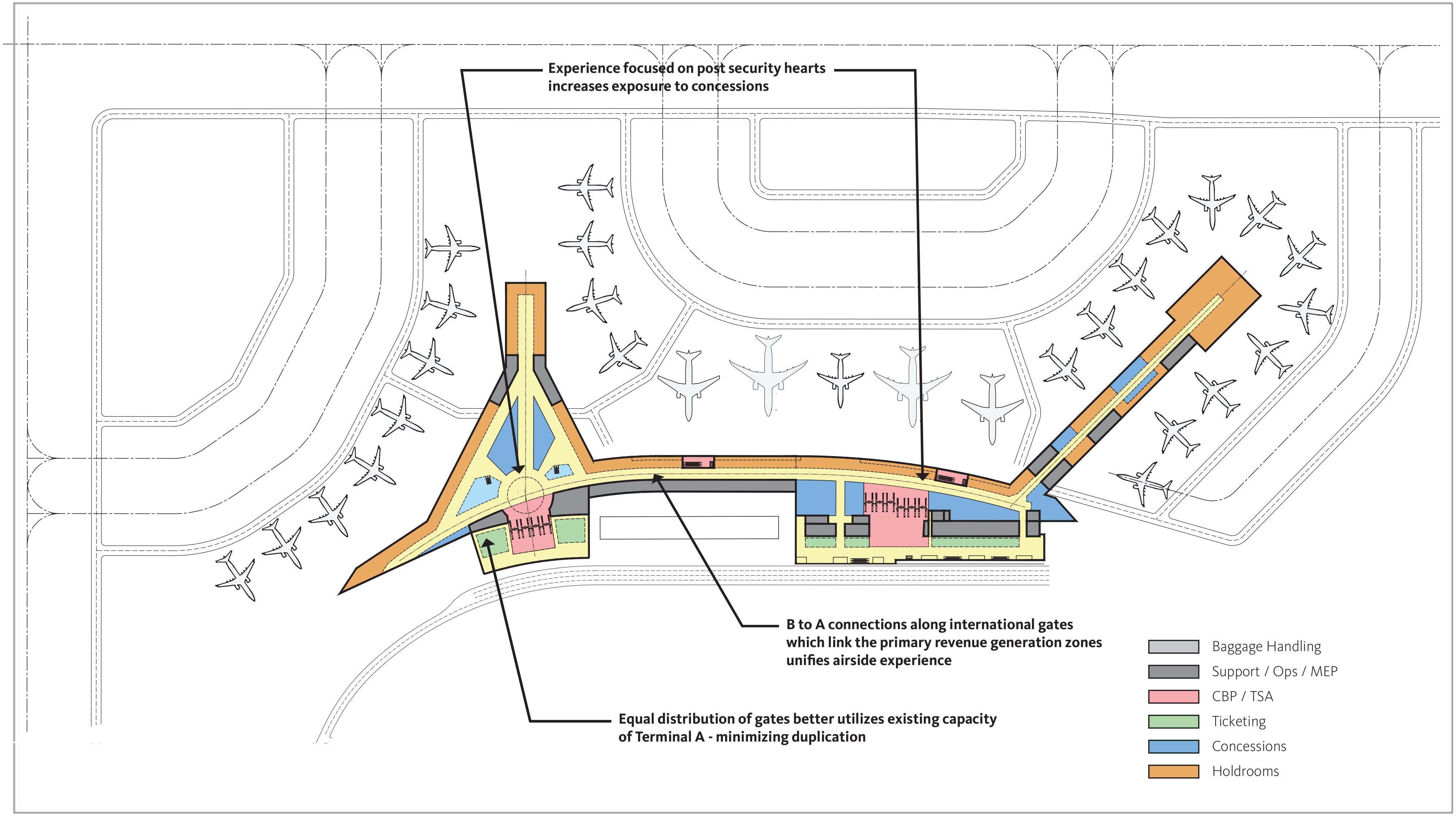
*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2037 - Overview
Functional Stack



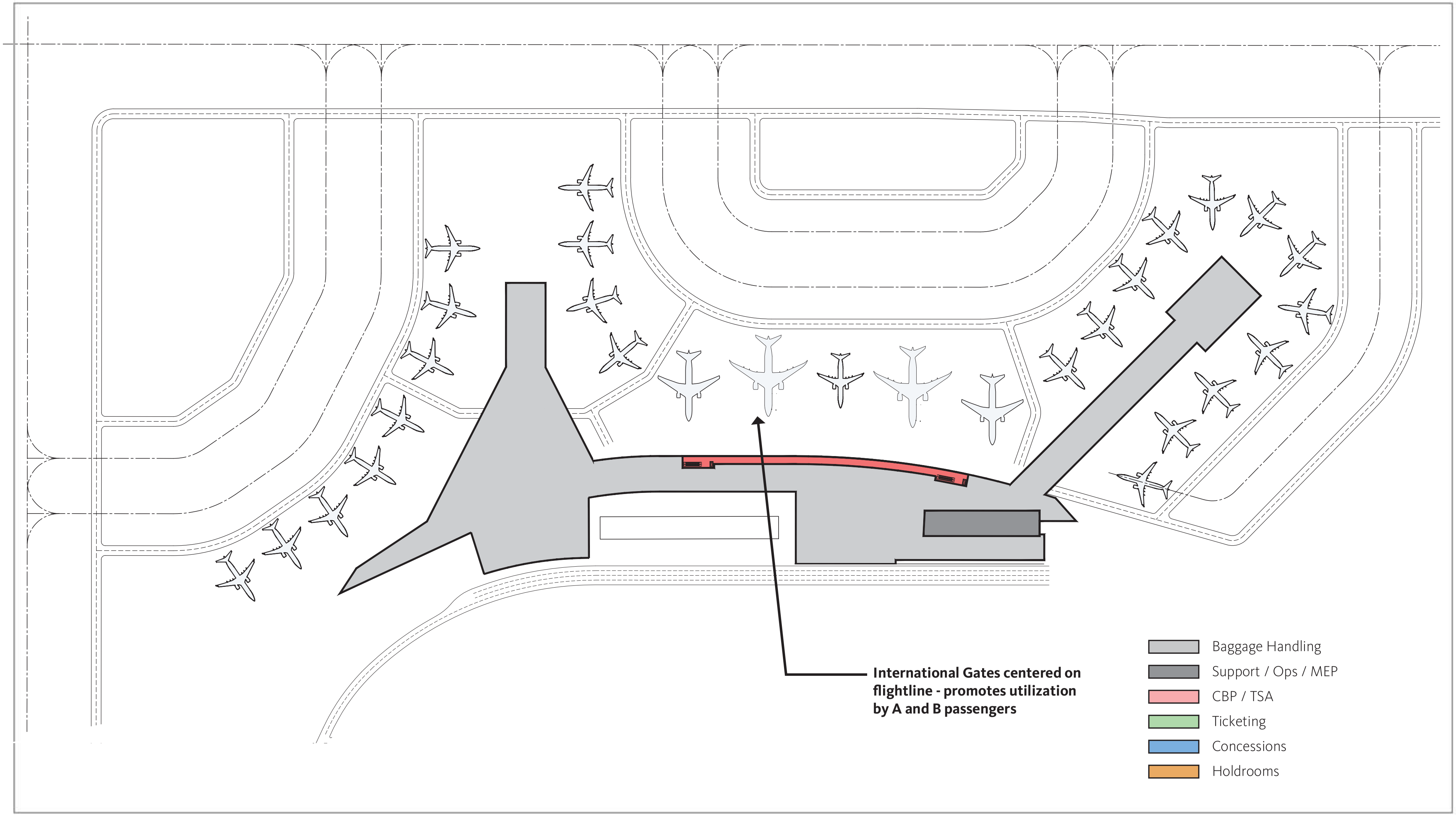
*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2037 - Overview
Arrivals Level



*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2037 - Overview
Departures Level



*Illustrated with optional early build-out of post security retail and central security checkpoint in Terminal A

Consolidated Terminal
2037 - Overview
Mezzanine Level

APPENDIX H

LAND USE

HIGHEST & BEST USE ANALYSIS

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H. HIGHEST AND BEST USE ANALYSIS

Part of overall master planning efforts at Bradley International Airport (BDL) included a market analysis outlining potential demand for new industrial, office, retail, and hotel development on non-aeronautical Airport-owned land. This appendix outlines the implications of the highest and best use analysis on each of the potential non-aeronautical development areas identified over the course of the master planning exercise.

H.1 SUMMARY OF FINDINGS

There is a significant quantity of for-sale land available elsewhere. Within close proximity to BDL, there are 13 properties for sale. These comprise over 370 acres of development opportunities ranging from 1.5 acres to 129 acres. Irrespective of market support for specific land uses, or the unique aspects of each of the Airport's development sites, these available properties will compete directly with any attempts by the Airport to successfully attract development to Airport property on Schoephoester Road, Ella Grasso Turnpike, or the North Side Development Area.

In addition, developers are more likely to engage with private landowners in a sale as opposed to a ground lease with the Airport. First, a leasehold interest in land does not afford the same level of site control as a fee simple, ownership interest. Second, responding to a public procurement, followed by negotiating a ground lease with a public entity, requires developers to commit significant resource up-front and introduces a great level of complexity. Purchasing land from a private party is already a risky, complex process; introducing both a ground lease and a public procurement further complicates the process and adds additional risk.

Should the Airport issues RFP(s) for these development areas to prospective developers, it may not receive responses due to these factors. If the Airport does receive responses, the financial offers from developers may be below market (that is, less than what a private landowner may receive) as the developer accounts for the added risk of a publicly procured ground lease.

Competition for nearby available land impacts all development areas. Specific considerations for each development area follow.

H.1.1 Schoephoester Road

Figure H-1 – Schoephoester Road Sites

The connectivity to the area and the region afforded by Schoephoester Road is a benefit to many land uses. Proximity to Ella Grasso Turnpike and Connecticut Route 20 may support new warehouse and distribution facilities, as trucking routes are key to these industries. In addition, land uses that depend on heavy vehicle traffic, such as shopping malls and retail gas stations, may also benefit from the connectivity afforded by Schoephoester Road.

These properties also benefit from numerous large-scale and auto-oriented uses, including multiple Airport-operated and private parking lots, car rental facilities, a Bobby V's Restaurant and Sports Bar. The site is also adjacent to the large UTC Aerospace Systems factory. The volume of auto-oriented uses surrounding the site, as well as the presence of a major manufacturing facility, may drive demand for industrial, office, and retail uses.

However, while Schoephoester Road is a busy road corridor handling between 10,900 and 12,800 vehicles per day, it does not serve nearly as much traffic as Ella Grasso Turnpike, which handles between handles between 15,500 and 17,800 vehicles per day. For this reason, land uses which depend on significant traffic volume may be better suited to properties on Ella Grasso Turnpike.

With regard to the broader market for specific land uses, the industrial real estate market is improving, though at this moment may still present limited opportunities for new construction. The office market is unlikely to support new construction, as rental rates are too low and there is a significant amount of space available. There may be market demand for freestanding retail, but less so for shopping malls. Retail gas at Schoephoester Road properties may find customers from nearby rental car facilities and employers, but traffic volume may not be sufficient. Finally, hotel development may be supportable in these areas, though success will most likely be driven by proximity – if not a physical connection – to the BDL terminal.

H.1.2 Ella Grasso Turnpike

These properties benefit from greater direct access to a major thoroughfare than property along near Schoephoester Road, which also facilitates access to other major roadways, including Connecticut Route 20. This may drive demand for a broad range of uses, particularly retail and industrial, which rely on high traffic and highway-accessible locations. As noted, Ella Grasso Turnpike handles between handles between 15,500 and 17,800 vehicles per day, which may provide stronger support for retail gas stations, for example, compared to properties near Schoephoester Road.

Figure H-2 – Ella Grasso Sites

However, in contrast to Schoephoester Road properties, these properties do not benefit from direct adjacency to major activity centers, such as UTC Aerospace Systems, which may impact demand.

With regard to the broader market for specific land uses, these properties face the same challenges as those near Schoephoester Road. Industrial has the greatest, though still limited, potential. There is likely marginal support for new office construction. Freestanding retail may have some market support, though shopping malls do not. Finally, the distance of these properties from the BDL terminal precludes the opportunity for new hotel development.

H.1.3 North Side Development Properties

The North Side Development Area will face the same market challenges as other Airport-owned properties. Industrial has the greatest, though still limited, potential. There is likely marginal support for new office construction. Freestanding retail may have some market support, though shopping malls do not. Finally, the remote nature of the North Side Development Area precludes the opportunity for new hotel development, which in this market will benefit greatly from terminal adjacency (particularly a physical connection).

Figure H-3 – North Side Site

The North Side Development Area faces an additional challenge: with no major thoroughfares coming through the site, there is little that would support land uses requiring high traffic volume – namely retail gas. This lack of roadway connectivity will also limit the potential for industrial development. Both of these land uses will require investment into roadways serving the site – either by the Airport or other public agencies serving this area of Connecticut–or by developers themselves. The added cost and complexity of new roadway construction will further increase the difficulty of attracting development to this area.

H.1.4 Summary

Based upon the detailed evaluation below of current (2017) market conditions, the development potential or demand for nonaeronautical development of airport property is relatively low. **Table 1** provides a summary of the development potential and land use of locations reviewed.

Table H-1 – Highest and Best Use Analysis

Development Area	Development Potential	Most Likely Development
Schoephoester Road	Low-Moderate	Industrial, Highway Retail
Ella Grasso Turnpike	Moderate	Highway Retail/Gas Station, Industrial
North Development Area	Low	Industrial uses

H.2 METHODOLOGY

Assessing the "highest and best use" for a site is an exercise in assessing the potential for new real estate development. The highest and best use is that use (residential, office, retail, industrial, parking, and/or others) a development site can physically accommodate, local regulations allow, and for which there is market support. Specifically, the exercise consists of the following components:

Site Assessment – This is an analysis of factors that impact a site's physical development potential, connectivity, adjacent uses, site configuration, potential environmental issues, and others. The depth of analysis relies on the information available: for example, if no environmental studies or analysis are available, this type of information cannot be factored in. There may also be legal and regulatory issues that impact the development potential of a site. Zoning regulations, which dictate use and density, can quickly rule out potential uses. However, a jurisdiction's zoning appeals, and variance procedures may still allow for a use under special or conditional rules, and therefore not outright exclude certain uses. For BDL, that development sites may be in more than one jurisdiction can be a potential factor and complicate the zoning and approvals process. The legal review also includes a review of easements and encumbrances (this information is typically found in site surveys and plats, which may or may not be readily available).

Market Analysis – Analyzing the market consists of two steps: 1) assessing key demographics and economic indicators as applicable (e.g. employment statistics, household incomes, etc.), and 2) assessing real estate market fundamentals that indicate how a project may perform (rent, absorption, vacancy, etc.). Assessing real estate fundamentals is itself a two-step process: 1) identifying competitive supply, focusing on trends in new construction and delivery and identify any projects which are proposed, planned, or under construction that may compete with any potential new development, and 2) quantifying demand by assessing trends in asking rent, leasing activity, absorption, and vacancy. Market analysis is not necessarily site-specific; rather, the analysis addresses market-wide trends for each potential use that may impact development opportunities at any location in the market area (assuming physical development potential and legal considerations addressed above support a use).

Identifying the highest and best use first requires that the conclusions drawn from these components support the use without exception. Then, if multiple uses find support, the use or uses for which market support is the strongest becomes the highest and best use and may be considered for development and marketing of a site.

H.3 SPECULATIVE VERSUS BUILD-TO-SUIT

New development can take on two primary forms: “speculative” development and “build-to-suit” development. While there may not be market support for speculative development, there may still be opportunities to strategically target specific users for one-off development opportunities. The market assessment herein explores potential opportunities for both types of development.

A speculative development project is one where a developer finances, builds, and owns a multi-tenant property with only some or no tenants committed to signing leases prior to securing financing and/or groundbreaking. In robust markets where there are low/decreasing vacancy rates and high/increasing rental rates, speculative development may result. That is, if market trends indicate growing demand, developers and their financing partners may be willing to take on leasing risk (that is, financing and constructing a property while still missing tenants) in exchange for delivering a property more quickly and ahead of their competitors. This approach places these developers in a more advantageous position to capture market demand, ahead of their competitors who may not develop their properties as quickly. Developers may still pre-lease a project to some extent as a condition of securing financing and/or to reduce the overall risk of a project, but with strong enough market support, the project may commence without much of the available space committed. As a result, landowners may find themselves selling land to developers seeking to build new projects with some or no pre-leasing.

A build-to-suit development project is one where a user seeks to occupy a newly constructed building and hires one or more third parties to design, finance, build, operate, and/or maintain the building on their behalf. The user may finance and own the asset themselves or work with the third party who will own the asset and to whom the user will pay rent. In less robust real estate markets where there are high/increasing vacancy rates and low/decreasing rental rates, speculative development may be too risky. However, there still may demand from potential users seeking new construction for their sole use. These users may seek out developers who will manage a build-to-suit project on their behalf. Landowners may find themselves selling land directly to users, or their developers, seeking opportunities to build new facilities for their use. Industries which are growing in a region may signal potential build-to-suit opportunities as companies seek to relocate or to grow, even if the real estate market itself is relatively lukewarm.

For example, Company A wishes to build a new office building for a call center. Company A can use its own capital to fund the construction of the new project and hire third-party expertise design, build, operate, and/or maintain the building. As Company A funded the project with its own equity and/or debt, ultimately Company A would be the owner of the building. Alternatively, Company A hires a developer that not only performs the aforementioned tasks but also secures financing using a combination of the developer's own equity, third-party equity, and third-party debt financing. In this case, Company A does not own the building because it did not use its own capital. The developer and/or its partners own the property, and Company A pays the ownership group rent as a tenant in the building. In both cases, Company A has engaged in a build-to-suit project and has received a building for its use that meets its specifications, and in which Company A is the only (or the primary) tenant.

Therefore, while there may not be market support for speculative development, there may still be opportunities to strategically target specific users for one-off development opportunities.

Note that the concept of speculative versus build-to-suit development is not binary. Many projects can have elements of both depending on the associated leasing risk. For example, many new speculative office developments will not secure financing and/or break ground until the developer secures a major "anchor" tenant or least has some space pre-leased to one or more tenants. Many condominium developers, similarly, cannot secure financing until a certain number of condos in a proposed project are pre-sold. In particular, the concept breaks down somewhat with retail and hotels. New retail development typically does not occur without significant pre-leasing. Developers may seek site control and to resolve title and entitlement issues ahead of securing tenants, but many are unlikely to secure financing and/or break ground until all major tenants and some, if not all, smaller tenants have executed formal letters of intent to occupy space in the new project.

By contrast, for hotels, as the "users" of the hotel are its nightly occupants and group/conference bookings, the concept or pre-leasing or building for a, single tenant is irrelevant. In this sense, all hotels are "speculative," as they are wholly subject to market demand.

Ultimately, the success of any new development project is tied to a developer's ability to secure tenants. The market analysis herein addresses the potential for tenancy and users for various land use types, and the impact this may have on the requisite potential of speculative or build-to-suit development.

H.4 MARKET ANALYSIS

H.4.1 Economic Trends

There are 24,700 employees within a 20-minute drive of the Airport. Unemployment in Hartford County has fallen dramatically in recent months with an estimated unemployment rate of 4.7% in October 2016. Total employment in Hartford County increased by one percent year-over-year from October 2015, adding 5,500 jobs.

Figure H-4 – Area Employment by Industry, 2008 and 2014

Source: UC Census Longitudinal Employer-Household Dynamics OnTheMap (note: only includes data through 2014 for smaller geographies).

The primary employment sectors are manufacturing (25.4% of area jobs), transportation and warehousing (11.9%), and administration & support (9.7%) industries. These industries drive development for industrial uses. However, all three of these industry sectors have experienced a decline between 2008 and 2014. Therefore, there may not be sufficient growth to justify new, speculative industrial development (for further discussion, see Industrial below).

By contrast, Finance & Insurance, Health Care & Social Assistance, and Public Administration increased in this same period. Finance & Insurance employment has more than doubled. These industry sectors drive may drive demand for new office development regionally.

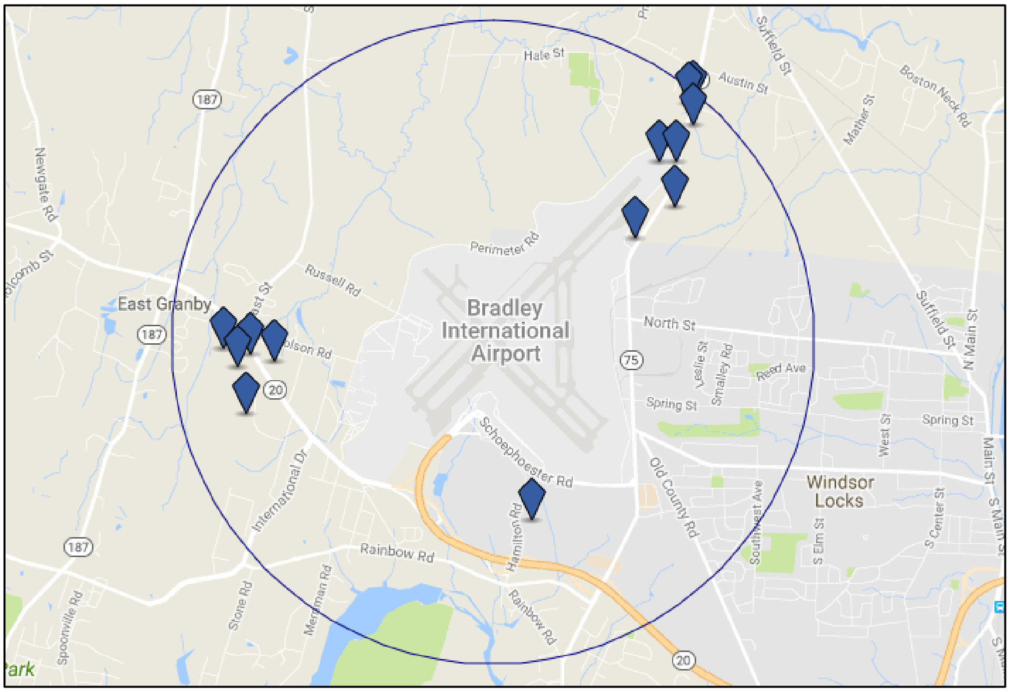
Retail Trade as an industry sector has remained stable; however, demand for retail development is not employment-driven, so much as it is driven directly by consumer demand for retail goods and services (addressed below).

H.4.2 Available Land

Prior to exploring each land use, it is important to understand the competitive landscape. Indeed, there is considerable for-sale land available for commercial development that will compete with Airport properties. Within a 2-mile radius, there are 13 properties for sale. These comprise over 370 acres of development opportunities ranging from 1.5 acres to 129 acres.

In addition, engaging with private landowners in a sale is a shorter and less complex process than procuring for a ground lessor of airport land.

Therefore, attracting development to Airport-owned land will face sizable competition from nearby, private landowners. Regardless of market demand for a land use, all development opportunities for Airport-owned land will face the same challenge from land available elsewhere in the market.



H.4.3 Economic Incentives

The area surrounding the Airport is located within the Bradley Airport Development Zone ("BADZ"), which provides tax incentives to specific types of businesses. A State-legislated program, the BADZ extends enterprise zone tax incentives – namely, property tax abatements and corporate business tax credits – to any business that "acquires or leases an idle facility or constructs, substantially renovates, or expands the facility and uses it for specified purposes."[1]

The specified purposes include:

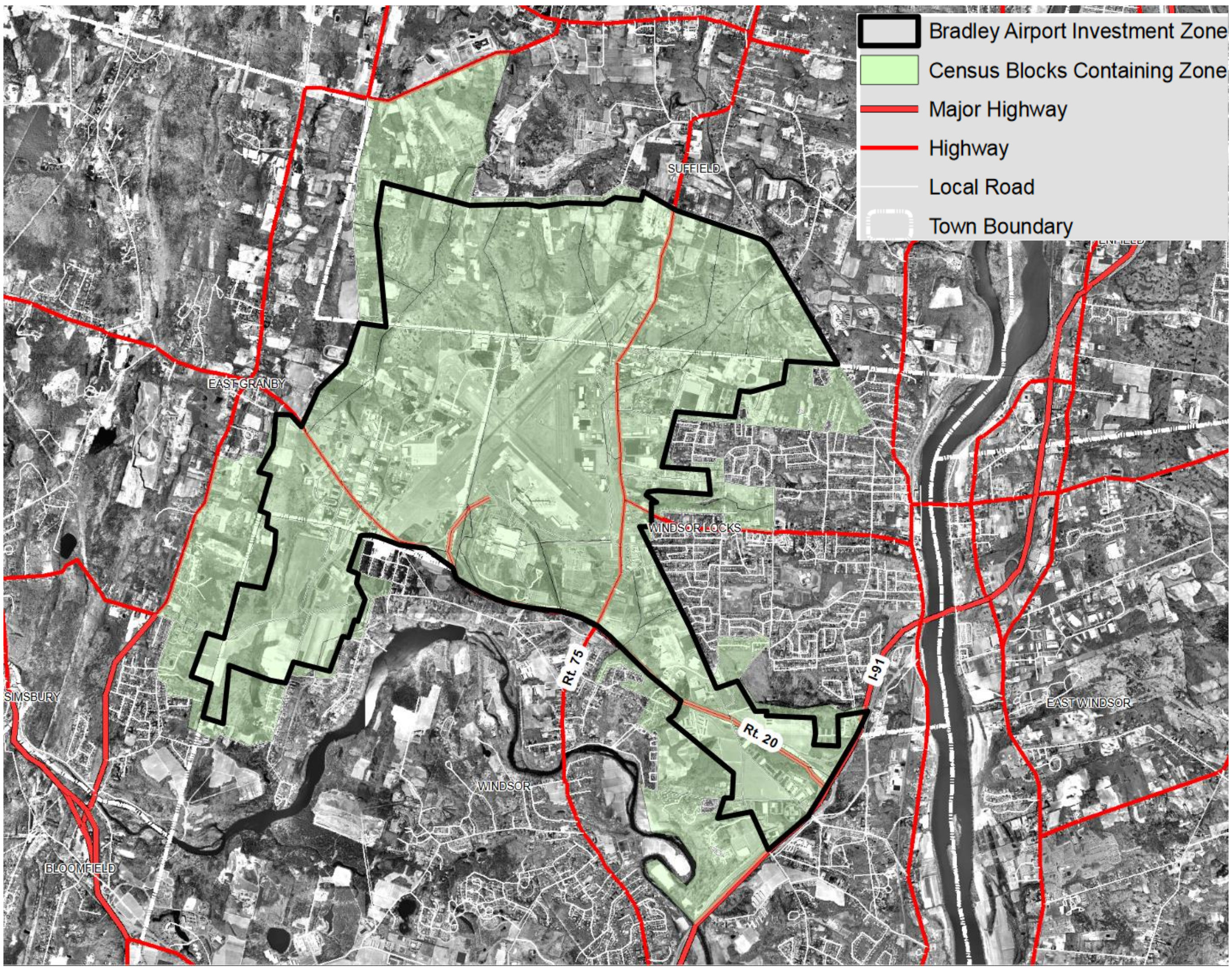
1. Manufacturing, processing, or assembling raw materials, parts, or manufactured products.
2. Performing research and development directly related to manufacturing.
3. Significantly servicing, overhauling or rebuilding machinery and equipment for industrial uses
4. Warehousing and motor freight distribution uses qualify for the incentives, but only if the business handles goods that are transported by aircraft to or from Bradley.
5. Business services, including information technology, also may qualify for incentives if, in the opinion of the Commissioner of the Department of Economic and Community Development (DECD), the applicant's business depends upon or relates directly to the airport.

[1] Source: State of Connecticut Department of Economic and Community Development

The existence of this program may work to attract new development to properties within the designated zone for one or more of specified purposes listed (for example, the tax incentives cannot be used for retail gas stations). The program is available to any business seeking to locate within the BADZ, with the exception of the airport property. Therefore, these incentives may somewhat reduce the market positioning of Airport-owned properties, relative to competing opportunities within the Zone.

The exclusion of airport-owned property was a change in the program as per the *2016 Supplement to the General Statutes of Connecticut, Title 32, Chapter 585, Sec. 82-75d, whereas,* airport development zones established do not include the actual airport property.

Bradley Airport Development Zone



Source: Capitol Region Council of Governments

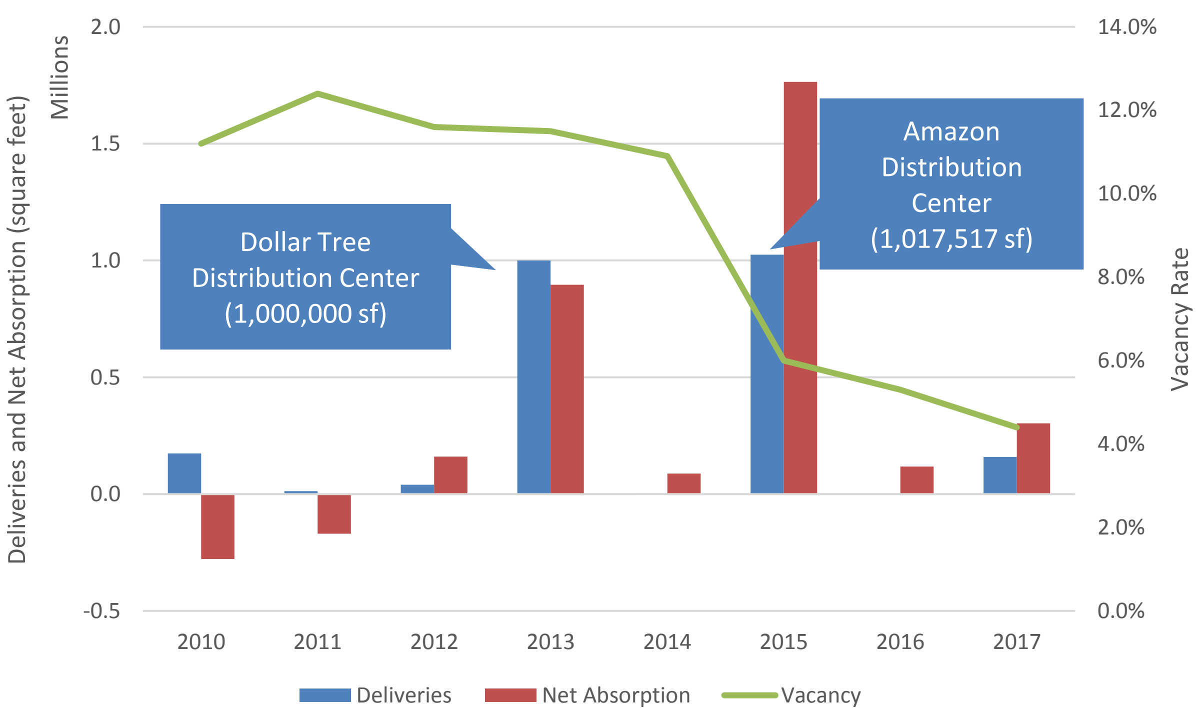
H.4.4 Industrial

The industrial real estate market has historically little speculative development, with build-to-suit projects primarily adding to the total inventory. The most notable of these projects have been new distribution centers for Dollar Tree (1 million square feet in 2013) and Amazon (over 1 million square feet in 2015). Otherwise, new construction activity has been low, indicating that developers are not delivering new industrial properties on a speculative basis at a great pace, instead of targeting ready opportunities to deliver new facilities for major users.

In addition, leasing (and therefore net absorption) peaked in 2013 and 2015. However, 2013 leasing activity was limited to the new Dollar Tree, and 2015 activity was largely made up of Amazon's project. Though there was additional positive leasing activity in 2015 above and beyond Amazon's new headquarters, net absorption has been relatively low – and some years, negative – indicating that overall demand for industrial users in the market is similarly low.

However, 2017 did see the first introduction of a new, speculative industrial property in the market for the first time since 2010: a developer delivered a 137,000 square-foot warehouse and distribution building at 330 Stone Road in Windsor, CT at the New England Tradeport. The property is approximately half-leased with 63,500 available, potentially indicating that the developer required at least a good portion of the property with a committed tenant prior to construction. However, this is the first project in many years, and therefore may not yet be indicative of a trend.

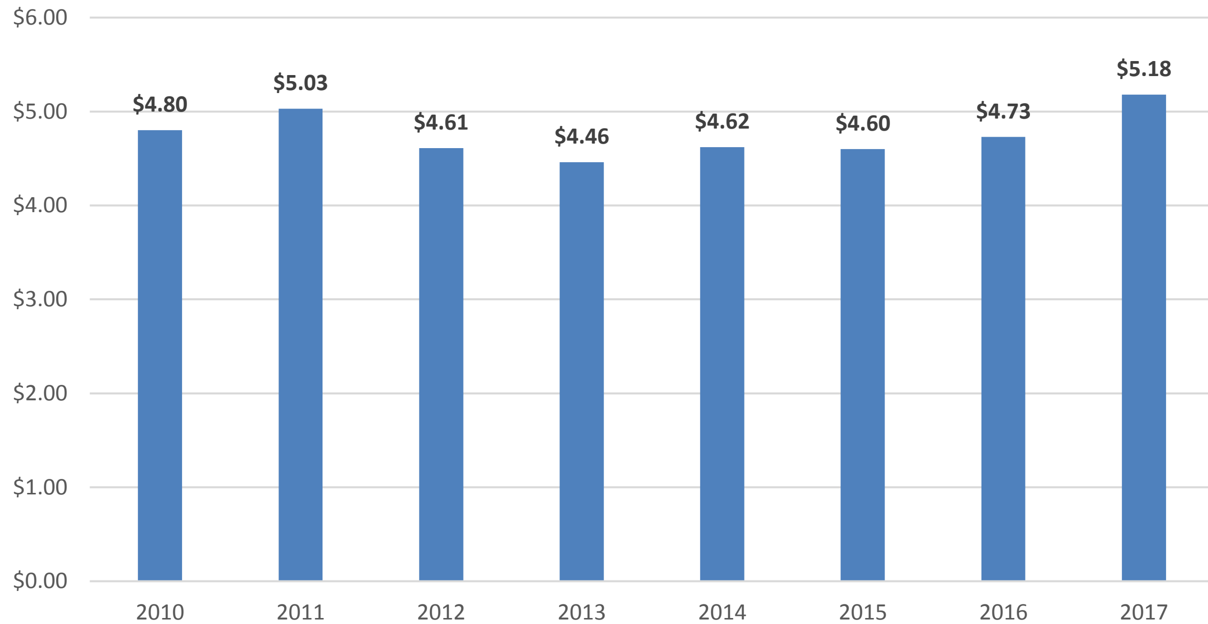
Figure H-5 – Industrial Real Estate Market Overview



Source: JLL, CoStar

This slow uptick in demand has had a similarly minor impact on asking rents. Rents in 2017 are the highest they have been since 2011, representing a 16.0% increase (an average of 3.8% per year) since rents dipped to their lowest in 2013. This may indicate that landlords are responding to some level of increasing demand – perhaps from the presence of Amazon and driven in part by significant leasing activity overall in 2015.

Figure H-6 – Industrial Average Asking Rent per SF (NNN)



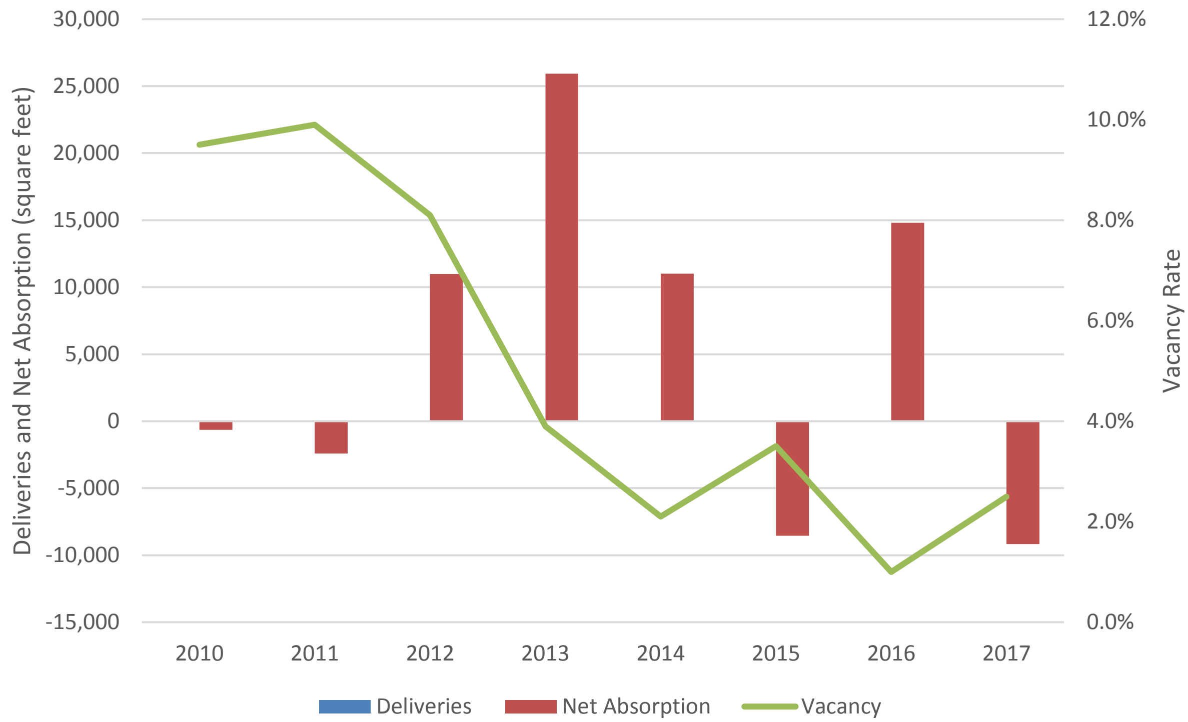
Source: JLL, CoStar

Going forward, rental rates may continue to increase, and this could indicate growing demand in the future, but in the near-term, speculative is still challenging. Recent development of the new property at the New England Trade port are encouraging but may not indicate a trend. Therefore, new construction may be limited to build-to-suit opportunities in the immediate future, though as rental rates continue this trajectory and leasing activity continues to grow, speculative opportunities may present themselves in the medium- and long-term.

H.4.5 Office

The office real estate market has seen no new construction, either for speculative or build-to-suit development. However, since 2012, and except for 2015, there has been consistent leasing activity and resulting positive net absorption and historically low vacancy for the market. By itself, this trend indicates growing demand from office tenants to locate into this market. However, the lack of new construction indicates that tenants are seeking – and finding – low-cost space in existing buildings. Therefore, while historically low vacancy rates may drive speculative and build-to-suit/fee development, the rental rates tenants are willing to commit to must also continue to rise before this growing demand can support new construction.

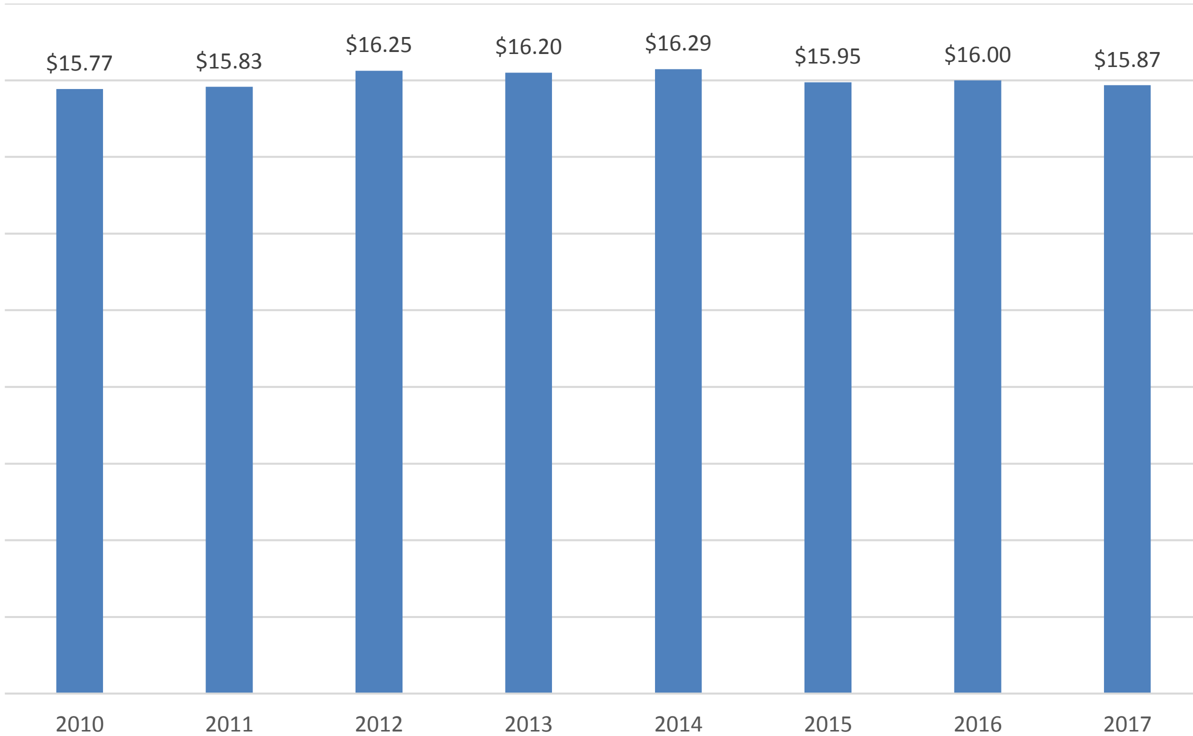
Figure H-7 – Office Real Estate Market Overview



Source: JLL, CoStar

Historically, however, rental rates have remained stable: asking rents increased from $15.77/sf gross to only $15.87/sf gross over this period, and 2017 average rents represent a decline since 2015 and 2016. This represents only a 0.6% increase in the last seven years.

Figure H-8 – Office Average Asking Rent per SF (gross)



Source: JLL, CoStar

The lack of new construction in the market is a result of what has historically been unchanging rents. Speculative development may therefore not be feasible until rates improve; in fact, build-to-suit opportunities may also be limited, as the cost of constructing a new building, and the resulting rent paid by a build-to-suit tenant, may also exceed going market rates. The growing strain on supply in the market may therefore eventually drive demand for new office construction in the medium- and long-term, though only if rental rates increase.

On the supply side, there is competition from large blocks of available space also on the market. The largest of these, building #3 in the Hamilton Sundstrand Campus located at 1 Hamilton Road, currently has 199,930 square feet available for lease. While currently occupied (and therefore not reflected on the previous chart), the tenant, the landlord, or both have indicated that space will be vacated in the future and that interested parties seeking a large amount of affordable, class B office space may have an opportunity to lease this space. In addition, there is a block of 50,484 square feet available in the Newgate International building park located at 2 Gateway Boulevard. Similar to building #3 in the Hamilton Sundstrand Campus, this space is currently occupied, and therefore not reflected in the previous chart, the tenant, the landlord, or both have indicated that this space will be vacated in the future and is therefore available to interested parties. Should a tenant be seeking to move into this market, it will likely consider the lower cost and complexity of leasing this existing space rather than constructing a new property.

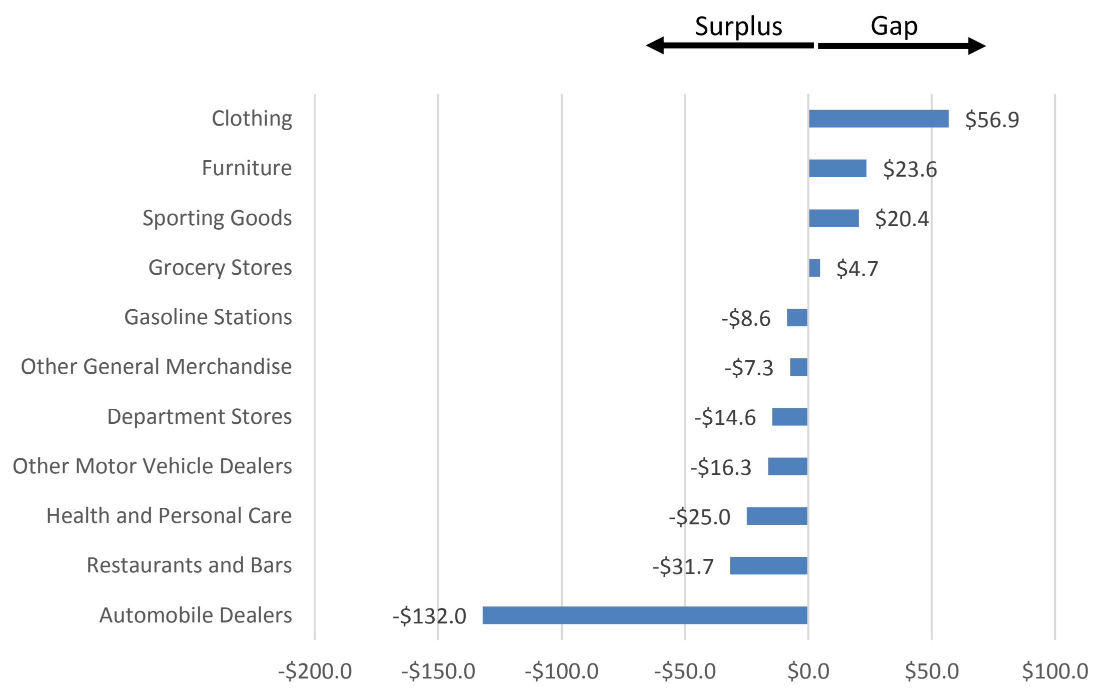
Therefore, while vacancy rates have decreased to historical lows, there are large blocks of space available to new tenants that will compete with new development (both speculative and build-to-suit). Office development is therefore unlikely in the near-term, however, continued movement into the market by tenants seeking affordable office space may drive both rents higher and available rates lower in the medium- to long-term.

H.4.6 Retail

Unlike office and industrial, which can benefit from build-to-suit opportunities, retail projects will only break ground once most of the major spaces have written commitments from tenants in the form of formal letters of intent. A gap analysis of retail spending in the area, which compares what residents have purchased versus what stores have sold, can help identify which types of retailers a development may target by identifying those retail categories for which there is unmet demand.

In a gap analysis, a positive number for a category indicates a "gap," or that purchases by residents exceed sales by stores; this indicates that residents are leaving the area to purchase these goods, i.e. that area stores are not meeting demand. By contrast, a negative number indicates a "surplus," or that sales by stores exceed purchases by residents. This indicates that stores are not only meeting residents' needs but are likely attracting customers from outside the market area as well.

Figure H-9 – Retail Gap Analysis, 15-minute drive from BDA



Source: JLL, Esri

Within a 15-minute drive from Bradley, there is significant unmet demand for sporting goods, clothing, and furniture, which may drive demand for freestanding development of these types of stores. The Airport may be able to specifically target these types of retailers to develop freestanding retail establishments or developers who have working relationships with these retailers and who may be interested in introducing them to Airport-owned property. However, surpluses in other categories strain the potential for new shopping mall development, as it may be difficult to find tenants for other retail spaces.

In addition, there are elements for automobile dealerships, gasoline stations, and grocers that must be considered in addition to the gap analysis:

Automobile Dealerships

Based on this analysis, auto dealers appear to be meeting resident “demand” for new vehicles: sales by area auto dealers greatly outnumber purchases by area residents. However, the market area for auto dealerships is significantly larger than a 15-minute drive. Individuals seeking to purchase a new or used vehicle are likely to have committed a significant amount of time to researching multiple auto dealerships for a particular type of vehicle, and because a vehicle is an infrequent purchase – relative to, for example, groceries – customers are more likely to travel a significant distance for the right car. That is, cars are the ultimate in “durable” or “comparison” goods – similar to furniture and electronics – consumers are more willing to commit time, research, and distance for the right product. Given the price point of new and used vehicles, and the relative frequency with which the average household purchase a new or used vehicle, consumers are likely to travel even further for the right car compared to even furniture or electronics. As such, auto dealerships have a much wider geographic draw, and the gap analysis is of limited use; therefore a dealership could be a target for new development. This particularly true for Airport-owned land proximate to existing dealerships, as these business benefit from economic “agglomerations,” where retailers of a similar type co-locate near one another in order to draw a larger group of customers who may be more willing to one dealership if they know there are others nearby where they can comparison shop.

Gasoline Stations

Regarding demand and supply for retail gas stations, the gap analysis indicates that there is a slight surplus in the market. However, gas station success is driven less by unmet demand and more by heavy daily traffic counts: the ability to capture a significant number of drivers coming to or from work – or to or from rental car facilities – is a major driver of demand and therefore feasibility.

The competitive supply of gas stations is largely concentrated in a retail corridor along the Ella Grasso Turnpike, south of Schoephoester Road. Much of the decision-making that will lead a consumer to more likely purchase gas at an alternate location in Airport-owned will likely have more to do with their direction of travel and relative position of a potential retail gas station that outright demand for gas.

For example, assuming the CAA, rental car companies, or UTC Aerospace Systems are a destination, consumers traveling north on Ella Grasso Turnpike toward Schoephoester Road will likely stop at this retail cluster rather than travel further north along Ella Grasso Turnpike to sites located near these facilities.

Grocery

There is a slight gap in grocery, equal to unmet demand for $4.7 million dollars in sales. However, it is likely not enough to support a new store. The range for grocery store sales per square foot in the United States is wide: the low end of this range includes stores such as Kroger at $553/sf and the upper end of the range includes stores such as Trader Joe's at $1,734/sf. Whole Foods falls somewhere in the middle at $874/sf.

This range can support a comparably wide range of potential grocery store sizes. For a market in which there is a $4.7 million gap, for a store that averages $500/sf, this unmet demand may support a store approximately 9,400 square feet in size. However, this is much smaller than even the smallest average store size: on average, a Trader Joe's is 12,000 square feet, and based on average sales per square foot of $1,734/sf, a gap of at least $20,808,000 would be required.

There are large grocery stores with lower sales per square foot, but these stores are typically much larger. For example, at Kroger's $553/sf average, a gap of $4.7 million in the Airport market may justify an 8,500-square-foot store. However, the average Kroger is much larger at 57,000 square feet. By these metrics, a gap of at least $31,521,000 would be required.

However, grocery stores are more nuanced that sales gaps and average sales per square foot alone. Grocers have very specific standards which they use to determine whether or not their particular brand is suited to a particular location. Common metrics include income, population, population growth, and existing supply. Ultimately, there is no one-size-fits-all indicator of demographic trends that may appeal to one grocer over another. Grocers may be attracted to a market with a lower population and slow population growth if median household income is high and rising. Likewise, areas with a lower income population can be attractive to grocers if the population is sizeable and also growing.

There are other nuances that may factor into location choice as well. For example, ties to community grocers are oftentimes factored in, as a major chain may have reservations about entering a market where locally owned business has a strong command of local demand.

Ultimately, a grocery store may fill the potential gap, the sales gap alone may not be sufficient to attract an additional grocer. However, numerous and varied factors will influence the likelihood of this occurring outside of the gap alone.

H.4.7 Hotel

To determine potential hotel demand, the value of recent, comparable hotel sales were compared to the cost of constructing a new hotel. If sale prices for existing properties exceed the cost of building a new hotel, there may be demand for new hotel construction on Airport-owned land. That is, if the cost to construct a new hotel is less than the cost to purchase an existing one, adjusting for construction risk, there may be an opportunity to attract capital that may have otherwise been directed to acquisition into new construction.

By contrast, if sales prices are below the cost to build a new hotel, new construction is unlikely. Capital from hotel investors will only seek out existing properties that can be acquired as-is or with some value-add opportunity (for example, some amount of renovation). However, demand must increase, and investors willing to expend additional capital, for a particular hotel market to experience new construction.

Recent sales of suburban select-service hotels – common for airport markets – throughout Connecticut, and one in New Hampshire were identified. These sales "comps" range from $65,934/room (Hampton Inn Waterbury in Waterbury, CT) to $134,800/room (Hampton Inn Portsmouth Central, near Portsmouth International Airport (PSM)). The median sale price of these comps is $88,599/room.

Table H-2 – Hotel Sales Prices

Sale Date	Hotel	City	State	Price USD	Room Count	Price per Room
Mar 2016	Hampton Inn Portsmouth Central	Portsmouth	NH	$16,850,000	125	$134,800
Mar 2015	The Fairfield Inn @ The Circle Fairfield	Fairfield	CT	$8,199,999	80	$102,500
Jul 2014	Crowne Plaza Danbury	Danbury	CT	$16,050,000	238	$67,437
Mar 2014	Hilton Mystic	Mystic	CT	$14,050,000	182	$77,198
Jan 2014	Best Western Plus Black Rock Inn	Fairfield	CT	$6,000,000	60	$100,000
Jan 2014	Hampton Inn Waterbury	Waterbury	CT	$6,000,000	91	$65,934

Source: JLL

By comparison, the median cost to develop a select service hotel is $111,000/room and can range from as low as $91,000/room to as high as $133,000/room. Compared to the median acquisition price of $88,599/room for the suburban select service hotels, median construction costs are higher. Therefore, there may not be demand for new hotel construction.

However, the sale price per room of the airport-proximate Hampton Inn Portsmouth Central does meet or exceed construction comps. That the highest hotel sales price per room is near an airport is indicative of other select-service hotels near airports around the country. While not as robust performers as hotels that are directly connected to airport terminals, hotels that are located as close as possible to the terminals – the Hampton Inn Portsmouth Central is located across the street from PSM – can perform better than their competitive sets (though this is not consistent across the country).

It is also worth noting that there were only 45,933 enplanements at PSM in 2015, compared to BDL's 2,969,962 enplanements in the same year. BDL is a much higher-volume airport than PSM and therefore may have an opportunity to drive demand for new hotel construction where it may not exist otherwise in the local market. The extent to which BDL can ensure this new hotel is constructed with terminal connectivity will determine the ultimate success of such a development; the farther away from the terminal BDL entertains developing a new hotel, the less likely it will be to succeed and attract investors.

The success of a new hotel will ultimately depend on the actual cost of construction, and therefore the Airport should target hotel developers and flags that have lower construction cost requirements. These would include select-service hotels at lower chain scales appropriate for the market, and such as the following:

- Best Western
- Days Inn
- Tru by Hilton
- Hampton Inn
- Fairfield Inn

The above list is neither definitive nor all-inclusive. The Airport is best suited taking a property out to the market to gauge demand.

H.5 CONCLUSION

In the case of all product types, the significant amount of land available elsewhere in the market will present a challenge to the Airport's efforts to secure development partners for its properties. The supply itself presents significant competition to the Airport's efforts, as BDL will be competing directly with other landowners for development opportunities. In addition, engaging with private landowners in a sale is a shorter and less complex process than procuring for a ground lessor of airport land, and potential development partners may be more willing to engage with private landowners due to the relative simplicity of the transaction versus a ground lease with a public entity.

Summaries for each product type follows:

H.5.1 Industrial

While most new industrial development has resulted from significant build-to-suit projects, there has been some new speculative activity. Rental rates may just be reaching the point where they support the cost of new projects, though this is not immediately clear in the near-term. The Airport may, therefore, experience the greatest chance of success by considering marketing sites to users seeking build-to-suit opportunities, though if rental rate and leasing trends continue, the speculative market may improve as well.

H.5.2 Office

Historically low vacancy rates indicate high demand, but this is driven by tenants seeking inexpensive properties at rental rates that may not justify new construction. The Airport may consider marketing sites to users seeking build-to-suit projects. However, there are some large block spaces currently marketed as available, some as large as 200,000 square feet. As such, the Airport may face competition from these available spaces, which are a lower-cost option for a user seeking space compared to building a new asset.

H.5.3 Retail

Developers do not begin construction without pre-leasing. There may be opportunities to attract clothing, furniture, and sporting goods retailers due to unmet demand for these goods, but other shopping mall tenants may be more difficult due to a surplus in the market. Therefore, shopping mall development may be difficult to attract. The airport may consider marketing sites to retail gas stations, auto dealers, and other retailers looking for standalone properties to rent through build-to-suit or own.

H.5.4 Hotel

Construction cost per room for new select-service hotels generally exceeds the sale price of comparable properties, indicating that there may not be demand for new construction. However, proximity to the airport may help drive demand for new lodging where it may not exist elsewhere. The closer to the terminal, the better; and the lower cost of construction, the better.